eman ta zabal zazu

Department of Architecture
University of the Basque Country UPV/EHU

Donostia, 2018

COMPREHENSIVE ANALYSIS METHOD FOR THE STUDY OF DISUSED RAILWAY LINES AS TERRITORIAL HERITAGE SYSTEMS: THE VASCO-NAVARRO RAILWAY

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

ARRITOKIETA EIZAGUIRRE IRIBAR

Thesis co-directors: LAUREN ETXEPARE IGIÑIZ
RUFINO J. HERNÁNDEZ MINGUILLÓN

eman ta zabal zazu

Department of Architecture
University of the Basque Country UPV/EHU

Donostia, 2018

DOCTORAL THESIS
BOOK 1 (ENGLISH)

COMPREHENSIVE ANALYSIS METHOD FOR THE STUDY OF DISUSED RAILWAY LINES AS TERRITORIAL HERITAGE SYSTEMS: THE VASCO-NAVARRO RAILWAY

Presented by: **ARRITOKIETA EIZAGUIRRE IRIBAR**

in the **Department of Architecture of the University of the Basque Country UPV/EHU**

in partial fulfilment of the requirements for the degree of **Doctor of Philosophy**

Led by: **Dr. LAUREN ETXEPARE IGIÑIZ** and **Dr. RUFINO J. HERNÁNDEZ MINGUILLÓN**

ESKERRAK

Ondorengo lerroetan azken urte hauetan modu batean edo bestean alboan izan ditudan guztiak eskertu nahiko nitutzteke.

Lehenik eta behin, lan honen gidari izan diren Lauren Etxepare eta Rufino Hernandezi eskerrak nigan jarritako konfiantzagatik eta eskainitako gidaritza eta aholkuengatik. Laureni, gainera, ikerketa gai honen inguruan masterrean lanean hasi nintzenetik, eta baita lehengotik ere, emandako sostengu eta laguntzagatik.

Eskerrik beroenak baita ere, bulegokide, lankide eta lagunak diren Irati, Maite, Dani, Matxalen eta Davidi. Ikerketa gai ezberdinetan lanean ari bagara ere, ikerkuntzaren munduan nirekin batera aurrera egiteagatik eta bide horretan eskainitako ordu guztiengatik. Hauekin batera egunerokotasunean alboan ditudan beste hainbat lankideri ere.

Eskerrak baita Euskal Herriko Unibertsitateari eta Arkitektura departamentuari lana burutzeko eskeinitako baliabideengatik eta bertako irakasleei edozein beharren aurrean erakutsitako prestutasunagatik.

Erakunde publikoei ere euren laguntza eskertu beharra diet, ikerketa burutuzeko informazioa eskuragarri jartzeagatik alde batetik eta emandako laguntza ekonomikoagatik bestetik. Doktoretza tesi hau Eusko Jaurlaritzako Hezkuntza, Hizkuntza Politika eta Kultura Sailak finantzatua izan da PRREDOC beka baten bidez. Waterlooko Unibertsitateko (Ontario, Kanada) Plangintza Eskolan egindako nazioarteko egonaldia ere erakunde berak babestu zuen.

Ildo horretan, Kanadako egonaldi horretan tutore izan nuen Robert Feick ere eskertu nahiko nuke, nire ikerketa gaian murgiltzeagatik eta, batez ere, 6. kapituluan erabilitako metodologietan egindako ekarpenengatik. Berarekin batera baita Plagintza Eskolako hainbat irakasleri ere izandako elkarrizketa eta bazkari tarteengatik. Halaber, nazioarteko tesiaren aipamena lortu ahal izateko iruzkinak egin dituzten Michael Hebbert eta Robert Feick doktoreak ere eskertu nahiko nituzte, erakutsitako prestutasunagatik eta egindako lanagatik.

Bestalde, Javier Suso aipatu nahiko nuke, 4. kapitulurako informazio iturri garrantzitsua izan dena, liburu ireki baten modukoa baita. Zu bezalako jendearen lanak mantentzen du ondarea gure memorietan bizirik.

Azkenik, lagunak eta familiakoak ez nituzke aipatu gabe utzi nahi, hauek baitira nire betiko euskarri eta ardatz. Barkatu lagunei beraiekin gustura pasako nituzkeen ordu asko nire egiteagatik eta etxekoei jasan beharreko umore txar guztiengatik. Eskerrik asko guztiei beti ondoan egoteagatik.

Bereziki eskertu nahiko nituzke gurasoak eta anaia, Ekaitz, momentu oro beraien babesa eskaintzeagatik eta dudan guztia aurrera atera nezan egindako esfortzuagatik. Eskerrik goxoenak, amaitzeko, Iker nire senarrari urte guzti hauetan alboan izateagatik eta nire alderdirik onena ateratzeagatik.

Bide honetan lagundu nautenak hamaika izan direnez, aipatu ez ditudan askori ere bihotzez esker mila.

ABSTRACT

Although the arrival of the railway was in the 19th century, several of them were closed in the 20th century. In the present 21th century, the future of these disused railways is questionable. Thousands of kilometres of disused railway lines that compose a railway heritage of great interest have been the object of study of several authors over the last few decades. Moreover, interventions for their reuse or reconversion have also been created. Nevertheless, the mismatch that exists between theoretical and practical achievements has been taken into consideration in this research with the aim to support that the analysis of the disused railway lines should have a comprehensive vision in order to achieve the same view in their protection or future interventions. In this regard, the objective of the work has been to develop a comprehensive methodology for the analysis of disused railway lines to show their potential in the territory.

For that purpose, theoretical and methodological aspects related to the subject of study and existing proposals have been considered on the one hand, while the future approaches and opportunities that disused railway lines can include have been studied on the other. In a first approach, the broad concept of heritage and its territorial character have been assumed in order to understand disused railway lines as complex heritage systems. Afterwards, disused railway lines have been presented as future territorial structuring transport axis and as an opportunity for the insertion and promotion of sustainable mobility models based on active or non-motorised transports, claiming that they may have potential as non-motorised transport systems. Finally, the interaction between transport and land uses, and a need of balance between them have been presented as issues to consider for sustainable development, claiming that disused railway nodes may have potential in developments based on non-motorised transport axes.

Accordingly, the comprehensive analysis method has been structured in the same way. The first leg of the method focuses on the comprehension of the elements, from their beginning to the present, giving emphasis to the importance of disused railway lines as heritage systems. Meanwhile, the second and third legs include the study of the opportunities that the railway system could give regarding a more sustainable development of the territory: on the one hand, the potential of the linear infrastructure in the territory as a non-motorised transport axis, and on the other hand, the potential of each node in its surroundings. Hence, different analysis areas and methods are used for the definition of the methodology. Each approach provides results of each type of railway element or created relation, but in turn provides results of the whole DRS. These results refer to the potential of a DRS as a territorial structuring system, including both the potential of the linear infrastructure and the potential of the nodes, in order to define general strategies or guidelines and specific action points for its reconversion.

As the initial step of the final Comprehensive Analysis Method (CAM), the study of the elements that are part of the system has been proposed. In this case, GIS based inventories have

been proposed as one of the main tools for data compilation of different periods, both at territorial and local level. Afterwards, a method based on accessibility analyses has been developed for the study of the relations between the linear infrastructure and the territory and, hence, to define the potential of the infrastructure in its surrounding territory. For that purpose, a multilevel approach with different accessibility measures has been used. Finally, a method centred on transport based developments has been developed for the study of the relations between the railway nodes and the territory and, hence, to define their potential in the surrounding territory. In this regard, different models have been used or adapted in order to measure the transport systems and land uses located in the node´s influence areas or to assess the balance between them.

The methodology creation, however, has been developed in several phases. In a first phase, an initial approach of a comprehensive method has been proposed by means of the analysis of different disused railway lines (DRLs of the Basque-Navarre territory) in order to define the different analysis areas that are necessary to consider. In a second phase, extensive studies for the proposed analysis areas have been developed to define the most suitable methods, tools and variables that each proposed approach could include, focusing on a specific disused railway line (the Vasco-Navarro Railway). Building on these phases, the final methodological proposal has been created and the potential of a whole system has been defined using the different analysis areas and their corresponding methods.

In this work, the CAM has been applied to the Vasco-Navarro Railway. However, in addition to this specific system or any other DRS of the Basque-Navarre territory, the method is applicable to other DRSs of similar territories and could be widespread to other DRSs or territorial systems composed of a linear infrastructure (or even a network infrastructure) and several nodes distributed along it.

In the case of the Vasco-Navarro Railway, several results that are related to the potential of the system have been obtained. On the one hand, five territorial zones that show different types of urban or rural settlements have been identified. On the other hand, smaller areas that can follow similar guidelines and connect the five previous zones have been defined in order to ensure the proper functioning of the whole territorial axis. Moreover, strategic points between zones and strategic accessibility areas have been also detected. Conversely, there is a lack of external connections between the whole system and its surrounding territories referring to public and non-motorised transport modes. Finally, ten main action points have been proposed taking into consideration the previous aspects.

LABURPENA

Burdinbidearen iritsiera XIX. mendean industrializazioari eta honen ondorengo hiri hazkundeari loturik egon zen eta, beraz, burdinbideek aktiboki hartu zuten parte hirietan gertantzen ari ziren aldaketa sakonetan (Aguilar, 1988). XX. mendearen bigarren erdian, ordea, errepide bidezko garraioaren lehiaren eta industriaren beherakadaren ondorioz burdinbide hauetariko asko itxi egin ziren. XXI. mende honetan, erabilerarik gabeko milaka kilometro burdinbide horien etorkizuna zalantzagarria da. Erabilera faltak eta denboraren igarotzeak, gainera, desagertzeko arriskuan jarri ditu, dagoeneko desagertu ez badira.

Hala ere, interes handiko ondarea osatzen dutela jakina da, azken hamarkadetan egile askoren azterketa gai bihurtuz. Arlo teorikoan, ondarearen zaharberritzea eta birgaitzea ez da xahutze modura ulertzen dagoeneko, biziberritzeko eta garatzeko aukera moduan baizik. Gainera, ondare mota batzuen balioestea, ondore industriala edo obra publikoarena esaterako, azken urteetan hasia da. Ildo horretan, Tarchinik (2010) jada hirien kasurako azaldu zuen burdinbide ondarea multzo oso bat bezala ulertzea dela burdinbide eremuak hiri dinamiketan egoki integratzeko modua, burdinbide ondarea beraren eraikuntza eta garapen prozesua ezagutu eta onartzez gain, arazoak konpontzeko eraldaketak sortuz.

Aldi berean, burdinbide horien edo hauen zatien berrerabilpen edo birgaitzerako esku-hartzeak ere garatu dira, hauek bi joera nagusi izanik: alde batetik, burdinbide eraikinetan (geltokietako bidaiari eraikinak batez ere) eta hauen inguruetan erabilera berriak ezartzeko egindako zaharberritze eta birgaitzeak; eta bestetik, bideen berrerabilera garraio azpiegitura berri gisa, garraio aktiboetarako batez ere. Proposamen horiek, ordea, ez dituzte arlo teorikoan azaldutako ikuspegi integralak eta aukerak aprobetxatzen. Orokorrean, elementu isolatu eta eraikinetan edo linean zentratzen dira, baina ez burdinbide osoan.

Ildo horretan, erdiespen teoriko eta praktikoen artean dagoen desadostasuna (Porcal, 2011) hartu da kontuan, erabilerarik gabeko burdinbideen azterketak integrala izan behar duela defendatzeko. Horrela soilik lor daiteke begirada orokor edo integral bera burdinbide hauen babes proposamen edo etorkizuneko esku-hartzeetan. Beraz, ikerketa honek arlo horretan sortzen den hutsune hori betetzea bilatzen du. Ondorioz, lanaren helburua erabilerarik gabeko burdinbideak aztertu ahal izateko metodologia integral bat sortzea da, burdinbide horiek inguruko lurraldean duten potentziala erakusteko.

Metodologiaren diseinurako oinarri gisa, azterketa objektuaren inguruko ikuspuntu teoriko eta metodologikoak eta egungo proposamenak ikertu dira alde batetik, eta erabilerarik gabeko burdinbideek etorkizunean izan ditzateken ikuspegi edo aukerak bestetik. Azken horien kasuan ere, alderdi teorikoak zein metodologikoak landu dira.

Ildo horretan, lehenenik, ondare kontzeptuaren ikuspegi zabala eta honen lurralde izaera aitortu dira erabilerarik gabeko

burdinbideak ondare sistema konplexu gisa ulertzeko, ondare elementu bakoitza lurralde mailako multzo beraren parte izanik. Alde batetik, ondare kontzeptua monumentuaren iruditik ondare kultural zein natural bezala izendatua izatera pasa da eta, bestetik, ondare elementu askok lurraldearekin duten etengabeko hartuemanaren ondorioz, paisaia gisako ikuspegien garrantzia aldarrikatu da.

Bigarrenik, erabilerarik gabeko burdinbideak lurralde egituratzaile izan daitezkeen garraio ardatz gisa eta garraio aktibo edo ez-motorizatuetan oinarritutako mugikortasun eredu jasangarriak txertatu eta sustatzeko aukera gisa aurkeztu dira, garraio sistema ez-motorizatu bezala potentziala izan dezaketela aldarrikatuz. Erabilerarik gabeko burdinbideak, horrela, zeharkatzen dituzten lurraldean lotura edo konexio ezberdinak susta ditzaketen elementu gisa ulertu dira, inguruko asentamendu eta nukleoak egituratzeko gai diren garapen linealak sortuz eta, ondorioz, burdinbideak egunerokotasuneko bidaia motzetan ibilgailu pribatu edo motordun garraio publikoaren alternatiba moduan proposatuz.

Azkenik, garraio eta lur erabileren arteko elkarrekintza, eta hauen arteko oreka beharra aurkeztu dira garapen jasangarriago baterako kontuan hartu beharreko aspektu gisa, erabilerarik gabeko burdinbide azpiegitura zein nodoek garraio ez-motorizatuetan oinarritutako garapenetan ardatz zein artikulazio bezala potentziala izan dezaketela aldarrikatuz. Horretarako, azpiegitura linealaren lurralde eskala zein burdinbide nodo bakoitzaren tokiko eskala hartu dira kontuan.

Horrela, garapen jasangarriaren testuinguruan, Erabilerarik Gabeko Burdinbideak (EGB) garraio aktibo edo ez-motorizatuko sistema gisa proposatzeko ondorengo hiru baldintzak hartu beharko diran kontuan: erabilerarik gabeko burdinbideak ondare sistema konplexu gisa ulertzeko beharra; hauek garraio aktiboko sistema gisa izan dezaketen potentziala; eta garapen jasangarria bultzatu beharra, horretarako, garraio eta lur erabileren arteko oreka mantenduz.

Ondorioz, azterketa metodo integrala modu berean egituratu edo antolatu da. Metodoaren lehenengo urrats edo ildoa sistemaren elementuen ezagutzan zentratzen da, hauen sorreratik gaur egunerarte, erabilerarik gabeko burdinbideei ondare sistema gisako garrantzia emanez. Bigarren eta hirugarren ildoek, aldiz, burdinbide sistemak lurraldearen garapen jasangarriago baterako izan ditzakeen aukerak aztertzen dituzte: alde batetik, azpiegitura linealak lurraldean duen potentziala garraio ardatz ez-motorizatu gisa eta, bestetik, nodo bakoitzaren potentziala inguruan. Ondorioz, azterketa eremu eta metodo ezberdinak erabili dira metodologiaren definiziorako. Ildo bakoitzak burdinbidearen elementu mota edo sortutako erlazio bakoitzari dagozkien emaitzak erakusten ditu, baina aldi berean, denen artean Erabilerarik Gabeko Burdinbide Sistema (EGBS) osoaren emaitzak ahalbidetzen dituzte. Azken hauek, erabilerarik gabeko burdinbide baten potentziala erakusten dute lurralde mailako sistema egituratzaile gisa, azpiegitura linealaren zein nodoen potentziala kontuan hartuz, sistemaren birmoldaketarako estrategia edo gidalerro orokorrak eta aktuazio puntu zehatzak definitzeko.

Amaierako Azterketa Metodo Integralaren (AMI) lehen urrats gisa, sistemaren parte diren elementuen azterketa proposatu da. Hortaz, sistemaren barne elementuak (linea eta nodoak) hartu dira kontuan alde batetik eta, bestetik, lurraldea aztertu da kanpoko elementu gisa. Horretarako, burdinbide sistemaren garai nagusiak kontuan hartzea proposatu da, etorkizunean sustatu daitezkeen egungo ondare elementuak identifikatu eta aztertzeaz gain, burdinbidearen antolaketa edo egituraketa historikoa, eta honek lurraldean duen presentzia ezagutzeko. Kasu honetan, ISGtan oinarritutako inbentarioak proposatu dira garai ezberdinei dagokion datu bilketarako tresna nagusi gisa, bai azpiegitura linealaren lurralde mailan eta baita bertan kokatutako nodoen tokiko eskalan ere.

AMIaren bigarren ildoan, irisgarritasun azterketetan oinarritutako metodoa garatu da azpiegitura linealaren eta lurraldearen arteko erlazioak aztertu ahal izateko eta, ondorioz, azpiegitura honek inguruko lurraldean duen potentziala definitzeko. Horretarako, irisgarritasun neurri ezberdinak dituen maila ezberdinetako ikuspegia erabili da, bertan, lurralde maila, hiriarteko maila eta hiri edo herri maila bereiztuz. Metodologiaren garapenerako, alde batetik, azterketa maila bakoitzerako irisgarritasun neurri optimoak aztertu, aukeratu eta egokitu dira eta, bestetik, aztertutako sistema eta lurraldearen arabera hainbat aldagai definitu dira, denbora mugak, garraio motak, abiadurak eta ibilaldi motak esaterako.

AMIaren hirugarren urratsean, garraioan oinarritutako garapen ereduetan zentratutako metodoa sortu da burdinbide nodoen eta lurraldearen arteko erlazioak aztertu ahal izateko eta, ondorioz, hauek beraien inguruan duten potentziala definitzeko. Ildo horretan, eredu ezberdinak erabili edo egokitu dira nodoen eragin eremu ez-motorizatuan kokatutako garraio sistema eta lur erabilerak aztertu eta hauen arteko oreka neurtzeko. Horretarako, garraio sistema eta lur erabilera azterketa eredu optimoak aztertu eta hiri eta landa guneetako baldintza zehatzetara egokitu dira, alde batetik bibliografiako adierazleak egokituz edo berriak sortuz eta, bestetik, aldagai berriak proposatuz. Kasu guztietan, Erizpide Anitzen Araberako Erabakien Analisia (EAAEA) erabili da nodo inguruen azterketarako, non Hierarkia Prozesu Analitikoa (HPA) erabili den adierazle ezberdinak antolatu eta haztatzeko. Haztapenaren egokitasuna ebaluatzeko, aldiz, sentsibilitate analisia erabili da. Azkenik, nodo eremu ezberdinen sailkapena eta multzokatzea ere proposatu da estrategia berdintsuak inplementatu ditzaketen eremuak identifikatzeko. Horretarako, eredu ezberdinen arteko konparaketa grafikoa eta metodo estatistikoak —Osagai Nagusien Analisia eta k-means erako multzokatzea— erabili dira.

Proposatutako azterketa eremu eta ildo ezberdinen, eta hauei dagozkien metodoen bidez, AMIaren emaitza gisa sistema oso baten potentziala definitu da. Metodologia horren sorrera, ordea, fase ezberdinetan garatu da. Lehenengo fase batean, erabilerarik gabeko burdinbide ezberdinen azterketaren bidez (Hego Euskal Herriko eta Nafarroako EGBak) azterketa metodo orokor baterako hasierako hurbiltzea egin da, azterketa metodo integral batean kontuan hartu beharreko azterketa eremu ezberdinak identifikatzeko. Fase hau aspektu teoriko eta metodologikoetako lehenengo atalean oinarrituko da, burdinbidearen sistema izaera aldarrikatuz eta hau ulertu ahal izateko alderdiak definituz. Bigarren fase batean, azterketa kasu gisa erabilerarik gabeko burdinbide bakarra erabiliz (Vasco-Navarro Burdinbidea) azterketa eremu bakoitzaren ikerketa sakona garatu da, eremu bakoitzean erabili beharreko metodologia, tresna eta adierazle egokienak definitzeko. Zati honetan, aspektu teoriko eta metodologikoetako atal guztiak hartuko dira kontuan, hasierako sistema ikuspegiaz gain, burdinbideak etorkizunean izan ditzakeen aukerak aprobetxatuz. Metodologiaren diseinurako prozesu guzti hau borobilduz, azken porposamen metodologikoa sortu eta eraiblerarik gabeko sistema oso baten potentziala definitu da, linea beraren potentziala zein nodoen potentziala aintzat hartuz. Hauetako bakoitza elementu mota bakoitzari dagokion erlazioez eta elementua beraren karakterizazioaz osatuta dago.

Ikerketa honetan, AMIa Vasco-Navarro Burdinbidean aplikatu da. Hala ere, sistema zehatz honetan edo EAE eta Nafarroako lurraldeetan kokatutako beste edozein EGBSetan erabiltzeaz gain, antzeko lurraldeetan kokatutako beste edozein EGBSetan ere aplika daiteke. Gainera, beste EGBSetara, edo azpiegitura lineal batez (baita azpiegitura sare batez) eta honetan kokatutako nodoez osatutako beste lurralde sistemetara ere zabal daiteke metodoa.

Vasco-Navarro Burdinbidea Hego Euskal Herriko eta Nafarroako erabilerarik gabeko burdinbide nagusienetariko bat da. Lehenengo atala 1887an zabaldu bazen ere, burdinbide osoa ez zen 1927 arte bukatu. Berrogeita hamar urte beranduago, aldiz, burdinbidea itxi egin zuten eta, azken urteotan, ibilbidearen kilometro gehienak bide berde edo bidegorri bilakatu dituzte. Maltzaga-Zumarraga burdinbidearen zati bat ere gehitu da azterketa kasura, honen bidez ondoko haranarekiko lotura lortzen baita eta hau azpiegitura lineal batek lurralde egituraketan duen eraginerako garrantzitsutzat hartzen baita. Biek batera 145 kilometro eta hiru probintzia ezberdin hartzen dituzte, paisaia eta lurralde ezberdinak zeharkatuz, hiri nagusietatik landa herri edo eremu natural babestuetaraino.

Aurretik aipatutako joera orokorrak jarraituz, Euskal Herriaren kasuan ere, industria iraultzaren iritsierak burdinbideen eraikitzea bultzatu zuen, lurralde guztian zehar zabaldutako burdinbide sare trinko bat sortuz. Hogeita hamargarren hamarkadan kilometro karratu bakoitzeko 120 metro inguru burdinbide zeuden, Espainiako mailatik haratago joanez eta Ingalaterra, Alemania eta Suitzako mailetara iritsiz (González et al., 2012). 1987an azken linearen itxiera gertatu zenean, ordea, 80 metro burdinbidetik behera mantentzen ziren erabileran kilometro karratu bakoitzeko eta, gaur egun, kilometro karratu bakoitzeko erabilerarik gabeko burdinbide kilometro portzentaje handiena duen Espainiako lurraldea izatera iritsi da (Association of Spanish Railways, 1993).

Vasco-Navarro Burdinbidearen kasuan, Azterketa Metodo Integralaren (AMI) bidez sistemaren potentzialari erreferentzia egiten dioten hainbat emaitza lortu dira. Alde batetik, hiri edo landa nukleo mota ezberdinak erakusten dituzten lurralde mailako bost zona identifikatu dira. Bestetik, burdinbide ardatz osoari funtzionaltasuna emateko, hau da, aipatutako lurralde mailako bost zonak batera funtzionatzeko, hauen arteko loturak bermatzeko beharrezkoak diren eta ezaugarri berdintsuko estrategiak beharko dituzten eremu txikiagoak definitu dira. Gainera, zona ezberdinen arteko puntu estrategikoak eta irisgarritasun eremu estrategikoak ere antzeman dira. Azken hauek, sistema osoaren funtzionamenduan eragiten ez badute ere, hiriarteko eskalan osotasunean funtziona dezakete. Beste muturrean, sistema osoak kanpoko lurraldearekin duen garraio publikoko edo garraio ez-motorizatuko lotura falta aipatu beharra dago. Azkenik, aurreko alderdiak kontuan hartuta hamar aktuazio puntu edo gune nagusi identifikatu dira.

Kontuan hartzeko da, Erabilerarik Gabeko Burdinbide Sistema (EGBS) baten birgaitze edo berreabilpenerako zona edo eremu bakoitzak bere estrategia propioak izan ahal baditu ere, guztiek ikuspuntu bera jarraitu beharra dutela sistema osoaren batasuna eta kohesioa mantenduko badira. Aztertutako kasuan, eremu guztiek behar orokor komun bat erakusten dute, garraio azpiegitura jasangarrien beharra. Ildo horretan, esan beharra dago erabilerarik gabeko burdinbide bat ardatz ez-motorizatu bat sortzeko azpiegiturarik egokiena dela. Bestalde, azpiegitura honetan zehar kokatutako burdinbide nodo edo eraikinak ardatz ez-motorizatuari lotuta egongo dira modu batean edo bestean, azpiegitura linealak eskaintzen duen potentziala gauzatuz. Horretarako, nodo inguru bakoitzari zehazki dagozkien jarduera eta ezaugarriak bilatu eta bermatu beharko dira. Ondorioz, hauetariko batzuk hirien beharrei lotuta egongo dira, non jarduera eremu handiak kokatzen badira ere, naturguneen falta identifikatu den. Beste batzuk, aldiz, tokiko landa garapena susta dezaketen jarduerak dituzte helburu eta, azkenik, aisialdi eta turismo jarduerei erabat lotuta dauden eremuak ere badira. Gainera, guztiek izango dute inguruan garraio eta lur erabileren arteko oreka lortzea helburu, baina beti ere inguruko zona edo eremuekin elkarlanean, sistema osoaren banaketa ekiditeko. Kontuan hartu behar da, ordea, linea dela sistemako elementu nagusia, burdinbideak bere inguruko lurraldean jatorriz zuen izaera egituratzailea erakusten duena. Izaera egituratzaile hau izango da XIX. mende honetan burdinbidearen ondarea balioan jartzeko ezaugarri garratzitsuenetarikoa.

Amaitzeko, AMIaren emaitzen argitan, gobernu autonomikoek bideratutako sistema osoaren interbentzio proposamenak sor daitezke, baina baita diputazioei dagozkien eta aipatutako eremu batzuk hartzen dituzten proposamen zehatzagoak, edo udal edo beste agente publiko nahiz pribatuek gidatutako aktuazio lokalak ere. Guzti hauek, ordea, analisi osoaren emaitzetatik ondorioztatutako estrategia orokor baten parte izango dira. Horrela soilik izango da posible sistemaren osotasuna mantentzea, nahiz eta esku-hartzeak zehatzak edo denboran zehar banatutakoak izan. Etorkizuneko erabilerarik gabeko burdinbideen birmoldaketarako beharrezko baldintza izango da, gainera, gaian parte aktibo diren departamentu ezberdinen arteko kolaborazioa, batez ere horietako bakotzak sitemaren atal baten edo elementu bakun batzuen ardura duen kasuetan.

CONTENTS

Index

PART II: INITIAL APPROACH OF THE METHOD

PART III:DEVELOPMENT OF THE METHOD

List of Figures

List of Tables

List of Acronyms

ABRM	Archive of the Basque Railway Museum
ADIF	Railway Infrastructure Administrator of Spain
AGG-GAO	Gipuzkoa General Archive
AHP	Analytic Hierarchy Process
AI	Accessibility Index
AL1	Accessibility Level 1
AL2	Accessibility Level 2
AL3	Accessibility Level 3
ARGN	Archive of the Regional Government of Navarre
ARMA	Archive of the Railway Museum of Asturias
C	civitas
C	number of towns or cities
CAM	Comprehensive Analysis Method
CHCfE	Cultural Heritage Counts for Europe
CI	Consistency Index
CIAM	Congrès Internationaux d'Architecture Moderne
CNU	The Congress for the New Urbanism
CR	Consistency Ratio
DRL	Disused Railway Line
DRS	Disused Railway System
ED	Euclidean Distance
ESDP	European Spatial Development Perspective
ETC	European Territorial Cooperation
ETN	Navarre Regional Strategy
EU	European Union
Feder	European Regional Development Fund
FEVE	Narrow Gauge Railways
FFE	Association of Spanish Railways
GIS	Geographic Information System
GR	Large distance
HHI	Herfindahl-Hirschman Index
I	Travel Impedance
ICOMOS	International Council on Monuments and Sites
IDEA	Diversification and Energy Saving Institute
IDENA	Spatial Data Infrastructure of Navarre
IEN	Statistical Institute of Navarre
IGN	National Geographic Institute (Spain)
INE	National Statistical Institute (Spain)
IOHLEE	Basque Association of the Industrial and Public Works Heritage
LAG	Basque Regional Planning Guidelines
LPP	Partial Regional Plans
LPS	Regional Sectorial Plans
MAK	Municipal Archive of Kanpezu
MAV	Municipal Archive of Vitoria-Gasteiz
MCA	Multicriteria Analysis
MCDA	Multicriteria Decision Analysis
MIT	Massachusetts Institute of Technology
NP	Node/Place
N	nodus
NCU	Nodus/Civitas/Urbs
ND	Network Distance
P	Population
PA	Potential Accessibility
PAA	Provincial Archive of Araba/Álava
PCA	Principal Component Analysis

PDAT	Territorial Action Master Plans
POT	Regional Management Plans
PSIS	Supramunicipal Sectorial Plan
RI	Random Index
SP	strategic point between zones
SPESP	Study Programme on European Spatial Planning
TICCIH	The International Committee for the Conservation of the Industrial Heritage
TOD	Transit Oriented Development
U	urbs
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPC	Polytechnic University of Catalonia
USA	The United States of America

INTRODUCTION

Context

Arrival of railways and their posterior decline

ARRIVAL OF RAILWAYS

Since its inception, the railway was linked to mining and industry, transporting the ore to the first factories in the emerging industrial revolution. These first rail lines were drawn by animal traction. It was the industry and commerce time, and communication routes and means of transport became essential tools for them. In this way, recently created railway lines had an incalculable influence in their surroundings (Daly, 1846)[1].

The first railway station was built in Liverpool in 1830 (Crown Street Station) by J. Foster (probably) and G. Stephenson. This occurred after George Stephenson invented the first locomotive and, hence, it became possible to transport coal between Stockton and Darlington in 1825. It was in 1826 when passenger transport was first conducted between Liverpool and Manchester (fig. 0.1). By 1840 England was supplied with 2130 km of tracks. At the same time (1826), in the northeast United Estates mining equipment was transported between Carbondale and Honesdale (Pennsylvania) and in Quincy (Massachusetts). The first passenger transport was realised between Baltimore and Ohio in 1827 and the railway between Philadelphia and Columbia was built in 1831 (Aguilar, 1988).

After England, railway lines were built all over Europe in few years: in 1832, Lyon-Saint Étienne Railway was built in France; in 1835, Brussels-Mechelen Railway in Belgium and Nuremberg-Fürth Railway in Germany (fig. 0.2); and in 1837, Vienna-Brüm Railway in Austria. The railway also arrived to Russia in 1837 and to Italy and Holland in 1839 (Aguilar, 1988).

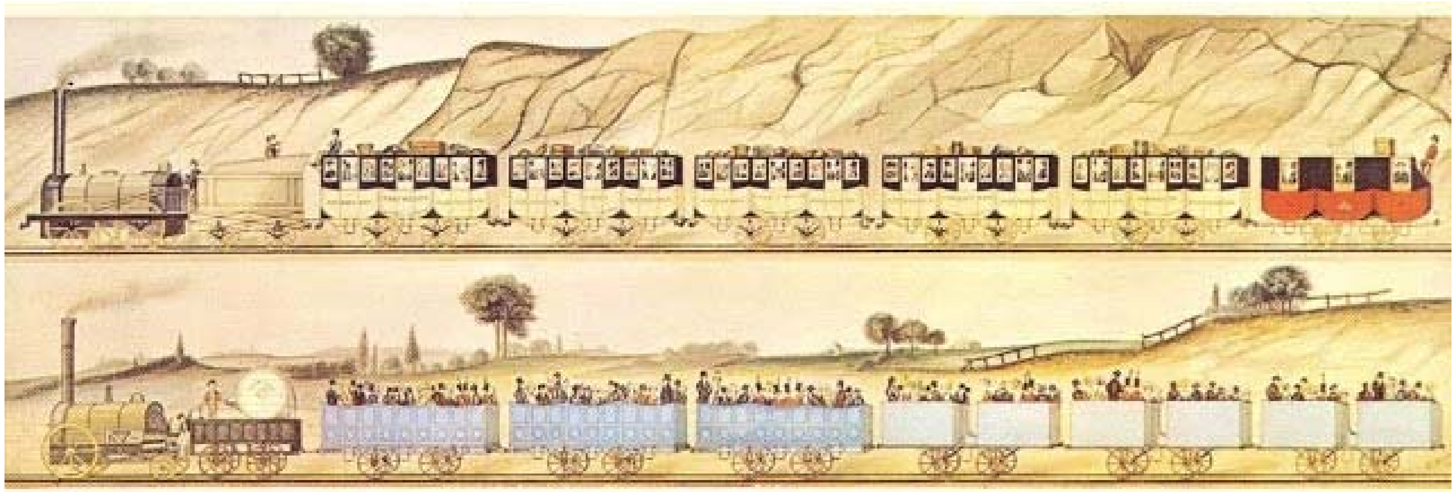


Figure 0.1 Liverpool and Manchester Railway. 1st class carriages drawn by the locomotive 'Jupiter' (above). 2nd and 3rd class carriages drawn by the locomotive 'North Star' (below). Last seen December 2017, in: http://imparareconlastoria.blogspot.ca/2015/10/68-europa-e-nord-america-nella-prima.html

[1] César Daly was the first theorist of railway architecture (Aguilar, 1988).

Figure 0.2 Railway design between two cities, which are nowadays part of town centre of Nuremberg, unkown author (1834) (Walz, 1977).

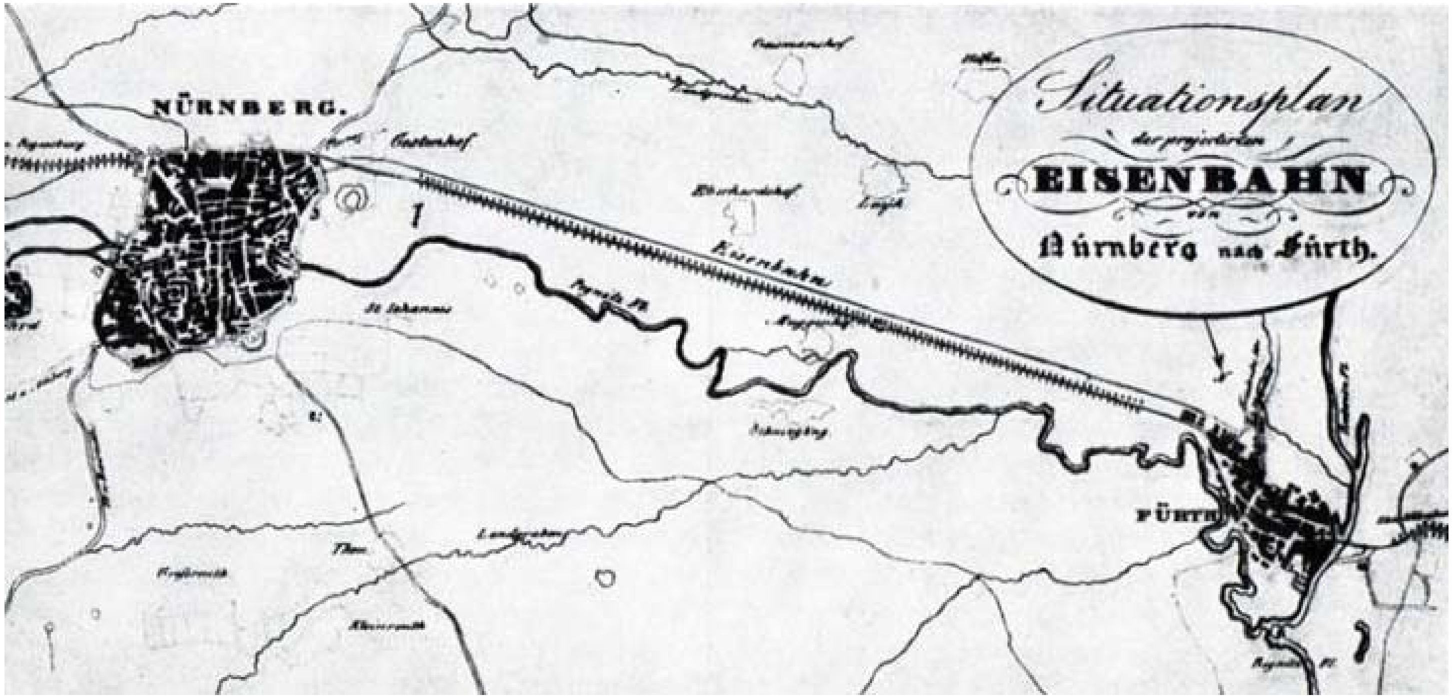


Table 0.1 Kilometres of railways in Europe in 1930 (left). Data from González et al., (2012)

Table 0.2 Kilometres of railways in the Basque Country depending on the year and gauge or type (right). Some data from González et al., (2012)

RAILWAYS IN EUROPE (m/km2)			
Basque	120	**Germany**	118
Spain	32	**Switzerland**	117
Italy	62	**France**	129
England	119	**Belgium**	291

DIFFERENT TYPES OF RAILWAYS IN THE BASQUE COUNTRY				
	Wide gauge	**Narrow gauge**	**High speed**	**m/km2**
1877	256	48,2	--	42,00
1900	273	323	--	82,29
1930	310	563	--	120,50
1986	305	270	--	79,30
2020	305	270	186	105,07

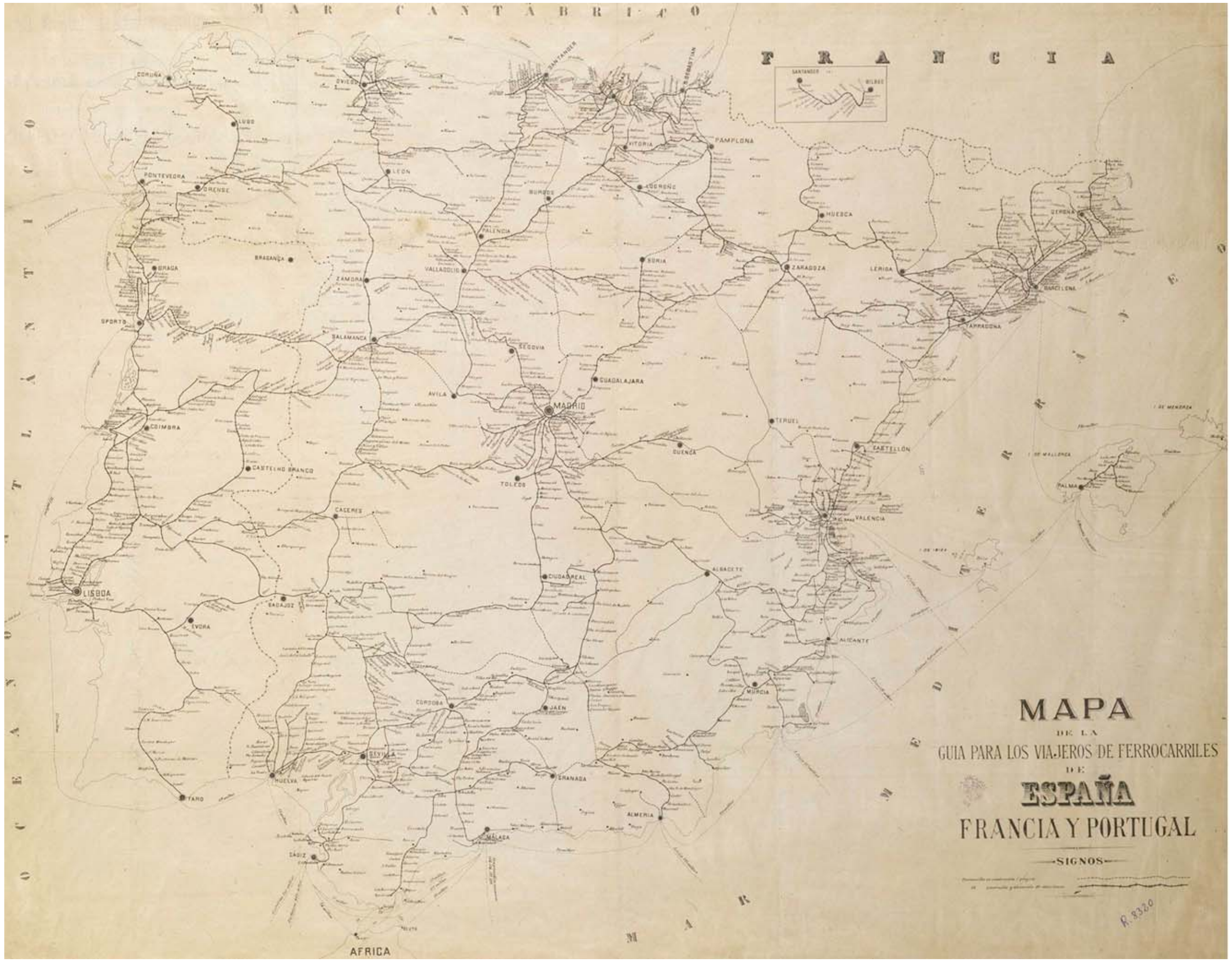
In the case of the Basque Country, in 1860 there was not any kilometre of railway line (González et al., 2012). The arrival of the industrial revolution[2], however, promoted the creation of a dense railway network that expanded all over the territory (fig. 0.3 and 0.4). In this regard, the Basque Country reached almost 900 kilometres of railway lines (120.5 ml/km^2) in the 20^{th} century[3] (table 0.2), which were more than the Spanish level and similar to English, German or Swiss level (González et al.,

[2] The beginning of the industrial revolution in the Basque Country was linked to the relocation of custom offices in the coastal (1841).

[3] Olaizola (2008) mentioned that in 1927 there were 825 km of railway lines (310 broad gauge y 515 of narrow gauge). Last seen December 2017, in:http://ferropedia.es/mediawiki/index.php/Breve_Historia_del_ferrocarril_en_el_Pais_Vasco._Por_Juanjo_Olaizola_Elordi

2012) (table 0.1). Furthermore, the Basque-Navarre railways also had to deal with the existence of two different gauges. Some of them were built in the "normal" Spanish gauge (1,67 m), while others in the narrow gauge (1 m) (fig. 0.4). Moreover, the "normal" gauge (also called broad gauge) was different from the international standard gauge, which is used almost all over the world.

The structural organisation of the Basque railways was developed around two main items: the access control of national and international transports and the supply of raw material or the exit of the steel industry goods (Macías, 1994). Hence, railway lines had an active role in the modernisation of the region (fig. 0.5, 0.6, 0.7 and 0.8), structuring the valleys and the territory of the 19th century.



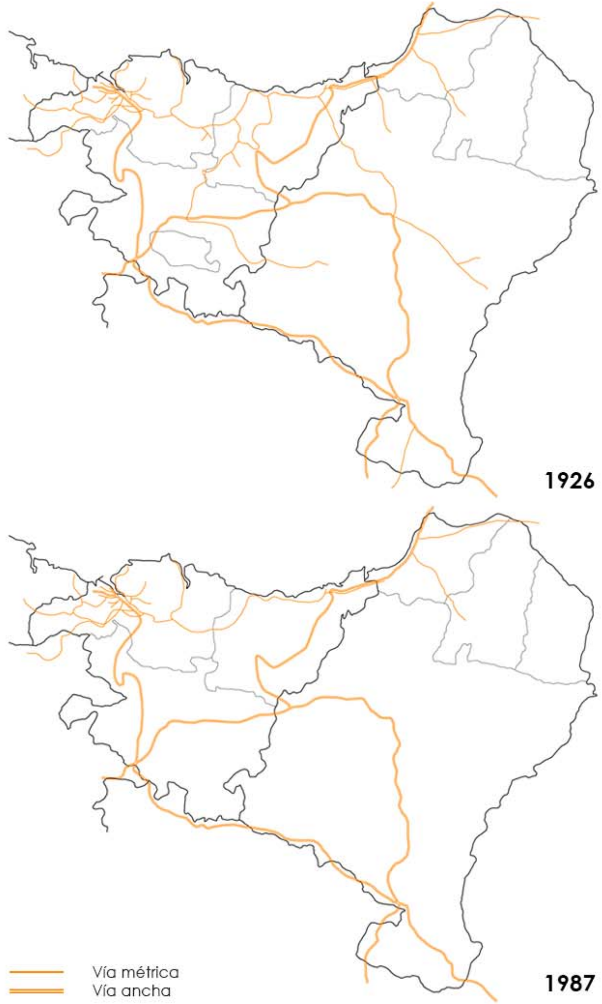


Figure 0.3 Map of the guide of rail passengers of Spain, France and Portugal (1870-1879), J. Palacios (left). Hispanic Digital Library

Figure 0.4 Narrow and broad gauge railways of the Basque-Navarre territory in 1926 (all the lines were already built) and 1987 (closure of the last line) (below).

Figure 0.5 View of Bilbao, from a railway station (1). Skelton, P.

Figure 0.6 View of Bilbao. A tram in the left, an interurban train in the centre and an urban train in the right (2). Archive of the Basque Railway Museum (ABRM)

Figure 0.7 La Naja (foreground) and Concordia (background) stations in Bilbao (3). ABRM

Figure 0.8 Three railway crossing close to Bilbao, 1963 (4). Felix Zurita, Josep Miquel Solé's collection

DISUSED RAILWAY LINES (DRL)

Primitive railways were developed in all over the world in order to adapt them to new technological advances. Their electrification was an example of it. However, some of them were not able to compete against subsequent road traffic or to face the industry decline. Therefore, some specific elements or even whole railway lines have been substituted, reused or abandoned, if not already disappeared.

The well-known Euston station in London, for example (fig. 0.9, 0.10, 0.11 and 0.12), was opened in 1837 and extended several times, but it was demolished and substituted in the sixties. Conversely, the abandoned metro stations in Paris, continue to deteriorate, although their reconvertion to restaurants, swimming pools, discos, or underground gardens have been proposed (fig. 0.13, 0.14 and 0.15). In this regard, the small City

Hall metro station in New York, disused since 1945, has been preserved due to its elegance and distinctive design elements, such as its arched ceilings or glazed tiles (fig. 0.16).

Nevertheless, large station areas remain usually abandoned because huge investments are necessary for their reconvertion or even preservation. Buffalo Central Terminal (fig. 0.17, 0.18 and 0.19), Michigan Central Station (Detroit) (fig. 0.20 and 0.21) or the International station of Canfranc (fig. 0.22), all of them legally protected as heritage elements, are examples of it.

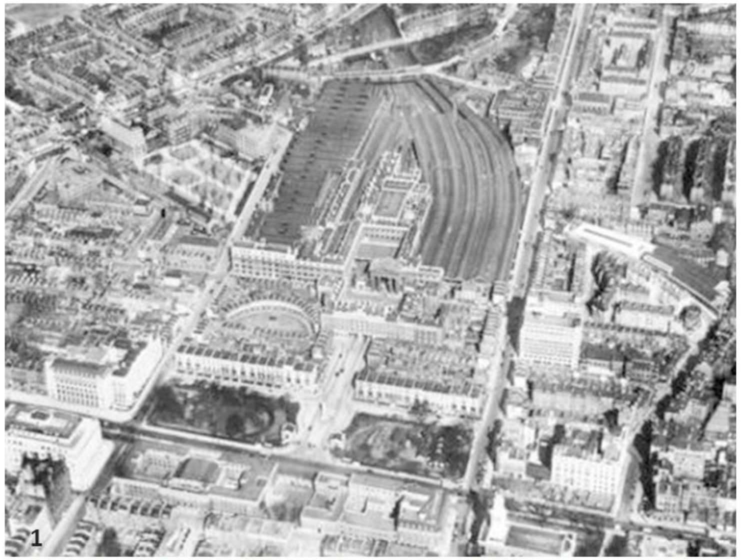


Figure 0.9 Euston Station in 1936. The Arch is tucked into the middle of the site, with the Great Hall behind and offset slightly to its left (1). Historic England, EPW049910

Figure 0.10 The doric arch of Euston Station (2). Historic England

Figure 0.11 Current aerial view of Euston Station (3). Webbaviation

Figure 0.12 Current Euston station (4). David Hawgood

Figure 0.13 Abandoned metro station (Arsenal) in Paris (1). Last seen December, 2017 in: http://www.20minutes.fr/france/diaporama-3437-photo-737333-stations-fantomes-metro-parisien

Figure 0.14 Underground garden proposal for an abandoned metro station in Paris (2). Manal Rachdi OXO Architects and Nicolas Laisné Associés

Figure 0.15 Swimming pool proposal for an abandoned metro station in Paris (3). Manal Rachdi OXO Architects and Nicolas Laisné Associés

Figure 0.16 City Hall metro station in New York (4). Michael Freeman

Figure 0.17 Buffalo Central Terminal (5). Andre Govia

Figure 0.18 Track platforms of the Buffalo Central Terminal (6). Timothy Neesam

Figure 0.19 Interior view of the Buffalo Central Terminal (7). Scallop Holden

Figure 0.20 Michigan Central Station (1). Jean-Pierre Lavoie

Figure 0.21 Interior of the Michigan Central Station (2). Jeremy Blakeslee

Figure 0.22 International station of Canfranc (3). Hannu

In the Basque Country, the increasing road transport or the industry decline induced the closure of many of these railway lines throughout the second half of the 20th century. The kilometres of railway lines have highly decreased (79 ml/km^2) and nowadays, it is the territory with the highest percentage of kilometres of disused railway lines per square kilometre in Spain (Association of Spanish Railways, 1993) (table 0.2). The construction of the future High Speed Railway wants to overcome this decrease trying to compete with the road transport.

Furthermore, the existence of two different gauges and the difference to the international standard gauge hindered any continuity between different railway lines at international level,

DISTRIBUTION OF DISUSED RAILWAY LINES BY REGIONS			
Region	**Km**	**%**	**m/Km2**
Andalusia	1626	24,3	18,6
Castile and Leon	799	12	8,5
Aragon	726	10,9	15,2
Castilla-La Mancha	643	9,6	8,1
Catalonia	471	7	14,8
Valencian Community	429	6,4	18,4
Basque Country	378	5,7	52,1
Community of Madrid	313	4,7	39,1
Murcia	264	4	23,3
Extremadura	202	3	4,9
Navarre	200	3	19,2
Balearic Islands	186	2,8	37,1
Asturias	173	2,6	16,4
Cantabria	144	2,2	27,2
Galicia	78	1,2	2,6
La Rioja	69	1	13,7

Table 0.3 Distribution of disused railway lines by regions in Spain. Based on the Inventory of Disused Railway Lines developed by the Association of Spanish Railways in 1993 (Aycart, 2001)

but also at state and territorial level. It should be added that almost all current disused railway lines were historically narrow gauge.

All these kilometres of disused railway lines and the redevelopment of the existing ones have made the high existence of railway elements or lines that have been adapted, reused or abandoned in the Basque territory. Henceforth, the concept of “disused railway line” will be used referring to the railways that do not have a rail use.

On the one hand, there are examples of railway stations of disused railway lines that are used as railway stations of other existing railway lines, such as the case of the railway station of Zumaia (fig. 0.23 and 0.24) that belonged to the Urola Railway and it is currently a station of the existing Donostia-Bilbao Railway. There are also partially didused railway stations in the Donostia-Bilbao Railway, where a pilgrim hostel has been included in the railway station of Deba (fig. 0.27 and 0.28), for instance, in order to take advantage of the upper stores, which once included the worker residences. On the other hand, there are abandoned railway stations that comprise a great heritage that represent part of the history and could included new uses. Ephemeral actions developed in these areas, such as in case of La Naja Station in Bilbao (fig. 0.25 and 0.26), could promote their initial valorisation.

Nevertheles, entire disused railway lines, composed of a linking corridor and several built elements located along it, such as the Urola or the Vasco-Navarro Railway (fig. 0.29, 0.30, 0.31 and 0.32), are the subject of study of this research, since they are considered strategic for regional development in the foreseeable futue.

Figure 0.23 A station of the Urola Railway in Zumaia, 1986 (1). Th. Leleu

Figure 0.24 Station of Zumaia of the existing Donostia-Bilbao Railway (2).

Figure 0.25 Station of La Naja in Bilbao (3). Bilbao Bizkaia Architecture

Figure 0.26 Ephemeral intervention in La Naja station (4). Last seen December, 2017 in: https://www.arquitecturayempresa.es/noticia/rehabilitacion-del-bia-space-la-naja-bilbao

Figure 0.27 Station of Deba of the existing Donostia-Bilbao Railway (5). Beltri

Figure 0.28 Interior or the railway station of Deba (6). Montajes Eléctricos Montelec S.L

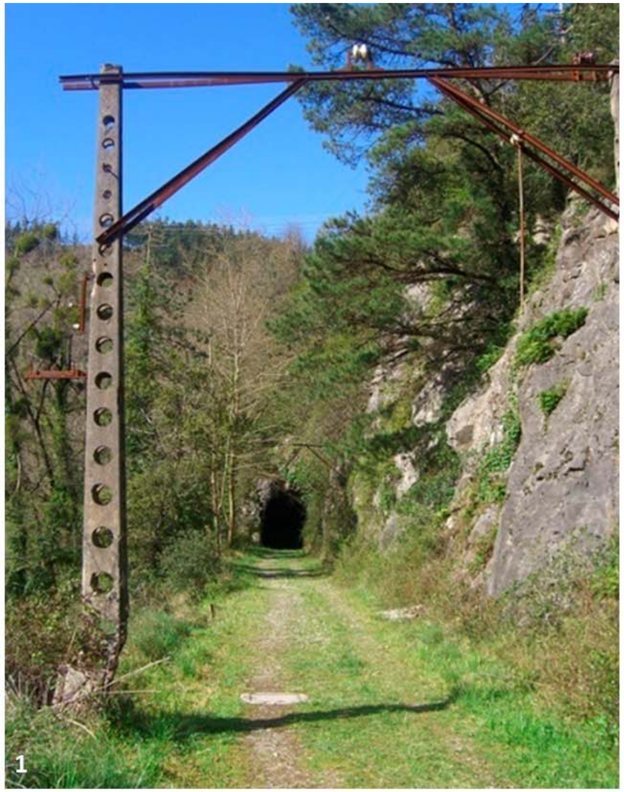


Figure 0.29 Route of the Urola Railway (1).

Figure 0.30 Railway station of the Urola Railway in Iraeta (2).

Figure 0.31 Tunnel entrance of the Urola Railway (3).

Figure 0.32 Railway shed of the Vasco-Navarro Railway in a ruin state (4).

The Basque-Navarre territory

The territorial contex of the disused railway lines of the Basque-Navarre territory is described below taking into consideration four factors defined by the regional planning.

PHYSICAL ENVIRONMENT

The Basque-Navarre territory covers the space between the Pyrenees and Picos de Europa limited by the sea in the north and the river Ebro in the south. In this regard, it is characterised by creating a geographical articulation of fourfold influence: Atlantic, Mediterranean, continental and peninsular (Meaza, 1989). Furthermore, it is featured by having two watersheds that vary considerably in nature: the Atlantic or Cantabrian side and the Mediterranean side. Rivers flow for short distances and valleys are narrow in the first one. Meanwhile, rivers have longer distances and flow into the Ebro River in the second, creating plain terrains and open landscapes.

The hydrological network is a key element in its surrounding dynamic and in overall regional planning. First residential, industrial and infrastructural occupations arose near the rivers, occupying lowland areas and becoming rivers into main territorial structuring elements. This phenomenon occurred especially in the northern slope, where narrow valleys are converted into almost artificial corridors (Basque Government, 2008b).

The areas near the urban cores and the plains areas of the territory were the initial locations of the industry that has moved away from cities over the years. The proximity to the energy (hydroelectric plants) and all these previous factors made the industry to be located near the rivers in most cases. The same applies for the railway due to geographical and technical reasons (adaptation to the existing terrain which entails creating fewer tunnels and bridges) on the one hand and strategic reasons (the initial arrival of raw materials and the exit of industrial goods or the subsequent passenger transport between cores) on the other hand. Nowadays, disused railway lines are presented as strategically placed linear elements, especially in the northern valleys.

SYSTEM OF SETTLEMENTS

The first main urban development process of the Basque-Navarre territory was link to the industrialisation and subsequent territorial modernisation. Although the process was different in each province, it was closely related to the arrival of the railway as González et al. exposed (2012).

With an early start, Bizkaia focused its development near the river at first, and expanded it in four radial directions after, creating a hierarchical centrifugal development model. Gipuzkoa presented a more delayed development with a decentralised and dispersed triangular organisation, creating a centripetal and not hierarchical development model. In Araba/Álava, the development process was focused in the capital, while there was not almost any development in the rest of the territory. The arrival and development of the railway corresponded to the models presented above, especially in Bizkaia and Gipuzkoa (González et al., 2012). Hence, railways are presented as structuring elements for the development of growth areas and their modernisation. In the case of Navarre, and although densities were rather low in general, the settlement system was quite well balanced, formed by the capital and other cores distributed in the territory and similar to the Gipuzkoa´s one. Nevertheless, the industrialisation process involved the vitalisation of the capital as the main regional core, which caused the loss of central role of the intermediate cities of the central zone of Navarre (Ferrer, 1991).

The current system of settlements is similar to the exposed above. However, new infrastructures and technologies, and the strategic location of the territory have made the connection with Europe becomes really interesting, where the Basque-Navarre capitals play an important role.

As described by the regional planning, the Basque Country has one of the highest urbanisation rates of Europe, similar to areas like the Dutch Raanstadt or the German Ruhrgebiet. In this regard, the three Basque capitals have almost 36% of the Basque inhabitants (67% taking into account their whole metropolitan area) and 86% of the inhabitants live in urban areas that have more than 10.000 inhabitants or in municipalities located in capital´s metropolitan areas. Furthermore, there is a large group of intermediate cities with 10.000 - 60.000 inhabitants that create a structuring urban network and offer opportunity, diversity and balance to the territorial model. These urban cores are mainly located in the northern area. Finally, there are rural areas or municipalities with less than 5.000 inhabitants, which have suffered a decrease of population and number of settlements due to industrialisation and urban development process (Basque Government, 2008d). All these result in an increasingly more significant limit between cities and rural areas.

The railway entailed the union of different type of cores (cities, towns and small settlements, both rural and industrial) in its arrival, while the closure of many of them took part in the increase of the presented limit between urban and rural areas.

SOCIOECONOMIC SYSTEM

Population growth occurs closely related to urban growth and, as a result, of industrial development. Accordingly, three different phases can be distinguished in the demographic process (Basque Government, 2008a): the highest population growth occurred from the industrial revolution to 1980, due to high immigration and birth rates; the population decrease produced after 1981 because of the crisis of the traditional industry; and the end of this decrease after the 21st century, when population began to growth slightly. Although there have not been significant variations in the last phase, population ageing has become a current society challenge.

Economic activities were also changed because of the industrial crisis of the eighties. On the one hand, the rapid development of technologies has strengthened the concept of knowledge economy. On the other hand, the tertiary sector has been acquiring more importance, lightening the primary and industrial sectors (Basque Government, 2008a). Nevertheless, some economic diversification is necessary in order to develop, especially in times of crisis. Hence, it should be mentioned the change of functions produced in the last years in rural areas, which incorporates activities related to tourism, local products, new technologies, natural and cultural resources, etc.

MOBILITY AND ACCESSIBILITY

The construction of new roads or the arrival of the railway and the automobile resulted in a social change because of the reduction of space-time and the decline in importance of pedestrians. Pedestrian walked along paths, but paths were transformed into roads during the 18th and 19th centuries, moving away pedestrians to hard shoulders (Etor, 1991). All these entailed a change in modes of transport that is currently questioned again.

In relation to mobility data, on the one hand, walking and cycling have the highest percentage of travels of the Basque Country (Basque Government, 2008c). On the other hand, in response to the increase of the motorised transport demand over the past decades, transport infrastructures have significantly increased. Nevertheless, the problem has not been solved, since there are imbalances in the communication of different areas, investment or renovation needed railways, freight transport problems, etc. Moreover, the closure of several railways that articulated whole valleys must be added. In practice, the construction of new infrastructures is not enough to deal with the increasing motorised transports (Hoyos, 2010).

Furthermore, interest in interprovincial and international communications has considerably augmented. Infrastructures of the 19th and 20th centuries (main roads, railways, power lines, etc.) structured the territory taking into account both main cities and smaller urban or rural areas. New high capacity current and future infrastructures (highways, high-speed railways or energy networks), however, exclude this smaller scale (Lozano & Arbaiza, 2010), favouring long-distance non-daily connections.

As a result of all these factors, the transport model is currently questioned. In this regard, sustainable mobility or active transport issues are necessary to take into account in order to deal with the economic and environmental problems of the current model.

Problem statement

There are thousands of kilometres of Disused Railway Lines (DRLs) all over the world, hundreds of them in the Basque-Navarre territory. They are understood as part of the history and there is interest in their safeguarding. DRLs set a railway heritage of great interest, but the lack of use and passage of time have made them to be in danger of disappearing, if not already disappeared. In the case of the Basque-Navarre territory, the closure of the last line was in 1987 and, hence, the current deterioration of most of the assets begins to rise considerably. Accordingly, how to preserve these lines and what they can be used for are part of the ongoing debate.

In this regard, some opportunities have already been suggested in the context section:

- DRLs are strategically located in both territorial level (low areas of valleys) and urban level (city centre areas). Thus, they could have a high influence in urban and territorial regeneration and development processes.
- DRLs go through urban and rural areas. Hence, they could diminish again the limit between urban and rural zones creating links between main cities, towns and rural areas.
- DRLs could act as cultural resources in urban regeneration areas or connected rural settlements, giving rise to an economic diversification and development of these areas.
- DRLs are linear infrastructures that maintain old local and regional level connections. Moreover, they are suitable for active transport modes that could reduce the economic and environmental problems of the current transport model.

Nevertheless, there are two main strands in current proposals:

- On the one hand, restoration and enhancement interventions of railway buildings (mainly station passenger buildings) and their environments for new uses. Several of the building interventions have been addressed as heritage element interventions. However, in practice, the extension of the concept of monument and its territorial dimension of last decades are not taken into account.

- On the other hand, the reuse of the paths as new transport infrastructures (mainly non-motorised transport means). The restoration of the built railway heritage is proposed as part of them, although in practice, this type of intervention focuses on a single building.

Hence, current proposals do not take advantage of all opportunities presented above or other new possibilities, and are more restricted and focalised. They are generally focused on isolated elements and buildings or on the line, but not on the whole. That is why a change of mentality is needed. This change is related to both theoretical and conceptual understanding of disused railway lines and their future practical intervention proposals.

The main problem of disused heritage elements is constant damage. In this regard, in the theoretical framework, regeneration and enhancement of heritage is not already understood as a waste of money, but as an opportunity to renew and develop. Moreover, valorisation of specific types of heritage, such as industrial or public works heritage, has begun over the last years. Accordingly, an approach to public spaces and a rediscovery of infrastructures as urban design elements have occurred due to the last theoretical and conceptual trends. This promotes the valorisation of old industrial areas, understanding them as opportunity areas for the recovery of heritage and urban centres (Tarchini, 2010). In the case of rail areas, Tarchini (2010) claimed that their value is in their public condition, which is separated from the urban network and organised in a continuous spatial network formed by different elements, and that is why future interventions should take advantage of the oppotunities of these characteristics. The considering of the railway heritage as a whole (formed by buildings, empty areas, access areas and the urban networks connections) is a way to enable this enclaves to be integrated effectively into urban dynamics, generating transformations for problem-solving, in addition to recognise the construction and development process of the railway heritage itself (Tarchini, 2010).

Practical approaches and interventions, however, show a mismatch between theoretical and practical achievements, demonstrating the difficulty to apply this integrated view (Porcal, 2011). This research would seek to fill the existing gap in this area and emphasizes that the analysis of the disused railway lines should have a comprehensive vision in order to achieve the same view in their protection or future interventions. In this regard, the objective of this thesis work is to create a methodology for the comprehensive analysis of disused railway lines, which will show the potential of the lines in the surrounding territory.

As already summarised in the conclusions of the V Conference for the Conservation of Industrial and Public Works Heritage in Spain (TICCIH, 2009), the definition of a conceptual framework and the development of methodologies that take into account the complexity of cultural landscapes (where industrial and railway heritage can be included, as will be shown later) are needed. In addition, industrial heritage areas should be noteworthy elements of urban and regional planning, taking into consideration that they are structuring axes of territory on occasions.

Case studies

Disused railway lines of the Basque-Navarre territory in general and in particular the Vasco-Navarro Railway are used as case studies in order to create an analysis methodology. A new approach and its related methodological processes are developed for that purpose.

On the one hand, the main disused railway lines of the Basque Country and Navarre are used to make a general analysis in order to address the new approach of the methodology. As it was said before, the Basque Country is the territory with the highest percentage of kilometres of disused railway lines per square kilometre in the state (Association of Spanish Railways, 1993). Twelve lines have been selected, which were used for the transport of goods and passengers. They are the ones that may have some potential in the regional planning of their surrounding areas (fig. 0.33 and table 0.4).

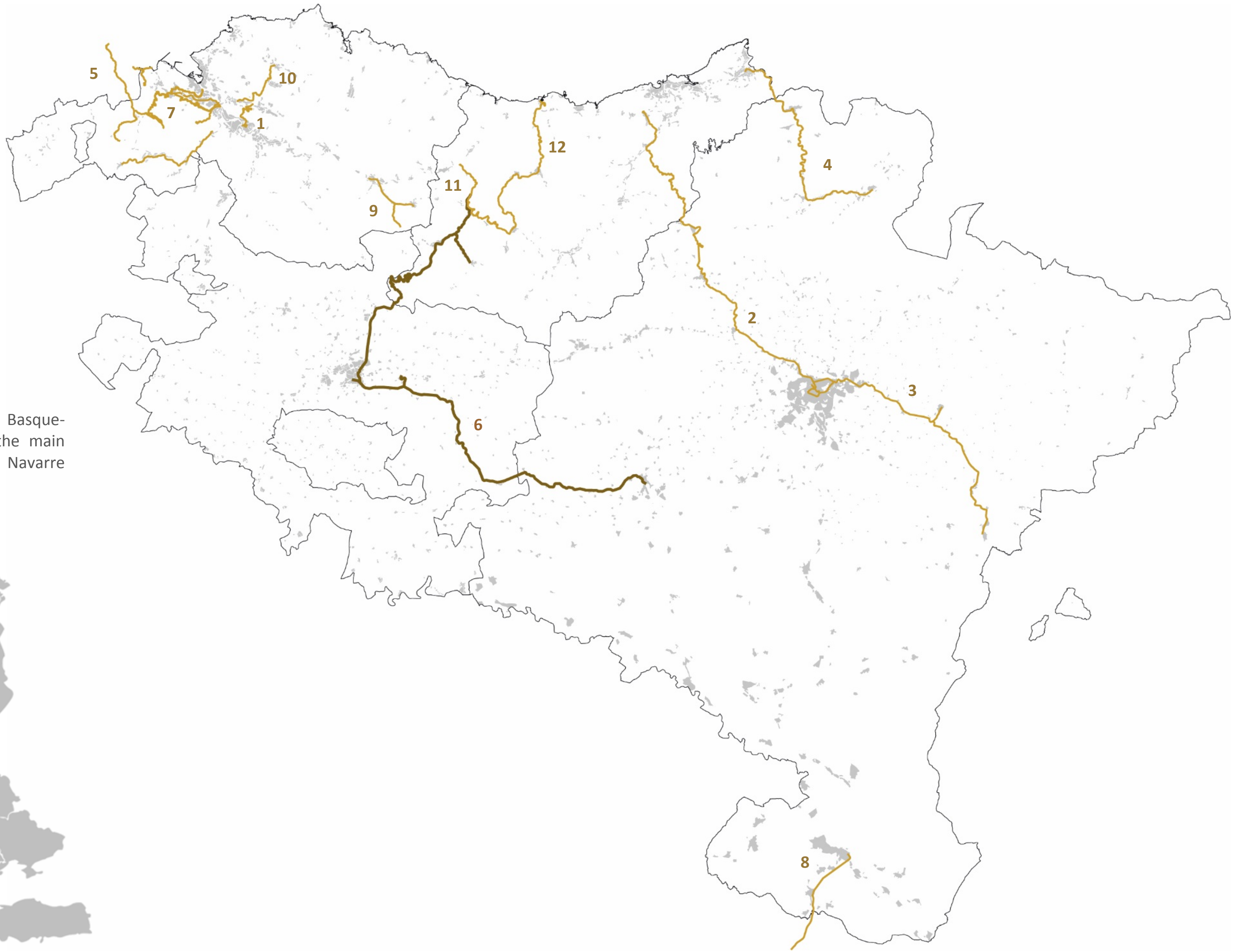
On the other hand, one of main lines presented above (the Vasco-Navarro Railway) is used to make a detailed analysis to go in depth into the definition of the methodology. The first section of the Vasco-Navarro Railway was opened in 1887, but the entire route was not completed until 1927. Fifty years later (1967), the railway was closed and most of the rail line kilometres have been turned into greenways or bicycle lanes in recent years. Furthermore, a part of the Maltzaga-Zumarraga railway has been added to the analysis because it enables the connection with the next valley, which is considered important for the territorial structuring effect of a linear infrastructure. They cover together three different provinces and 145 kilometres, crossing through diverse territories or landscapes, from main cities to rural towns or protected natural areas (fig. 0.33).

DRLs OF THE BASQUE-NAVARRE TERRITORY			
Railway line	**Open**	**Closure**	**km**
Bidasoa	1916	1956	51
Plazaola	1914	1953	84
Irati	1911	1955	59
Tarazona	1886	1972	21
Urola	1926	1987	27
Vasco-Navarro	1927	1967	139
V. branch Elorrio	1905	1975	15
V. branch Zumarraga	1888	1979	26
Lutxana-Mungia	1894	1977	13
Bilbao-Lezama	1895	1908	10
Sestao-Gasdames	1876	1969	22
Traslaviña-Castro	1898	1966	33

Table 0.4 Open and closure years of DRLs of the Basque-Navarre territory.

1 Bidasoa
2 Plazaola
3 Irati
4 Tarazona
5 Urola
6 **Vasco Navarro**
7 V. branch Elorrio
8 V. branch Zumarraga
9 Lutxana-Mungia
10 Bilbao-Lezama
11 Sestao-Gasdames
12 Traslaviña-Castro

Figure 0.33 Location of the Basque-Navarre territory (below) and the main DRLs of the Basque Country and Navarre (right).



Suitability and topicality of the issue

The research topic has been highly developed in last decades and years. However, more effort must be done due to two main reasons. On the one hand, the passage of time has made disused heritage elements in danger of disappearing. The more time that passes, the more likely the elements will disappeared, decreasing the potential that the whole line could have. On the other hand, old infrastructures and industrial areas are strategically located in urban areas, becoming the main resources that cities have for redevelopment and regeneration. The latter is an opportunity that will hardly return again (Tarchini, 2010), making the topic somewhat essential.

Furthermore, governments have been working for years in some of the issues of this thesis, such as cultural heritage or sustainable mobility. Conversely, these research areas are dealt with independently of each other. It is therefore necessary to integrate different research areas and disciplines in order to achieve a comprehensive perspective and as a result, a comprehensive methodological proposal. Trachana (2011) have already pointed out that heritage elements should be also analysed at a landscape level and their research should be developed in more different disciplines, such as regional planning and management, urban planning and architecture.

Finally, it should be noted that this research was supported by a research training grant from the Department of Education, Language policy and Culture of the Basque Government. An international stay in the School of Planning of the University of Waterloo (Ontario, Canada) was also supported by the same department. This stay of six months was an opportunity to interact with other research disciplines and see firsthand international examples.

Thesis organisation

The work has been divided in four parts, which are explained in next lines and represented in fig. 0.34:

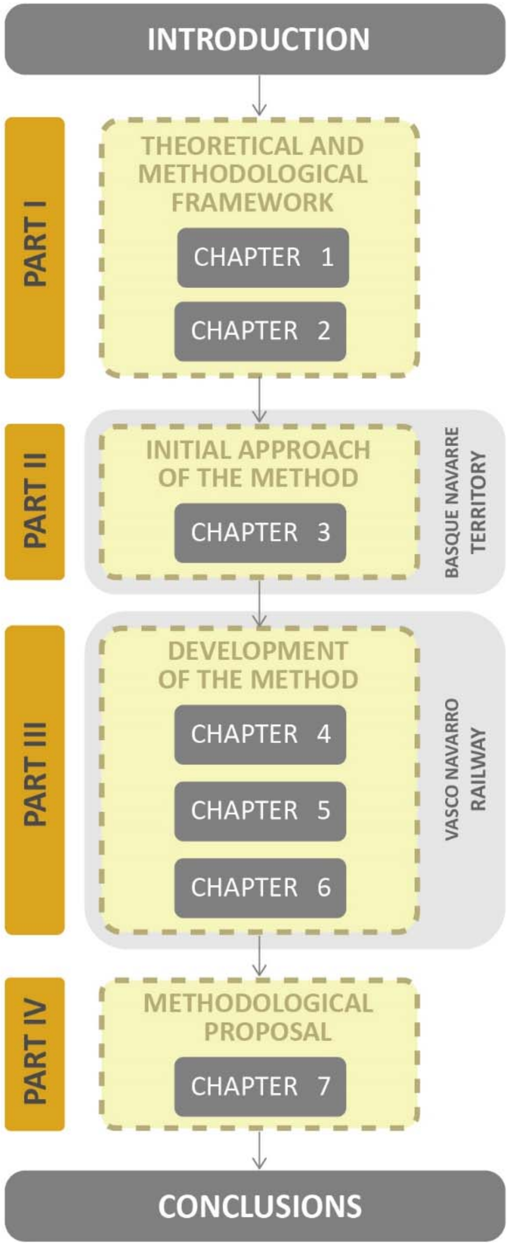
In **Part I**, the theoretical and methodological frameworks are presented and the objectives of the present thesis work are defined:

- Chapter 1 reviews the theoretical aspects that disused railway lines could comprise taking into account which the issue under consideration is, how it is presented in current planning proposals and which opportunities it could have. In this regard, firstly, the heritage nature of disused railway lines is exposed taking into account their territorial nature. Secondly, the current situation of disused railway lines in the regional and urban planning is shown. Finally, interactions between transport and land use are analysed and a specific urban development model is presented. Accordingly, the main objective of the research is defined.

- Chapter 2 exposes the methodological aspects of the conclusions obtained in the theoretical framework. Accordingly, the concept of system and its analysis are looked through, accessibility analyses are studied in literature and the node/place model and its variants are presented. Each of the three subsections of the methodological framework is directly based on one of the three subsection of the theoretical framework. Accordingly, the specific objectives are defined and the research process is designed.

Part II, Part III and **Part IV** focus on the creation of the methodology for the analysis of disused railway lines:

Figure 0.34 Flowchart of the thesis organization where the four parts of the research and their corresponding chapters are represented.



- Part II (chapter 3) shows an approach to the methodology for the analysis of disused railway lines by means of a case study. Twelve disused railway lines of the Basque-Navarre territory have been selected in order to obtain general results and compare the different lines between them.

- Part III (chapters 4, 5 and 6) develop a detailed analysis of one of the disused railway lines (the Vasco-Navarro Railway) for deepening the definition of the methodology. The analysis, in turn, has been divided in several chapters, focusing each of them in a different perspective.

- Part IV (chapter 7) presents the comprehensive methodology for the analysis of disused railway lines.

Finally, the conclusions obtained in this research and the further work are summarised.

PART I: THEORETICAL AND METHODOLOGICAL FRAMEWORK

1. THEORETICAL FRAMEWORK

This framework comprises the theoretical aspects that disused railway lines could embrace taking into consideration the composition of the subject of study and its future approaches. Accordingly, on the one hand, the heritage nature of disused railway lines is exposed and, on the other hand, their current situation in the regional and urban planning proposals or transport based development proposals are shown.

1.1. Disused Railway Lines (DRL) as heritage systems in the territory

The heritage value of an old architectural masterpiece is usually well known by anyone. However, other elements such as intangible items, daily use elements or industrial and infrastructural buildings do not have the same admiration, at least so far.

1.1.1. The concepts of industrial heritage and railway heritage

The concept of heritage has been extended from monument to cultural and natural heritage in last decades (Aguilar, 2001). Although the promotion of the railway heritage is still at an early stage, this heritage has been already recognized as cultural heritage and it is linked to other subtypes of heritage, such as industrial or public works. This has helped to understand the railway heritage in its entirety.

The historical-artistic heritage of the Basque-Navarre territory is regulated by the Spanish legislation (The Act 16/1985, of June 25, on the Spanish Historical Heritage), which introduced several variations in relation to the previous law (The Act on the Historical-Artistic Heritage of 1933) (Spain, 1933; Spain, 1985). The old law dealt with the concept of monument while the current one refers to scientific and technical interests as value factors, thus including industrial elements in their heritage elements spectrum, even though it is not directly mentioned. Moreover, the spatial definition of the concept of heritage has been also increased, referring to "zones" or "sites", such as archaeological sites and zones or natural areas, gardens and parks. Nevertheless, the heritage concept of this legislation (1985) is almost obsolete in relation to subsequent other plans. In thid regard, the Basque regional planning, at the beginning of the century, refers to the architectural heritage[4] as a concept that involves from any construction element or building to sets of buildings with cultural or historical significance. This means that the concept comprises in addition to architectural elements, industrial and engineering works of urban or rural areas, including public works, infrastructure service facilities and others (Basque Government, 2000).

INDUSTRIAL ARCHITECTURE

In order to comprehend the concept of industrial heritage it is necessary to define before the concept of industrial architecture. As Sobrino (1996) claimed, industrial architecture did not emerge as an outward-looking typological model (aestheticism), but a prototype (functionalism) able to organise the spatial distribution of the volumes and foresee their development (flexibility) over time. This type of architecture was created for the mechanical era and was thus, a result of the industrial revolution, which brought ideological changes such as compatibility, time precision, exchangeability, quality control, etc. (Aguilar, 1999).

The beginning of the industrial revolution in the Basque Country was in 1841, when customs were moved from the hinterland to the coastal. As explained before (see Introduction), industrial areas were strategically located near rivers and urban areas. However, industrial sites were moved out of urban areas over the years and related to an economic crisis, which resulted in hundreds of disused industrial facilities. In this regard, deindustrialisation was seen as an opportunity to recover urban

[4] This review focuses on architectural heritage but being aware of the existence of other type of heritages such as intangible elements, movable heritage, etc.

land and promote urban renewal (Herreras & Zabala, 2012). At the same time, an interest for the study, valorisation and safeguarding of this type of architecture was emerging as an opposite feeling. Other European regions, such as England (first), Holland, Belgium and France took the first steeps and Mediterranean areas came after. In Spain, Cataluña and the Basque Country were pioneers in the valorisation and preservation of industrial architecture, since they were the most industrialised regions (Herreras & Zabala, 2012).

Accordingly, the definition of industrial architecture was developed in relation to its valorisation. That is why there was not almost no definition until some years ago. Nevertheless, it has been a widely studied issue in recent years. Aguilar (1999) defined industrial architecture as the architecture that has exploitative or industrial purposes, is related to commerce and is based on socioeconomic necessities. In addition, industrial architecture is not limited to industrial use buildings; it is also the architecture of the ideology of the mechanical era. This was related to the appearance of new industrial materials, such as iron, steel or reinforced concrete and new architectonic typologies (markets, slaughterhouses, stations, etc.) which were created in response to the new necessities of the industrial society. Something similar occurs with technical facilities (public works, such as canals, bridges, railways or water, gas and electricity supplies) or residential buildings (working class) (Aguilar, 1999).

The main features of the industrial architecture were also defined by Aguilar (1999): functionality; rationality, sincerity and transparency; prefabrication; architecture based on catalogues; assembled architecture; standard style; and brand architecture.

INDUSTRIAL HERITAGE

In 2003, a National Assembly of TICCIH[5] (The International Committee for Conservation of the Industrial Heritage) was held in Moscow. This assembly arises from the need to recognize the importance of studying and preserving the elements that had an active role in the industrial revolution, since the material evidence of these profound changes has a universal human value. As a result of the assembly, the well known Nizhny Tagil Charter for the Industrial Heritage was released, which exposes the basic principles of definition, valuation, classification, protection, preservation, training and dissemination of industrial heritage. According to the charter:

> Industrial heritage consists of the remains of industrial culture which are of historical, technological, social, architectural or scientific value. These remains consist of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education. (TICCIH, 2003)

Furthermore, The Dublin Principles were created in collaboration with TICCIH in the 17th General Assembly of ICOMOS[6] (International Council on Monuments and Sites) in

[5] The first International Conference for the Conservation of the Industrial Heritage took place in the Museum Ironbridge (UK) in 1973. However, it was in 1978, as a result of the third edition of this conference (Stockholm) when the world organization (TICCIH) was created. This congress is held every two or three years since 1973 and its main objectives are the development of international cooperation and promotion of national initiatives for the conservation of industrial heritage.

[6] ICOMOS is a non-governmental international organisation dedicated to the conservation and protection of the world's monuments and sites and related to the UN (United Nations) by means of UNESCO (United Nations Educational, Scientific and Cultural Organisation). It was created in Warsaw in1965, following the principles of the newly created Venice Charter (International Charter on the

2011. In those principles (Joint ICOMOS-TICCIH Principles for the Conservation of Industrial Heritage Sites, Structures, Areas and Landscapes), 14 common principles were defined, where the first one referred to the definition of the concept.

> The industrial heritage consists of sites, structures, complexes, areas and landscapes as well as the related machinery, objects or documents that provide evidence of past or ongoing industrial processes of production, the extraction of raw materials, their transformation into goods, and the related energy and transport infrastructures. Industrial heritage reflects the profound connection between the cultural and natural environment, as industrial processes –whether ancient or modern- depend on natural sources of raw materials, energy and transportation networks to produce and distribute products to broader markets. It includes both material assets –immovable and movable-, and intangible dimensions such as technical know-how, the organisation of work and workers, and the complex social and cultural legacy that shaped the life of communities and brought major organizational changes to entire societies and the world in general. (ICOMOS, 2011)

In turn, each association (TICCIH and ICOMOS) has its national committee working on the preservation of industrial heritage at the state level. Furthermore, at a regional level, the Basque Country has also worked in the areas of dissemination and defence of its industrial heritage since the early eighties (IOHLEE (coord), 2012). In 1982, the first conference on Protection and Revaluation of the Industrial Heritage was held in Bilbao and as a result, the Association of Friends of the Technical Museum of Euskadi was emerged in 1984 and its successor, IOHLEE[7] (Basque Association of the Industrial and Public Works Heritage), in 1989. According to IOHLEE, industrial heritage should be understood as a wide perspective object that includes not only buildings, architectural structures and production machinery, but also the means of transportation and communication through which raw materials and products came and were marketed, residences, associative and healthcare centres for workers, public services and ultimately, the landscapes modified by the extractive and industrial activity[8].

Finally, citizen perspective results also important in the valorisation, defence and dissemination of industrial heritage and consequently, in the wide nature of the current definition. The demolition of the Doric portico of Euston Station (1835-1837) in 1962 is understood as the beginning of the citizen movement, sensitising public opinion and thus disseminating widely the interest in this heritage (Herreras & Zabala, 2012). Accordingly, and as in the case of industrial architecture, the development of the concept of industrial heritage was linked to the study and valorisation of industrial architecture.

In this framework, the concepts of industrial architecture and industrial heritage are not limited to factories or industrial buildings themselves, but encompass the entire manufacturing process, including infrastructures, services, as well as the concept of place. This is also reflected in the legislation and planning documents referred to industrial heritage, which have

Conservation and Restoration of Monument and Sites, 1964) and with the objective of promote the theory, methodology and technology applied in conservation, protection and valorisation of monuments and sites of cultural interest.
ICOMOS is also responsible for proposing assets be introduced into the World Heritage List and TICCIH is its special adviser in industrial heritage issues.

[7]They work in the protection, preservation and enhancement of the industrial and public works heritage, following the principles embodied in the Nizhny Tagil Charter (2003). This association consists of a multidisciplinary team and it was responsible for making the inventory of industrial and public work heritage of the Basque Country.

[8] Last seen October 2017, in: http://www.avpiop.com/

been developing and expanding the concept over the years.

At state level, the first Spanish plan on industrial heritage was created in 2001 (Industrial Heritage National Plan) and replaced by the current one in 2011. There are some differences related to both the concept of industrial heritage and the elements covered. The first plan refers to "set of elements", while the second distinguishes between "set of movable or immovable assets and systems of sociability" and uses the same scheme for the classification of the assets, presenting an evolution. In the section of immovable assets in turn, the concept of "industrial systems and networks" is included to the concepts (industrial elements, industrial sets and industrial landscapes) of the previous plan. Consequently, according to the plan, industrial heritage should be understood in a comprehensive way and their assets as an integral whole composed of the landscape in which they are inserted, the industrial relations with which they are structured, the architecture that characterizes them, the techniques used in their procedures, the files generated and their symbolic practices (Spanish Institute of Cultural Heritage, 2011).

At regional level, although there is not any specific plan on industrial heritage, cultural heritage legislation needs to be taken into consideration, since industrial heritage should be understood as part of the general cultural heritage (TICCIH, 2003). The Act 7/1990, of July 3, on the Basque Cultural Heritage classifies assets in three categories[9] (monument, monumental set and cultural space), while the Act 14/2005, of November 22, on the Navarre Cultural Heritage classifies heritage assets in seven categories[10] (monument, historical set, historical site, archaeological zone, cultural landscape, historical route and historical garden). This difference is closely related to the dates of each law and that is why the Basque law is out of date, although it was pioneer in its conception. Since then, several new drafts have been presented, even adopted. First of all, the Regional Sectorial Plan of the Basque Cultural Heritage was drafted (2000) and adopted (2001) from the regional planning area, although this approach was after dismissed. Afterwards, several drafts have been presented with the aim to update the current cultural heritage law (Basque Country, 2011; 2015 and 2017). Although none of them have been definitively approved, the latter two present a similar classification (six categories) than the Navarre law. In the Navarre legislation however, direct reference is also made to industrial heritage defining the concept (article 66) and its protection (article 70) in the Chapter II of the Title V (Navarre, 2005).

[9] Monument: all movable or immovable asset which, individually considered, has an important cultural interest. Monumental set: any group of movable or immovable assets which forms a cultural unit. Cultural space: constituted by places, activities, creations, beliefs, traditions or past events linked to relevant forms of expression of the culture and lifestyle of the Basque people. (Basque Country, 1990b)

[10] Monument: immovable assets that constitute architectural or engineering achievements or colossal sculptures provided they have historical, ethnological, artistic, scientific or social interest. Historical set: group of immovable assets that forms continuous or dispersed foundation unit, conditioned by a physical structure representative of the evolution of a human community for being witness of their culture or constituting a use value and enjoyment for the community. Historical set is also any individualised core of assets within a superior population unit that fulfils the same characteristics and can be clearly delimited. Historical site: Place or natural spot linked to events or memories of the past, popular traditions, cultural or natural creations and human works that have historical value. Archaeological zone: Place or natural spot, where there are movable or immovable assets that can be studied with archaeological methodology, whether they have been extracted or not and whether they are on the surface, underground or under water. Cultural landscape: Natural spot, area of ethnological interest, group of buildings or facilities linked to lifestyle, culture and traditional activities of the Navarre people. Historical route: communication path with cultural, historical, ethnological or technical importance. Historical garden: delimited space, product of human management of natural elements, sometimes complemented with masonry structures, and estimated to be of interest depending on its historical origin or past or its aesthetic, sensory or botanical values. (Navarre, 2005)

Taking into account all of the above, the concept of heritage has been broadened from monument to cultural and natural heritage that refers to a past period, even if it is recent. Therefore, if the industrial heritage will be understood as an integral heritage, the monument, the artefact, the document or the oral history would be under study (Aguilar, 2001). As Aguilar (1999) claimed, a bridge, a railway or a lighthouse is not only an engineering or artistic work but also the result of a specific economic organisation of communications. In the case of a railway, the trace that its construction left is an important part of the heritage, complemented in turn by all the elements that are part of the heritage system.

Nevertheless, although a wide subject of study is included theoretically in the concept of industrial heritage, most of the studies, and especially inventories and catalogues, focus on architectonic and technologic elements in practice, leaving aside for example, the transportation or communication sectors.

RAILWAY HERITAGE

As in the general concept of heritage, railway heritage is also composed by a wide range of elements. That is why railway heritage refers to lines that cross, link and define the territory; constructions; rolling stocks and devices that reveal the development of the transport technology and a desire to progress; company files; and the oral memory (Aguilar, 2008).

Furthermore, García Álvarez[11] (2007) used the general concept of Historical and Cultural Railway Heritage and argued that it consists of a set of heterogeneous elements that can be classified depending on their features and uses (artistic railway heritage, industrial railway heritage and documental railway heritage). This research work focuses on industrial railway heritage, which in turn, is composed of elements linked to industrial railway activities and divided in various groups: vehicles; other movable assets of railway use; pieces; immovable assets formed of buildings or groups of buildings; railway facilities; infrastructure, path and all its element and facilities; and sets that integrate several of the previous ones (García, 2007). This rigorous classification of the different types of railway heritage is interesting to comprehend not only the broadness of the concept, but the importance of non-separation of elements, since each element is part of the whole railway complex, set or system.

The architecture that represents these elements (railway architecture) is part of industrial heritage so they share features like functionality, prefabrication, standard architecture, etc., leaving aside aestheticisms (although beautiful exceptions could always be found). The main element of this architecture has always been the station, which supposed the creation of a new architectural type[12]. The typology makes possible to repeat the shape of the building with same variations, since the design of the railway architecture was not limited to the creation of one station area, but the design of all buildings in all towns (Ferrari, 2010). In this regard, the type was reduced to a scheme that resulted from the process of deducing a common base form or outline of the set of formal variants, and the characteristics of

[11] Alberto García Alvarez is director of the Association of Spanish Railways (FFE), created in 1985 and which works in the recovery, custody and dissemination of the railway heritage and collaborates with companies of the Spanish railway public sector, such as Adif, Feve, Renfe or Eusko Trenbideak.

[12] Type is the concept that describes a group of elements that have a same formal structure and can be grouped by their common features without losing their own singularity. Elements that have continuity can be found forming the so called “typological series”, each of them a type with its own entity. However, it does not prevent from defining a new formal structure when they act towards one another, creating the “base type” concept, which will give meaning to the continuity of the series (Moneo, 1978).

this base form must be understood as the formal structure that has an intrinsic possibility of allowing variants (Ferrari, 2010).

Thus, the station is a building that has its own entity and maintains a series of continuous structuring elements that define the base type. But at the same time, it is a building in constant relation to the real problems and the existing society, which are necessary to solve or be adapted to, by means of a constant transformation (Aguilar, 1988). Accordingly, the station comprises the terms of a new typology but gives a response to each city or environment, all this based on the industrial features of functionality, prefabrication and standardisation. That is why a classification of stations is made in several categories according to their features or needs.

Nevertheless, the station is only one of the elements mentioned above, just part of the whole railway system. In this regard, the passenger building of a station is not an element of basic need in the complex system of constructions of a new railway line. It is therefore, a secondary element in a railway operation (Aguilar, 1988). In this regard, the analysis of the passenger building within its own railway structure is necessary (Aguilar, 1988), since the historically most important and characteristic element is a component of a system, where its potential is increased.

1.1.2. From industrial and railway heritage to cultural landscape

The concept of heritage has been extended from monument (understanding it as an isolated element) to other broader concepts (monumental sets, sites, cultural and natural heritage, cultural landscape, etc.) that are related to the surrounding territory. Heritage in general, and industrial and railway heritage in particular, have been closely linked to the territorial development, and this gives rise to comprise several heritage elements in inclusive heritage areas, such as industrial valleys, port areas, mining areas and communications. “Territory” and “landscape” are essential ideas in this approach and “cultural landscape” the global concept that the railway heritage could adopt for its comprehensive analysis.

LANDSCAPE

Landscape and territory are a reality in constant evolution (Galindo & Sabaté, 2009), so the railway heritage is not surrounded by a static or past environment, as has been seen on occasion. On the one hand, railway heritage should be understood in its continuous evolution and especially in the evolution of its surrounding reality. On the other hand, it is necessary to comprehend the changes that are producing in that evolution, such as the industrial revolution or its decay. The industrial transformations changed past territorial patterns, adapting strong industrial tradition spaces or creating new scenarios, such as railway transports (Herreras, 2012). The closure of railway lines should thus be understood as another turning point in the territorial evolution and as an excellent starting point for the next stage.

However, landscape is not always immediate or evident. It is a dynamic and complex reality, so in addition to its explicit elements (physical, material and tangible ones), it has a series of components (intangible ones) that are difficult to distinguish with the naked eye, but it would be devoid of identity without them (Cruz, 2010). Heritage should be understood and analysed in this broad landscape concept, as an integral part and considering it beyond mere support. As an identity value, landscapes are extended over time, providing continuity and, hence, balance to the history (Juaristi, 2012).

There is not a total consensus when defining the concept of landscape. That is why it is important to comprehend the territory as a social construction, the result of a long process of human intervention on environment (Troitiño, 1998). On the one hand, landscape could be regarded as the field seen from a specific point, but on the other hand, there is a human factor that could take part in both landscape transformations and perception. Nowadays, the definitions most often used encompass these two approaches. According to Trachana (2011), the landscape covers the place itself, its geomorphology and natural features; its built environment, infrastructures, open areas and gardens, constructive features and spatial organisation; visual relationships and other elements of the urban and territorial structure. But it also covers social and cultural practices, economic processes and other intangible dimensions of the heritage that define its identity and diversity.

In this regard, for the European Landscape Convention[13] adopted in 2000 by the European Council, "landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (European Council, 2000). Moreover, the Convention includes landscapes that might be considered outstanding as well as everyday or degraded landscapes, such as industrial landscapes.

[13] Historical background to this Convention are the Mediterranean Landscape Charter (Seville Charter, 1992) and the Recommendation nº R(95)9 referred to the Conservation of Cultural Sites integrated within the Landscape Policies (1995). The European Landscape Convention was held in Florence in October 2000 and it was based on the conviction that landscape plays an important role of general interest in cultural, ecological, environmental and social issues, and can contribute to the employment creation. The general objectives of the Convention were to promote landscape preservation, management and land-use planning, as well as the organisation of European cooperation in this field (European Council, 2000).

INDUSTRIAL LANDSCAPE

Industrial landscape has been described as the most complex and elaborated form of human land occupation and simultaneously, as the most ephemeral structure. Accordingly, when built elements or people are subordinated to a productive goal and this is over, the first ones are substituted or abandoned while the second ones need to emigrate or change their lifestyles in order to stay (Trachana, 2011). Therefore, industrial landscapes have been usually related to the adjective "degraded", but its current definition shows the features it has as both an important part of the society that it serves and heritage of the current society.

According to Trachana, the main characteristic of industrial landscapes is their dynamic nature, i.e. their capacity for constant transformation due to the rapid technology development and as a result, their rapid obsolescence and their need for adaptation. Hence, intervention and transformation of industrial landscapes could be justified as a new stage of the landscape (Trachana, 2011), presenting the landscape in continuous evolution, as mentioned before.

Furthermore, as the concept of landscape is conditioned by the human factor, industrial landscape has been built by the human being for economic purposes. Therefore, these intervened landscapes involve an interaction between their components and complementary elements located in a consistent scenario that are not necessarily limited to a continuous area or a single company, such as productive settlements built around a river axis, a harbour front, or a communication or energy infrastructure. In this way, industrial heritage elements appear when necessary, linked to a higher set, such as a port, railway, mining zone or a big industrial site (Herreras, 2012).

Industrial landscape is thus formed by elements of diverse nature, which as a whole, comprise the surrounding territory and could even organise and structure it. For instance, it is the case of transport landscapes (water, passenger, goods, energy or communications transport) which according to Aguilar (2007), are the ones that better describe the current territory. They are comprised of networks, lines, signals, landmarks, their facilities or influenced areas, while they are scenarios of multiple activities. These routes and scenarios have developed over time, defining a territory that keeps several material remnants of that time and is redrawn on the latest ones (Aguilar, 2011).

These transport and industrial landscapes are the ones that have constituted the society for decades and they are still present in the daily life. Some of them have evolved, but others involve the risk of disappearing, since they are obsolete and stuck in the past. In this regard, the Spanish Industrial Heritage National Plan (2011) has already proposed the identification of the main industrial landscapes and initiated action plans. These plans should favour local development in addition to preserve cultural heritage (Spanish Institute of Cultural Heritage, 2011).

CULTURAL LANDSCAPE

The concept of landscape is useful in the context of heritage preservation because it emphasizes the context nature or the relations between elements (Juaristi, 2012). The entire context gives meaning to the landscape in general and the heritage in particular, creating the broad concept of cultural landscape.

In 1972, the Convention concerning the Protection of the World Cultural and Natural Heritage of UNESCO was held in Paris and an innovative definition of heritage was given using the notion of “site” in order to protect landscapes and integrate the concepts of cultural and natural heritage (UNESCO, 1972). Nevertheless, it is in 1992 when the World Heritage Committee included the concept of cultural landscapes in the Operational Guidelines for the Implementation of the World Heritage Convention of UNESCO. The Convection thus became the first international juridical instrument to identify, protect and preserve cultural landscapes of outstanding universal value. According to the several revisions of the Guidelines, cultural landscapes “are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal” (UNESCO, 2015). They represent the "combined works of nature and of man", so the concept is based on cultural and natural aspects. The agent (cultural) is formed by the action of a social group and the environment (natural) by the natural landscape on which they act (Sauer, 1925).

In addition, under the Cultural Landscape National Plan[14], cultural landscape is the result of the interaction between people and natural environment over time. It is represented by a territory that is perceived and valued for its cultural features, which are the result of a process and the basis of the identity of a community (Spanish Institute of Cultural Heritage, 2012). In the same way, Trachana (2011) defined cultural landscape as

[14] Cultural Landscape National Plan was created in 2012. Cultural heritage (The Act 16/1985, of June 25, on the Spanish Historical Heritage) and natural heritage (the Act 42/2007, of December 13, on Natural Heritage and Biodiversity) were separately considered until then. It aims to safeguard landscapes of cultural interest, understanding “safeguard” as the necessary measures to ensure the viability of the cultural landscape, including identification, characterisation, documentation, research, protection or enhancement acts, covering definition, delimitation, component analysis and management aspects, and using a sustainable development approach (Spanish Institute of Cultural Heritage, 2012)

the result of the development of human activities in a certain territory composed of the following components: natural environment, human action and developed activity. Thus, a third component (activity) is included in relation to the definition of landscape.

Therefore, as Herreras claimed, cultural landscapes could be considered as the "memory of the territory" because it is possible to perceive and interpret in it the formal expressions of human activities over time. Consequently, their valorisation and management are current responsibilities, in addition to an opportunity to create high quality environments and societal values for future generations (Herreras, 2012). In this regard, intelligent heritage management is considered strategic to economic development while areas in decline opportunities for future transformations (Sabaté & Schuster 2001).

LINEAR LANDSCAPE

The World Heritage Committee identified several groups or systems related to cultural and natural heritage in addition to cultural landscapes, such as historical cities and city centres, heritage channels or heritage routes. In this regard, and in order to identify the existing gaps of the World Heritage List, a group of experts met in 1994. Several meetings of regional experts took place, from which two were related to linear landscapes: the first one was linked to cultural routes (Madrid) while the second one to channels (Canada).

In this framework, linear landscapes should be understood as networks that could organise and articulate their surrounding territory. They can be natural (rivers) or artificial (transport infrastructures) but they all have a high system or comprehensive value. Historical routes, channels, railways, road, etc. are presented as linear landscapes, linear infrastructures with historical character, territorial vision and heritage value. Nonetheless, they are not monumental elements but functional elements that played an important role in the interaction with other areas, which are currently precious past or decayed testimonies of territorial exploitation and organisation (Porcal, 2011).

In this regard, the transport network is not a singular monument, industrial set, environment or a place in the landscape. It is a group of communication routes based on a productive system of infrastructure construction, and a technological legacy that it is necessary to know and preserve (Aguilar, 2010). It was also a symbol of the progress to be benefited of, since it influenced the surrounding territory creating a new hierarchy (Herreras, 2012).

These infrastructures were adapted to the territory interacting and integrating in the surrounding environment, forming part of it and in turn, imposing in the future. Thus, land territorial infrastructures are characterised by their high heritage, symbolic and cultural value on the one hand, and its territorial dimension and dynamic character on the other hand (Porcal, 2011).

CULTURAL ROUTE

As part of linear landscapes, cultural routes were also issue of interest for the World Heritage Committee. In 1997, the European Institute of Cultural Routes and the mark of European Cultural Route were created by the European Council and in 1998, the International Scientific Committee on Cultural Routes of ICOMOS was created with the support of UNESCO. However, the Charter of Cultural Routes was not ratified until 2008. In this charter[15] the concept of cultural route evidences the evolution of the ideas referred to its perspective and the increasing importance of the context and territorial level, and reveals heritage macro-structure at different levels (ICOMOS, 2008).

Cultural Routes are thus defined as all means of transportation (terrestrial, aquatic or other type) that are physically determined and characterised by having its own specific dynamic and historic functionality to serve a certain purpose, and meets the following conditions: being the result and reflection of interactive movements of people and multidimensional interchanges of goods, ideas, knowledge and values between towns, countries, regions or continents over long periods of time; having created a multiple and reciprocal fecundation of affected cultures in space and time, which is presented in their tangible and intangible heritage; and having integrated the historical relations and cultural assets associated with its existence in a dynamic system (ICOMOS, 2008).

In this regard, the cultural and heritage value of the Way of St. James has been recognised by the European Council since 1984 and it was declared the first cultural route by the Council and World Heritage by UNESCO in 1987. It should be added that several of the former railways fulfil the requirements mentioned above, even if they are not declared as cultural routes.

[15] The Charter of Cultural Routes was ratified in the 16th general assembly of ICOMOS (2008) that was held in Quebec. Its objectives are: to lay the conceptual foundations and research methodologies of the cultural route category in relation to other categories; to raise essential mechanisms to develop knowledge, valorisation, protection, conservation and management of cultural routes; to establish orientations, principles and basic criteria for the correct use of cultural routes as social and economic development resource, with respect for its authenticity and integrity, its conservation and its historical significance; and to lay the national and international cooperation bases for the creation of research, safeguard, conservation and development projects of cultural routes and its financing (ICOMOS, 2008).

Taking into consideration all of the above, the importance of the railway heritage as heritage asset or set is shown, both as cultural landscape and route. In this framework, railway heritage should be understood as a territorial system. Rodríguez et al. (2010) have already claimed that the development of the concept of heritage into a territorial level has led to a reflexion from which new ways to consider and assess the former public works derive. Instead of a limited valorisation of individual assets that could be recognised as monuments, the need to reflect on historical linear infrastructures is raised, as axes and networks that define and structure the territorial heritage, with a heritage assessment in no case lower than the one associated with its nodes (Rodríguez et al., 2010). In this regard, a progressive awareness of the heritage value of historical linear infrastructures that structure rural and mountain areas has been also shown last years (Porcal, 2011).

Accordingly, in the analysis of the railway heritage and its interventions, heritage elements and the created relations or influences should be taken into account, taking into consideration the whole landscape. This position is already supported in literature in relation to public works heritage, since that is where it takes special importance. Aguilar (2010) claimed that public works heritage requires that account be taken of both its individual and territorial level as part of a network or system, since it is the only way to contextualise the work as a whole.

The above analysed concepts should be considered then in addition to the heritage concept, since the railway heritage and its surrounding environment present more opportunities the wider the way to see, analyse and act on them.

1.1.3. Railway heritage and the relation to its surrounding environment

The railway is a singular mobility system that, in comparison with other means of transportation, has few path and transport variations, but presents a variable dynamic that has a high impact on the surrounding of stations and branches and was a decisive factor on the historical development process of the territory (Jaramillo, 2013). In this regard, the analysis of these railways and its territory should also be developed at different levels, enabling the comprehension of the changes produced at territorial, urban or architectural level. Furthermore, railway lines usually cross administrative boundaries of different levels or artificial thresholds between urban and rural areas or hinterland and coastal areas (Porcal, 2011). As a result, on the one hand, influencing areas with diverse nature are created regarding settlements, productive processes and territorial hierarchies. On the other hand, innumerable landscapes and environments that enrich the complete itinerary, both in the past and the present, are gathered in the same route.

As indicative of all this, and according to Ferrari (2012), the railway heritage has acquired a universal value, since it had profound historical consequences related to the cultural landscape that was created around it, such as structuring of the territory, new settlements installation, generation of significant urban areas, creation of a new architecture or incorporation of a new transport system that created new symbolic approaches, (space-time suppression and stations as city gates). That is why the analysis and posterior enhancement of the railway heritage should comprehend the transformations brought about and the new realities created by the railway. In turn, all of them should be valorised at the necessary and corresponding level.

ARRIVAL OF RAILWAYS

It is well known that the arrival of the railway produced profound changes. Although these changes occurred mainly in cities, this had consequences in rural areas, where large-scale depopulation was produced.

Nevertheless, the railway, understood as a network provided with nodes, is a large system that does not take into account administrative boundaries, but territorial and orographic features to which the railway must adapt. Accordingly, the analyses or future proposals should have a territorial approach, using boundaries that are dependent upon analysed elements and appropriate in scale to each objective. In this regard, there are several levels for both the analysis of the arrival of railways and the heritage analysis referred to disused railway lines. Divisions at three levels have already been shown in literature, such as one created by Ferrari (2010) composed of territorial, settlements and architectural systems.

AT TERRITORIAL LEVEL

Railway tracks have been adapted to the surrounding orography and territory, interacting and integrating in it and forming part of it in a short time. However, big transformations were produced in the territory due to the singular features of these infrastructures, such as turning radius, slopes, etc. In addition, several construction works were done (among which tunnels, bridges and viaduct were the most important ones) in order to address existing barriers. Nevertheless, the number of construction works can significantly vary depending on the type of territory, such as in the case of the Basque-Navarre territory.

The territorial nature of railways might be recognised taking into consideration all of the above. The railway network articulated the territory, organised its surrounding environment and thereby created a new territorial hierarchy. Thus, it had a selective power to choose some areas and exclude others (Aguilar, 1988). In this way, the new settlements created by the railway or the old ones supplied by it have been favoured by a series of advantages and conveniences of modern society. Conversely, the problem was being excluded from the modernisation process that the railway brought. However, in addition to urban areas and before them, strategic economic areas, such as industries, mining areas or ports drew the attention of railways, since they were the objective of their construction.

Nevertheless, the territorial hierarchy did not only depend on the railway path, i.e. if the railway crosses or not the influenced area. The railway was a system composed of the network and the different nodes, where the latter was the element that created the connection between the continuous track and its surrounding environment. So the nodes in turn, created a second hierarchy within the territory.

Finally, the arrival of the railway also supposed the space-time suppression. Before railways, stagecoaches operated as means of transportation between different settlements. They were inaccessible for most of the society and passed through roads of poor conditions. Conversely, the railway linked several cities and settlements with durations that were unimaginable at the moment of its creation, making them accessible to all segments of society. Furthermore, the railway connected hinterland and coastal areas in several cases, increasing the importance of tourism at that time.

AT URBAN LEVEL

The arrival of the railroad was linked to industrialisation and subsequent urban development, so the railway took an active part on the profound changes that were producing in cities (Aguilar, 1988). A railway was usually created to deal with the new demands of the recent industrialisation, such as the supply of raw material or the exit of the different industry goods. However, it soon became the transportation mode of citizens and a structuring element of their cities.

In this regard, the railway was one of the most incisive factors for the creation of a series of changes in cities (Aguilar, 1988). Accordingly, the setting of the railway in general and its stations in particular, had an important influence on urban development processes. As Aguilar (1988) claimed, the railway station acted as an attraction pole, but in turn, the railway track created a barrier that could limit the expansion of the city. Being the location of the railway station central or peripheral, the railway track is shown as a barrier or limit, since a railway could stimulate or inhibit the growth of the city. The station was usually peripheral due to the necessity of large areas for its implementation and the lack of these areas in city centres. Nevertheless, there are some cases where the creation of a central station was possible by means of the utilisation of the areas of demolition of walls or the large plots obtained in the Mendizábal Disentailment (in Spain) (Aguilar, 1988).

The two cases and their influences in the city were studied in Aguilar (1988). Accordingly, there was not any problem in the case of the central station at first. However, on the one hand, the growth area was limited, so the rapid development or expansion of the railway and its facilities could have not been guaranteed. On the other hand, several dangerous crossings and environmental degradation problems were created, especially in non-terminal station cities. Nonetheless, the central station became one of the most important elements of cities or towns, in the case of the Basque-Navarre territory, together with the public spaces of the old towns composed by the city hall, the church or the pelota court.

In the case of the peripheral station, the urban sprawl was even more related to the railway and its station. The station building usually was the first urban implementation of the area, resulting in the creation of the station street that connects the city centre with the new area. Over time, the station area was surrounded by the new city in most cases (Aguilar, 1988). In this regard, cities have usually grown towards the areas where the station was located, creating new development areas of industry, commerce, residence, etc. However, the distance between the station and the old city was essential for the attraction level of new developments. If this distance was too long, the station would remain as a single element and out of the city, although new constructions could be created around it. On the other hand, the new areas created around the railway station had an industrial nature in several cases. They were the direct beneficiary of the railway by means of the supply and transport of raw materials and industry goods. Together with this, residential buildings and services were built in order to respond to the needs of the new industries and their employees. Nevertheless, the whole city benefited from the railway by means of the urban development, creating new residential and equipment areas in the zones between the old city and the new station area.

Finally, the railway station has also been presented using the concept of node-place at urban level (Bertolini & Spit, 1998). The station element presents a double character depending on the approach: the station is a “node” in the whole railway system and transport network, since it is other stop among others; but the station also plays an important role in the creation of a new “place” in the city, acting as its structuring element. Hence, the station and its surrounding neighbourhood were presented as an opportunity for the New Urbanism, since they were the node and the place of several actions, such as new mobility patterns, mixed-use land occupations, configuration of deregulated areas, consolidation of industrial fabric or use of new architectural typologies and construction materials (Sobrino, 2008).

AT ARCHITECTURAL LEVEL

The arrival of railroad ushered a new architecture with industrial character and hence, with characteristics mentioned before: functionality, standardisation, prefabrication, series construction, new materials, etc. The new created typology was used in the station constructions, so the elements were designed as a whole and adapted after into each station area. Each station area, in turn, could be formed by several buildings, such as passenger building, warehouse, offices, workshops, garages, power stations, bathrooms, residences, etc. Moreover, their relative location could vary, creating different schemes of spacial organisation. In the Basque Country and Navarre, the station was usually formed by the passenger building and a warehouse, located both in parallel to the tracks. In the upper floors of the passenger building, in turn, the residences of workers were included.

Nevertheless, as all industrial architectural elements, station areas were adapted to the necessities of each time, including or removing elements depending on needs and expanding or reducing areas without taking into account the surrounding environment, since the station area did not have a direct contact with its surrounding urban expansion. In this regard, the passenger building was the only element that was opened to the city and, consequently, the only building that had a direct relation with it. As mentioned before, the passenger building was not an essential element for the railway exploitation, but it was the core of its surrounding area and the attractor or new uses. It was the intermediary between the city and the railway, i.e. the city and the exterior, the city and the modernity. That is why railway stations have already been presented as city-gates, which justifies the aesthetical and representative nature of some buildings, without depriving their functionality.

FORMER RAILWAYS

Due to its territorial nature, the railway network is an essential element to comprehend the evolution of the spatial organisation of a society. It is the materialisation of people and good flows, territorial policies or relations between different cities (Aguilar, 2011). That is why, as in the case of the influences created by the railway, the analysis of railway heritage should include a territorial level analysis, in addition to the urban and architectural levels. Until recently, this was not the case. Nowadays, however, there are heritage trends that promote the analysis by means of the correct insertion of heritage elements into a territorial system (Sobrino, 2005).

AT TERRITORIAL LEVEL

A former railway line shows a heritage value (called system or total value) at territorial level that is higher than the heritage value of each element. This system is composed by the railway track and all its components, in addition to build heritage elements or intangible elements. Accordingly, the system or total value could only be exploited taking into consideration the whole system, instead of each single element. In this regard, besides the specific railway elements, the surrounding environment (landscape, other type of heritage, services and equipment, etc.) also has special importance and hence, its knowledge becomes essential.

The railway track that tried to adapt to the orography is, nowadays, an integrated and even camouflaged element. It maintains the necessary features for an obsolete railway use (slopes or turning radius among others). Nevertheless, these characteristics are also suitable for other uses, such as non-motorised routes, which make them different from other type of routes of similar use (livestock routes, historical paths, mountain trails, etc.). In this regard, accessibility of people with reduced mobility is the main distinguishing feature that disused railway routes could provide. Moreover, railway tracks are much more straight and direct than the roads of that period, which could benefit its surrounding environment taking into account the distances between the different urban cores.

Furthermore, in the same way that the railway structured and prioritised its surrounding territory, a disused railway could also be in the future a territorial structuring element, since it could influence the areas located around it. The disused railway track could not only benefit the cities and towns that it links, but the small rural towns and areas that are dependent from bigger cores located around them. In addition, the selective power that the railway had in the past can be expanded over the whole track with its closure. In this way, the benefited areas would be related not only to the station or halts, but to the entire route by means of the correct enhancement of the railway system.

AT URBAN LEVEL

The railway heritage should be recognised as a built heritage, composed of a group of buildings and spaces that are part of the urban pattern and are in a state of functional obsolescence, but have physical and environmental possibilities to interact with a wider network of public uses, in order to address both its differential and integral management in cities (Tarchini, 2010). Accordingly, railway built elements and areas have a great heritage value and high future potentiality, but they are in turn, large empty areas composed of railway elements and industrial facilities located around them.

These buildings and areas were located on the city periphery in their creation, but nowadays, they are usually sited in the city centre (Aguilar, 1988). Furthermore, most of cities have a lack of suitable open or green areas due to the rapid growth of last decades. In addition, these areas are suitable to resolve the barrier effect that the railway created in the past and is currently represented in its surrounding environment, since new developments tried to turn their back on the railway in order to reduce the negative effects (noise, degradation, lack of security, etc.). Therefore, all this could create new unions or links in the city, which were inexistent or unworkable until then.

In the case of the Basque Country, new urban developments have already been generated in old railway areas in most of the towns and cities. In this regard, new developments created in the railway areas of the towns along the Urola Railway (Zumarraga, Urretxu, Azkoitia, Azpeitia, Zestoa and Zumaia) were analysed in a previous research work developed by the author (Eizaguirre-Iribar, 2013). In most of them, new residential areas (in the industrial and empty spaces around the railway area) and open spaces (in the railway zone and the areas close to it) were created. However, a psychological barrier is preserved between the old line or railway areas, and the rest of the development area, which is reinforced by the placement of street parking areas, hindering the creation of transversal links between the two zones. In some cases, there is also a lack of connections in the longitudinal axis of the railway area, not taking into consideration one of the most important features of the linear infrastructure (being an articulating element). Furthermore, the lack of use of the railway station and other built heritage elements or the independent interventions created for them —without taking into account the whole railway system— do not favour the development of the new area. In this regard, and more particularly in the cases that the settlement or core is located out of the city, it is important to create integrated interventions in order to include the station as part of the railway system. If not, although the surrounding area is favoured by the creation of the new use, the union with the city is not restored.

AT ARCHITECTURAL LEVEL

The protection and enhancement of the railway heritage could create an attraction point in the new area (as the station did in the past) or regenerate an existing zone, in addition to ensure the future of this heritage. For that purpose, the passenger building and other railway buildings could be “containers” of new and several uses, and be refurbished as single heritage elements in order to guarantee their preservation. Although this is a common intervention nowadays, the added value that the railway heritage once had (total or system value) is not restored in this way. The reason lies in the fact that the heritage element is not part of a territorial system and accordingly, it is not distinguished from other type of isolated heritage elements. Hence, built railway heritage should be understood as environment activator, but in turn as linker between the territorial system and its surrounding environment, as it was in the arrival of the railway. The third level or the most specific level of analysis is thus reached, always bearing in mind its territorial and urban level.

Finally, the industrial procedures used, such as prefabrication or serial construction, and the new architectural typology created for railway stations enable the rapid identification of these heritage elements. In this regard, visual relationships are created between the different heritage elements (nodes) and along the linear infrastructure, favouring the continuity of the system.

Added to this, the problem of the preservation of the railway heritage has a main advantage: the memory of the old railways is still present in the society in general; and in railway surrounding areas in particular, by means of elements like the station neighbourhood, the station street, the station walkway, or a bar or restaurant called “station”. All this is referred to local identity and collective historical memory. They are essential for current or future successful interventions, which should always include civic participation processes or similar actions.

Taking into consideration all of the above, the importance of the territorial level of the railway heritage system and its integration in the context are shown. As a result, railway heritage management should also include the regional and urban planning approach (Fernández et al., 1996), in addition to the architectural level referred to individual assets. Furthermore, historical infrastructures and linear preexistences should be taken into account in territorial interventions, using them as previous conditions, opportunities or potential areas for the interventions, in the same way as preexistent urban fabrics are assumed in the design of the city (Rodríguez, et al., 2010).

1.1.4. Registration, protection and enhancement of railway heritage

Once the study object (railway heritage in a wider approach of heritage system) and its relation to the surrounding environment have been defined, registration, protection and enhancement issues of railway heritage should be analysed. These are the main actuation phases that need to be into consideration. In this regard, the Nizhny Tagil Charter has already noted the importance of cataloguing, registration and research of these assets. According to it, registration is an essential part of the study and international inventories or data bases are indispensable tools for it. In addition, evaluation criteria and heritage values need to be identified in order to preserve properly the heritage assets. Conservation in turn, should be guided by the preservation of the functional integrity of the element or set, thus defending reversible or minimum impact interventions (TICCIH, 2003).

INVENTORY AND CATALOGUE[16]

In relation to industrial heritage, the Industrial Heritage National Plan contemplated an initial catalogue (2001) list and a minimum catalogue (2011) at state level, where the elements were selected by TICCIH-Spain. Different governments and institutions have been working on these elements since then, but none of them is direct subject of study of this research. At regional level, the Inventory of Industrial and Public Works Heritage of the Basque Country was realised by IOHLEE, where all heritage elements are included, regardless of whether they are interesting for their future protection. There is not a similar inventory in Navarre, since only the elements that have some protection (regional or local) are registered.

[16] An inventory of heritage assets is understood as identification, location, description and collection in a document of a series of goods characterised by their heritage interest for a space area or territory.
A catalogue is understood as the inventory accompanied by documentation and specific studies that enable establishing specific tools for the research and knowledge of the assets and proposing management and intervention tools for them (Government of Navarre, 2011).

The first phase of the Inventory of Industrial and Public Works Heritage of the Basque Country was made between 1990[17] and 1994, and 1227 elements of several industrial sectors were inventoried. The second phase was elaborated in 2004 and 2005, reaching 2680 elements or sets. In this regard, around 11 per cent of the total figure (578 elements) refers to the transport sector, and counties or districts were used as research areas because they correspond to a geographical and socio-historical reality that homogenises several municipalities (Herreras & Zabala, 2012). In addition, data sheet and dossiers were used in order to inventory properly both elements and sets. Each element had its data sheet, while the whole corresponding set or assembly was analysed in the same dossier. In this regard, the interest of institutions and researches in addressing the issue of heritage with a general approach of set or system is shown. In practice, however, a lack of a suitable procedure is observed, since in the case of railways, different heritage elements are incorporated in a same set, such as the different elements of a station area, but they are not included in a whole set of the railway system. Finally, and as part of this inventory, the existence of a GIS (Geographic Information System) based map, where all inventoried elements are georeferenced, should be mentioned.

As a next step, since 2010 the Inventory of Industrial Landscapes within the Autonomous Community of the Basque Country has been developed. Ten industrial landscapes were initially recompiled, from which two of them are related to DRLs: Characterisation and Valorisation of the landscape of the Vasco-Navarro Railway; and Characterisation and Valorisation of the industrial landscape of the Urola Railway. These comprehensive inventories[18] include a historical-technical description, a current description and the identification of the elements linked to the railway. As a result, a heritage valorisation of the landscape and its consequent protection proposal were made. Data sheets of each railway element and planimetry of the surrounding territory are also included in the document. In this regard, each document has a global nature of the analysed railway system.

Furthermore, although without a heritage approach, there are other inventories related to DRLs that could be of great help for their future protection of enhancement. On the one hand, an Inventory of Disused Railway Lines was made at state level in 1993, developed by the Association of Spanish Railways for the Ministry of Public Works, Transports and Environment and the main railway companies (Renfe and Feve). In this inventory 187 DRLs were identified and analysed, which amounted 7684 kilometres of lines, 954 stations, 501 tunnels and 1070 bridges (Association of Spanish Railways, 1993). The Basque Country and Navarre have 5.7% and 3% of the total kilometres, while Andalusia has 24.3%. However, the Basque Country has the highest percentage of disused lines per square kilometres (52.1 m/km^2), against the second highest value of Autonomous Community of Madrid (39.1 m/km^2) (table 0.3) (Aycart, 2001). On the other hand, some inventories and catalogues related to the new uses of these railway lines can be found, such as the Inventory and Diagnosis of Non-motorised Infrastructures in Spain (2006) or the Catalogue of Green Routes Network of the Historical Territory of Araba/Álava (2013). In 2001, there were 947 km of DRLs that had been converted in greenways in Spain, 80 of them in the Basque Country and Navarre (Aycart, 2001); while in 2014, the values were 2684.28 and 371.9 km[19].

[17] The first Basque legislation about cultural heritage was approved in 1990 (the Act 7/1990, of July 3, on the Basque Cultural Heritage).

[18] They can be consulted only in paper format

[19] Last seen 2014, in: http://viasverdes.com/itinerarios/principal.asp

Finally, there are several publications in relation to DRLs and their elements in literature, which are suitable to the comprehension of these heritage systems, although they are not inventories or catalogues. In this regard, Juan Peris Torner collected information about used and disused railways in Spain in his web (spahishrailway.com) and Juanjo Olaizola published several books related to railways in the Basque Country and Navarre or other ones related to certain disused railway lines, including specific data about the history and the current state of the lines and all built elements.

As an example to compare with the Basque-Navarre territory, the case of Canada and United States is used throughout this document. In this regard, on the one hand, and referred to railway stations, the Canadian National Railways' stations in Ontario (Canada) are recompiled and analysed in a website by Jeffrey P. Smith (www.cnr-in-ontario.com), including all type of information and sources. On the other hand, registers referred to all railway lines can be found, such as the Atlas of Railway and Waterway History in Canada (Andreae, 1997) or the project The Ontario Railway Map Collection of Paul Delamere (ontariomap.webs.com), where all railway lines and their station or other elements are recorded in Google Earth. These inventories are referred to both disused and used railways. Finally, as in the case of Spain, inventories related to the new uses of the lines (rail-trails) can be found. In the case of the United States, in addition, there are inventories related to abandoned railway lines, such as the Inventory of Abandoned Railroads in Florida (State of Florida, 1985) or the website of Greg Harrison (www.abandonedrails.com) were abandoned rails of the US are recorded and mapped and 1514 abandoned routes have been identified until 2016.

To sum up, an inventory or catalogue provides basic information for the posterior analysis of any of these elements. But, in turn, they are useful to know what is still preserved in the entire territory, and determine the typologies implemented in the past and the uniqueness of existing elements (Zarazaga-Soria et al., 2005).

VALORISATION AND PROTECTION

The elements of the inventories that are of special interest or value will be selected and legally protected, and consequently, they must comply with the requirements that ensure their conservation. Nevertheless, all inventoried elements can be considered of interest, since they are physical testimonies of certain time and offer an unexplored extensive area for studying the recent past (Herreras & Zabala, 2012).

Accordinly, some valorisation criteria were established by the Industrial Heritage National Plan of 2011 for that selection:
- Intrinsic values: testimonial value, typological singularity or representativeness, authenticity and integrity.
- Heritage values: historical, social, artistic, technologic, architectural and territorial values.
- Viability values: possibility of integral action, estate of preservation, management and maintenance, social profitability and legal status (Spanish Institute of Cultural Heritage, 2011). [20]

In the case of the Basque Country seven values, which are similar to the previous ones, were proposed for the selection of the elements: historical value, artistic-architectonic value, authorship value, system or set value, iconographic value, preservation and reutilisation potential and representativeness (Herreras & Zabala, 2012).

[20] Sánchez (2012) proposed seven criteria and several subcriteria for the assessment of industrial heritage after studied several plans and charters.

According to the different criteria the heritage elements are classified in different protection levels and heritage categories. In the case of the Basque Country and according to the Act 7/1990, of July 3, on the Basque Cultural Heritage, the protection levels are three: Listed Cultural Asset, Cultural Asset that needs to be included in the General Inventory of the Basque Cultural Heritage, and elements that need to be preserved by urban planning (Basque Country, 1990b). The same classification is used in Navarre (Navarre, 2005) although the levels are named differently. These three levels are renamed in the later Basque drafts: Cultural Asset of Special Protection, Cultural Asset of Medium Protection and Cultural Asset of Basic Protection (Basque Country, 2015 and 2017). Furthermore, heritage categories are also taken into account in their protection. As mentioned before, although the current Basque legislation (1990) is limited, the Navarre (2005) and the future Basque law present a broad classification of heritage protection categories, including cultural landscape or cultural routes in addition to monument, monumental set, archaeological zone or cultural site.

Nevertheless, in practice, in the case of the Basque Country, the theoretical broad concept of heritage results in the protection of isolated elements or small groups of elements, without taking into account their whole potential. In this regard, the listed cultural assets protected at regional level (Listed) in relation to different railways are the next ones: Station of Canilla, Portugalete (1996); Station of Neguri, Getxo (2001); Viaduct of Ormaiztegi (2003); Bridge of Alzola, Barakaldo (2005); Station of Desierto, Barakaldo (2008); Station of Oñati (2011); Bridge of Hendaia-Donostia Railway, Irun (2012); Bridge of Leizaran Railway, Andoain (2012); Station of Atxuri, Bilbao (2012); Station of Urola Railway, Zumaia (2012); Station of Vascongado Railway, Deba (2012); Substation of Vascongado Railway, Deba (2012); and Station of Gernika (2012)[21]. In all these cases, owners must preserve, take care and protect the assets in order to ensure their integrity and avoid their damage or destruction, and new uses must ensure the conservation of listed assets (Basque Country, 1990b).

Although in the Basque Country and Navarre the listed cultural assets could be few in number, the other presented two protection levels enable to ensure a basic preservation of assets, avoiding for example their demolition.

In the case of Ontario (Canada) and in order to compare again, heritage protection issues are regulated by the Ontario Heritage Act, R.S.O. 1990, c.0.18 (last amendment in 2009). In this case, heritage properties and geographic features or areas could contain built heritage resources, cultural heritage landscapes, heritage conservation districts or archaeological resources and/or areas. These properties or areas are divided in different categories: provincial heritage properties (which are owned by the Crown in right of Ontario or by a prescribed public body); or properties of cultural heritage value or interest, heritage conservation districts or resources of archaeological value. In the last three cases, it is necessary to list the property on the municipal register first and on the provincial register after. Then, it should be included on the Canadian Register of Historic places, although it is not a requirement of the Ontario Heritage Act (Ontario, 1990). There are 84 railway stations or elements listed on the Canadian Register of Historic places in Ontario and 411 in all Canada. Furthermore, heritage railway stations designated of national interest by the Historic Sites and Monuments Act (1985), are regulated by Heritage Railway Stations Protection Act (1985). In this regard, railway companies

[21] Until April 2012. The elements that correspond to disused railway lines are underlined.

are involved and the preservation of these elements is guaranteed.

> Unless authorized by the Governor in Council, no railway company shall remove, destroy or alter or sell, assign, transfer or otherwise dispose of a heritage railway station owned by it or otherwise under its control; or alter any of the heritage features of them (Canada, 1985).

Finally, it should be mentioned that only few railways all over the world have been included in the World Heritage List. In this regard, ICOMOS published a list of the main industrial World Heritage assets in 1988, and elements such as the Semmering Railway (Austria), the Rhaetian Railway (Switzerland) or Mountain Railways of India have been designed World Heritage Site since 1995. In 1999, moreover, four criteria for internationally significant railways were also proposed by ICOMOS (1999): a creative work indicative of genius; the influence of, and on, innovative technology; outstanding or typical example; and illustrative of economic or social developments.

However, as Herreras & Zabala (2012) claimed, the legal protection of heritage elements is only the first step to ensure their conservation, since it is part of a broader process that includes the future enhancement and dissemination of the element in order to relocate it in the new social and territorial framework.

ENHANCEMENT

The enhancement of industrial heritage elements or systems should ensure their conservation or preservation. Nevertheless, it is also considered as an appropriate tool for the improvement and activation of the surrounding environment or the city where the heritage element is located. In this regard, in addition to host a new use, a correct urban regeneration could be achieved by means of this type of processes, where understanding the heritage assets as sets or systems is necessary when correspond. Therefore, as mentioned before, each element functions as part of the whole, sited in its surrounding environment or context.

Accordingly, García Alvarez (2007) claimed that the enhancement of the railway heritage is the way that this heritage can be available to the society. On the one hand, this could enable to recognise the asset taking into account its history, features or peculiarities. On the other hand, it could provide additional value to the surrounding environment, since the asset could function as a resource that helps to explain the railway history, reality and technical issues, or to complement touristic or leisure activities that enable its conservation, protection or recovery (García, 2007). For that purpose, the Identification, Protection and Enhancement Programme of the Historical and Cultural Railway Heritage of the Association of Spanish Railways (FFE) promotes the so-called cultural products, such as the ones that are linked to the programme: museums and railway collections; ecorail (activities that use the rails for the movement of light vehicles other than trains); charming railway stations (hotels, rural hotels or restaurants located in stations); greenways; or historic-touristic trains (Association of Spanish Railways, n.d.). All these products are related to cultural or leisure aspects that make the range of possibilities and opportunities narrower. In other words, DRLs could work, in addition to a cultural or touristic approach, at economic, intellectual, labour, social, heritage, etc. levels, which are not mutually incompatible. Hence, although those cultural products could operate independently, the interest increases when they are considered together, thus creating integral proposals.

Nevertheless, railway heritage restoration and enhancement interventions are generally focused on isolated elements (mainly buildings) or the line, but not on the whole. This makes the main actions for the enhancement of the railway heritage be divided in two approaches.

On the one hand, interventions in nodes mainly focus on the rehabilitation of stations and their environments. They may be carried out by the councils of each municipality or specialised associations, such as the Railway Heritage Trust in UK or the Rail Heritage Trust of New Zealand. In spite of the work of documentation, protection and restoration that they have

Figure 1.1 Railway station of Azkoitia (1). Archive of the Basque Railway Museum (ABRM)

Figure 1.2 Current state of the railway station of Azkoitia as a library (2)

Figure 1.3 Railway station of Goderich, 1958 (3). Al Paterson

Figure 1.4 New placement of the railway station of Goderich (4). Robert Boyce developed, each element is considered in isolation and with varied uses, which may lead to the fragmentation of the system. In this regard, these buildings are used as “containers”, ensuring the preservation of the heritage but without taking into account the total value that these elements had in the past, which is the feature that differences them from any other heritage building. However, this does not mean that the intervention could not be successful and could preserve the affected railway heritage. Examples include the Urola Railway’s station in Azkoitia (Basque Country), which has been considered one of the ten most beautiful libraries in the world by the AD German architectural journal in 2016 and won the National Award of Architectural Culture and Sustainable Urbanism in 2007, after two reconversion or expansion projects (fig. 1.1 and 1.2); or the Guelph & Goderich Railway’s station in Goderich (Canada), which was moved 250 m in order to replace it in the waterfront and converted in a popular restaurant (fig. 1.3 and 1.4).

On the other hand, interventions in line or path have specially focused on their reuse as non-motorised transport infrastructures. The so-called Greenways or Rail-Trails are thus created, which are widespread throughout Europe, but also in the US and Canada. In 1983, the protection of out-of-service railway platforms was considered of national interest by an American new law, which facilitate their reutilisation for other uses, while in 1987, the concept of greenway was created. Nevertheless the background of these two concepts could be found several years ago.

In the 19th century, urban and national park movement was developed (inspired by European boulevards) with examples as the Central Park in New York[22] (fig. 1.5, 1.6, 1.7, 1.8 and 1.9) or the park system created by Frederic Law Olmsted in Boston since 1869 (Fábos & Ryan, 2004). The Emerald Necklace connects Franklin Park through the Arnold Arboretum, Jamaica Pond and the Fens to the Charles River and the Boston Gardens and has 10 mile long (fig. 1.10, 1.11, 1.12.x and 1.13). This park system is considered the first greenway in America. After him (1899), Charles Eliot (Olmsted pupil) proposed an even more comprehensive Metropolitan Park System for Boston Metropolitan Area. In the 20th century, the concept of open space planning was created and developed (Shoaybi et al., 2006) by means of projects like the Open Space Plan for the Commonwealth of Massachusetts in 1928 (Charles Eliot II) or the Wisconsin's Heritage Trails Proposal by Phil Lewis in 1964. The latter proposed a statewide network of green spaces and greenways that he called environmental corridors, using mainly rivers or water systems and including cultural resources in addition to previous natural ones.

Greenways were also planned in Europe in the beginning of the 20th century, first in Germany and after in England. England proposals had the influence of Olmsted and the plans conducted in Germany (Turner, 2006). In this regard, Ebenezer Howard was responsible for the creation of the greenbelt concept applied in the outskirts of London. In the second half of the 20th century, greenways were considered and designed in Asia, especially in Eastern and Southeastern countries such as China, Japan and Singapore (Masnavi & Fathi, 2011).

However, it is in the end of the 20th century when the concept of greenway appeared in literature and its planning was developed. The writer William White used the concept of greenways in the 1970’s and the President`s Commission on American Outdoors for the United States in 1987. In 1990 Carles Little defined the concept of greenway in his book *Greenway for*

[22] Frederick Law Olmsted and Calvert Vaux won the competition and adoption of their plan for Central Park in 1858.

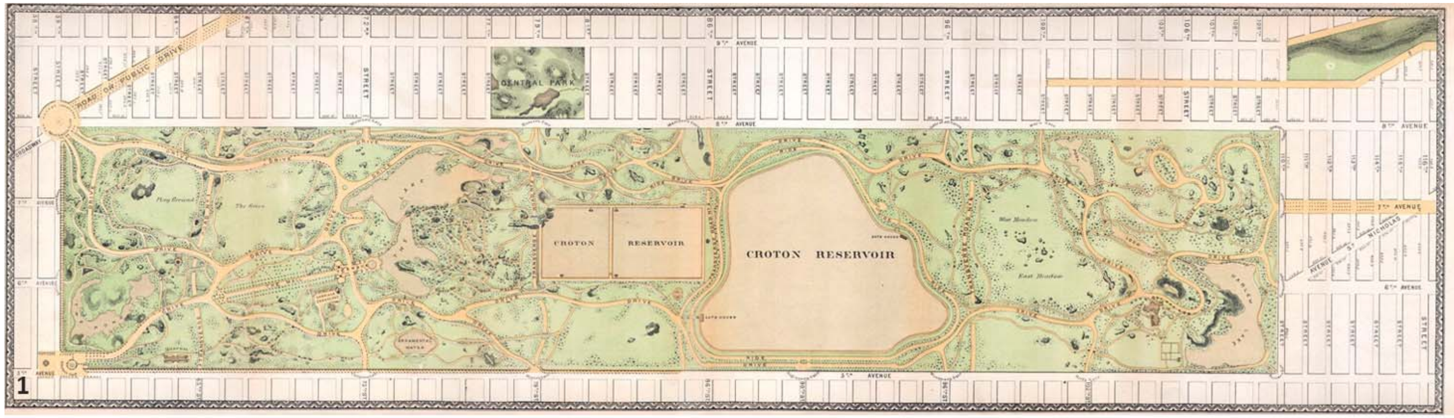


Figure 1.5 1868 Vaux & Olmstead map of Central Park, New York City (1). Geographicus Rare Antique Maps

Figure 1.6 Aerial view of Central Park from Rockefeller center (2)

Figure 1.7 Jacqueline Kennedy Onassis Reservoir at Central Park (3)

Figure 1.8 Green areas in Central Park (4)

Figure 1.9 Bethesda Terrace and Fountain in Central Park (5)

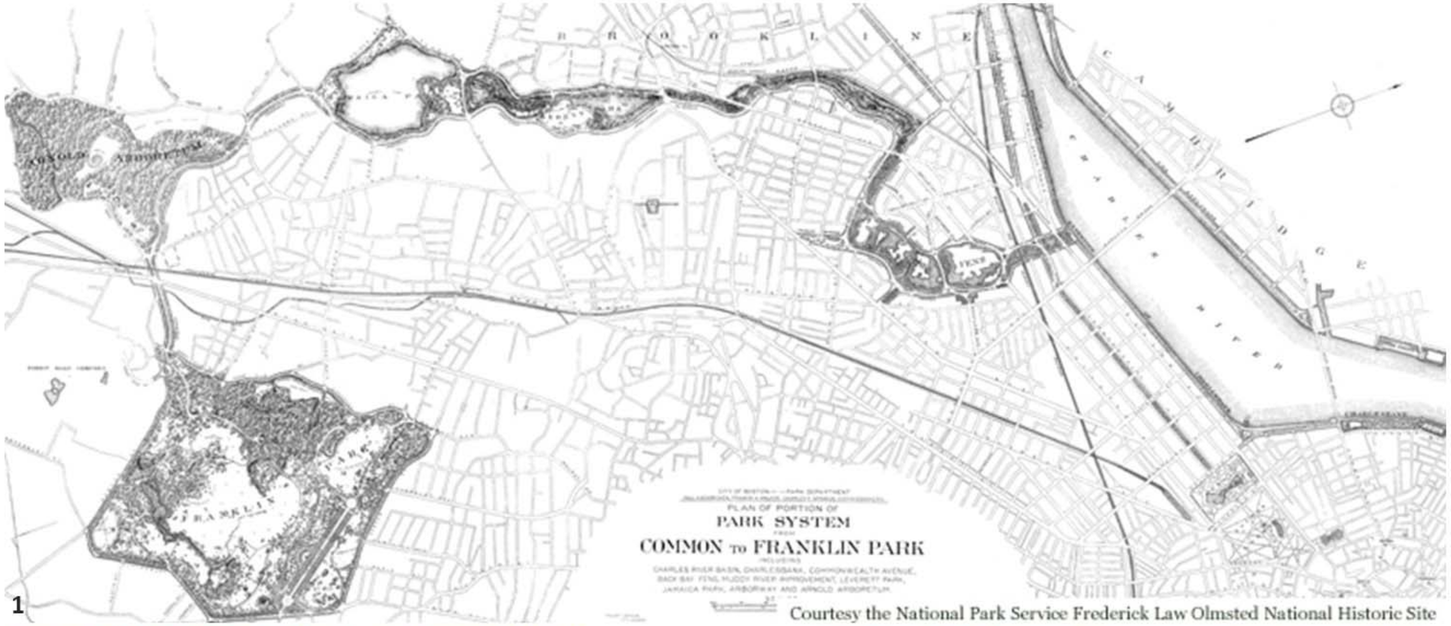


Figure 1.10 1894 plan for the Emerald Necklace Park System in Boston, Massachusetts (1). National Park Service Olmsted Archives

Figure 1.11 Back Bay Fens of the Emerald Necklace Park System (2)

Figure 1.12 Franklin Park of the Emerald Necklace Park System (3)

Figure 1.13 Back Bay Fens of the Emerald Necklace Park System (4)

America and reviewed 16 greenway projects. He defined greenway as a "linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, a scenic road, or other route" or, alternately, an "open space connector linking parks, nature reserves, cultural features, or historic sites with each other and with populated areas" (Little, 1995). Furthermore the European Greenways Association was founded in Belgium in 1998 and in the Lille Declaration held in September 2000 they defined greenway as:

> … communication routes reserved exclusively for non-motorised journeys, developed in an integrated manner which enhances both the environment and quality of life of the surrounding area. These routes should meet satisfactory standards of width, gradient, and surface condition to ensure that they are both user-friendly and low -risk for users of all abilities. In this respect, canal towpaths and disused railway lines are a highly suitable resource for the development of greenways (European Commission, 2000a).

Rail-trails are a specific type of greenway, since they are based on disused railway lines, and they are one of the most common forms of them. As in the case of greenways, the interest and actions taken in these issues come from several years ago. The first American rail-trail was created in 1965 (Elroy-Sparta Trail) in Wisconsin. Only a year after the last train used the railroad, the trail began to develop. In this regard, the National Trails System Act was signed into law in 1968 to initiate a "national system of recreation, scenic and historic trails" (United States, 2009) and the Rail-to-Trails Conservancy was created in 1986. Furthermore, due to the competition from trucking companies in the fifties and sixties and the Staggers Rail Act in 1980 the abandonment of railway increases dramatically in the United States. That is why, Congress became concerned about something need to be done to preserve the future of the rail system and in 1983 modified Section 8(d) of the National Trails System Act in order to preserve rail corridors (railbanking[23]). The constitutionality of railbanking was supported by the Supreme

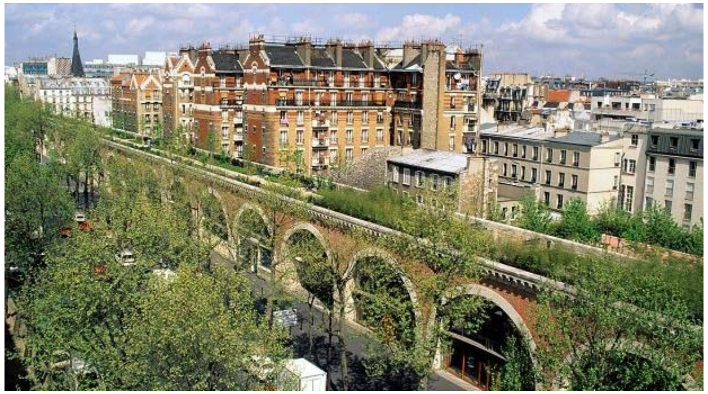


Figure 1.14 Promenade Plantée in Paris (above). Alamy

Figure 1.15 High Line in New York (below)

[23] Railbanking, as defined by the National Trails System Act, 16 USC 1247 (d), is a voluntary agreement between a railroad company and a trail agency to use an out-of-service rail corridor as a trail until a railroad might need the corridor again for rail service. Because a railbanked corridor is not considered abandoned, it can be sold, leased or donated to a trail manager without reverting to adjacent landowners. …Corridors that would otherwise be abandoned can be preserved for future rail use by converting them to interim trails. The old, inactive railroad route survives but is repurposed for other—potentially temporary—trail uses.
Last seen September 2017, in: https://www.railstotrails.org/build-trails/trail-building-toolbox/railbanking/

Court in 1990. Nowadays, the Promenade Plantée in Paris (1988-1993) and the High Line in New York (2009-2014) (fig. 1.14 and 1.15) are two well-known linear parks that are a consequence of the greenway or rail-trail movement. Several examples (Chicago, Philadelphia, Rotterdam, etc.) appeared after them.

Currently, these concepts are well extended all over the world and thousands of kilometres of disused railways have been converted into rail-trails (table 1.1 and 1.2). Furthermore, they are understood as more than leisure related and environmentally friendly paths. They could be heritage structuring elements and in turn, urban or rural development drivers. Iles and Wiele claimed that rail-trails and greenways are preserving the heritage and changing the face of communities, offering new lifestyles and business opportunities and improving the quality of life today and for future generations (Iles & Wiele, 1993). It should be finally commented that restoration of the built railway heritage is sometimes proposed

WORLD-WIDE RAIL-TRAILS

COUNTRY	NUMBER OF TRAILS (OPEN)	PLANNED TRAILS	LAST UPDATE
Canada	99 (5.282 km)	3	22.11.2015
Mexico	1 (84 km)	---	05.03.2011
United States	406 (12.322 km)	3	04.02.2016
Australia	79 (1.518 km)	2	03.12.2015
New Zealand	5 (206 km)	---	27.02.2010
Japan	3 (62 km)	---	14.01.2012
Korea	1 (27 km)	---	14.01.2012
Laos	1 (7 km)	---	22.06.2015
Taiwan	4 (38 km)	---	13.04.2015
	599 (19.546 km)	**8**	

Table 1.1 World-wide rail-trails.
Last seen June 2016, in:
http://www.bahntrassenradeln.de/

EUROPEAN RAIL-TRAILS

COUNTRY	NUMBER OF TRAILS (OPEN)	PLANNED TRAILS	LAST UPDATE
Austria	25 (250 km)	5	21.04.2016
Belgium	84 (1.000 km)	6	16.03.2016
Croatia	1 (50 km)	---	30.04.2013
Czech Republic	13 (70 km)	1	19.10.2015
Denmark	51 (700 km)	---	16.03.2015
Estonia	2 (50 km)	---	16.03.2016
Finland	1 (2 km)	---	16.03.2015
France	179 (3.250 km)	1	08.02.2016
Germany	720 (4.900 km)	86	21.04.2016
Hungary	8 (70 km)	---	02.02.2015
Ireland	4 (20 km)	3	28.01.2016
Italy	51 (690 km)	2	28.11.2015
Luxembourg	8 (150 km)	---	20.05.2013
Montenegro	3 (80 km)	---	25.10.2015
Netherlands	65 (280 km)	1	26.12.2015
Norway	9 (30 km)	---	18.01.2016
Poland	7 (120 km)	2	11.10.2015
Portugal	10 (200 km)	6	26.12.2015
San Marino	1 (3 km)	---	31.07.2013
Serbia	1 (2 km)	---	26.12.2015
Slovenia	3 (60 km)	---	20.01.2015
Spain	122 (2.100 km)	3	26.12.2015
Sweden	131 (1.700 km)	---	05.09.2015
Switzerland	12 (40 km)	1	19.03.2016
United Kingdom	154 (1.500 km)	1	12.01.2016
	1.665 (17.317 km)	**118**	

Table 1.2 European rail-trails.
Last seen June 2016, in:
http://www.bahntrassenradeln.de/

as part of greenway and rail-trail proposals, although in practice, this type of intervention focuses on a single element.

Taking all the above into consideration, enhancement of disused railway lines could comprise the valorisation of all their elements, favouring this way the extra potential of these buildings —that are part of a larger system— and structuring the territory around them —by means of the enhanced path—. In addition, all the system could include uses related to daily activities, beyond leisure and tourism. This is comparable at a smaller level to the enhancement of old industrial areas, which could organise and regenerate their surrounding areas, in addition to include new uses. There are several successful examples, such as: the ones in urban areas becoming in new cultural and creative hubs (The Old Truman Brewery, London; or Yaletown, Vancouver) or combining new alternative uses to modern high-rise buildings (Distillery District, Toronto); or the ones located out of the urban frame and converted in parks and open areas but maintaining the industrial elements and including new uses (Gas Works Park, Seattle; Don Valley Brick Works, Toronto; Zollverein Coal Mine Industrial Complex, Emscher Park or Landschaftspark in Ruhr, Germany) (from fig. 1.16 to fig. 1.29).

To sum up, the broad concept of heritage and its territorial character are clear steps for a comprehensive vision, and should also involve an integrated and crosscutting management (Porcal, 2011). Nevertheless, the actions taken for their protection, restoration and enhancement, are fulfilled in some isolated elements losing the system nature they once had. In this regard, a mismatch between theoretical and practical achievements demonstrates the difficulty to apply this integrated view (Porcal, 2011).

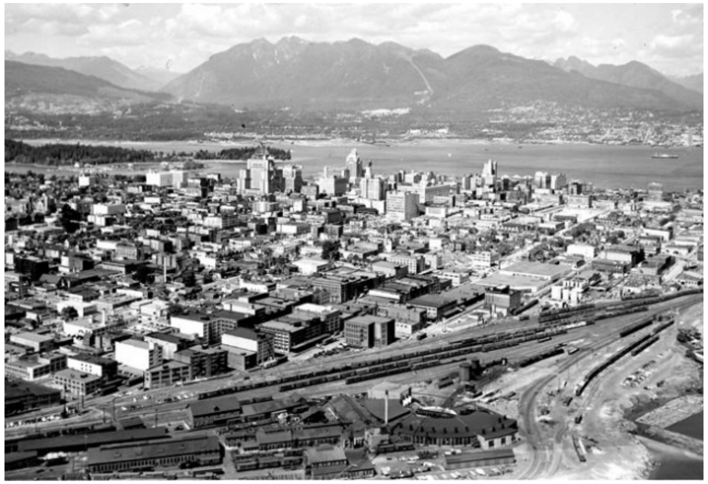
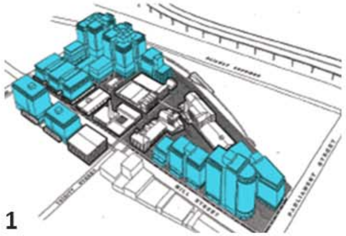


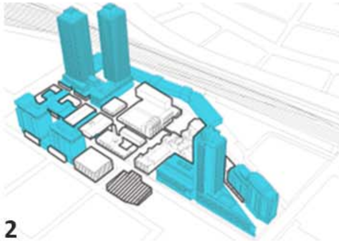
Figure 1.16 Yaletown in Vancouver, early 1900s (above). Roundhouse Community Arts & Recreation Centre

Figure 1.17 Warehouse and raised platform that was built at the height of the railcars in Yaletown and their current state (middle). City of Vancouver Archives (CVA)

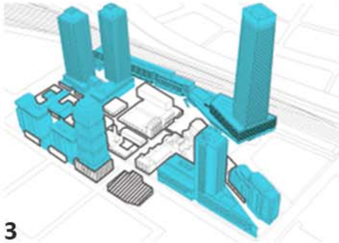
Figure 1.18 Current state of the raised platform in Yaletown (below)



1



2



3

4

5

Figure 1.19 Proposed built form in 1995 by the Heritage Plan for the Distillery District (1). Heritage Plan, Report No. 12. “Master Development Concept Plan, Built From” (ERA Architects, 2014)

Figure 1.20 Approved built form in 2013 for the Distillery District (2). (ERA Architects, 2014)

Figure 1.21 Proposed built form for the future for the Distillery District (3). (ERA Architects, 2014)

Figure 1.22 Aerial view of the Distillery District looking west in 1948 (4). City of Toronto Archives

Figure 1.23 Current state of Distillery District (5)

Figure 1.24 Gas Works Park site in 1966, before the park was built (1). Seattle Municipal Archives

Figure 1.25 Current photo of Gas Works Park (2). Nic Launceford

Figure 1.26 Historical photo of gasometer of the Landschaftspark Duisburg Nord (3). Jürgen Dreide

Figure 1.27 Current photo of the Landschaftspark Duisburg Nord (4). Thomas Berns

Figure 1.28 Historical photo of the Landschaftspark Duisburg Nord (5). Jürgen Dreide

Figure 1.29 Current interior photo of the Landschaftspark Duisburg Nord (6). Thomas Berns

1.2. Disused Railway Lines (DRL) as non-motorised axes in the Basque-Navarre regional planning

It is necessary to understand the railway heritage in a wider conception for its valorisation and future enhancement. This includes the analysis of current planning proposals, showing the disused railway lines in relation to the regional/spatial planning[24] in order to understand their current and future importance in these proposals.

1.2.1. Regional planning at European level

Some fundamental objectives for regional planning were established by the European Regional Planning Charter, adopted in the 6th Conference of European Ministers responsible for Regional Planning held at Torremolinos (Spain) in 1983. The objectives were four: balanced socio-economic development of the regions; improvement of the quality of life; responsible management of natural resources and protection of the environment; and rational use of land (European Council, 1983). The European Council has continued this provision with important documents, such as the European Spatial Development Perspective (ESDP) agreed at the Informal Council of Ministers responsible for Spatial Planning in Potsdam (1999), which defended a balanced and sustainable development by means of economic and social cohesion and defined three political objectives: economic and social cohesion; conservation and management of natural resources and the cultural heritage; and more balanced competitiveness of the European territory (European Commission, 1999). Three policy guidelines arranged for a sustainable regional development of the European Union (EU) (Federal Ministry for Regional Planning, Construction and Urban Development, 1995) should be added to the previous ones:

- Development of a balanced and polycentric urban system and a new urban-rural relationship.
- Securing parity of access to infrastructure and knowledge.
- Sustainable development, prudent management and protection of nature and cultural heritage.

These guidelines have a special interest in the contextualization of this research, since the enhancement of DRLs could take part and collaborate to achieve them.

BALANCED AND POLYCENTRIC URBAN SYSTEMS AND NEW URBAN-RURAL RELATIONSHIPS

According to Precedo (2004b), the city is the most competitive territorial structure and the driving force of economy because it works as an integrated spatial structure that favour interrelations and create synergies for the agglomeration economies. Moreover, it is the most competitive human resource and infrastructure supply that provides an added value to the urban area. It is also the connection point between a region and a global system, and the exchange centre of transports, communications, etc. That is why population is concentrated in cities, creating a cumulative urban development (Precedo, 2004b).

Nevertheless, the growth of cities and their concentration have produced the creation of new territorial realities with higher regional and local identities in last decades, such as polycentrism, network cities or the city-region. In this regard, globalisation has resulted in a territorial and local valorisation (Precedo, 2004b). The ESDP considers that the economic

[24] Several levels for the regional/spatial analysis are distinguished: regional level (1:100000 - 1:50000), county or district level (1:25000 – 1:10000) and local level (1:5000 – 1:1000) (Lozano & Arbaiza, 2010).

potential of all European regions could only been taken by means of a relatively decentralised urban structure with graduated city-ranking across the whole territory in order to obtain a balanced and sustainable development of cities and regions (European Commission, 1999). The polycentric scheme presents a hierarchy between cities, but without losing the importance of each of them, thus presenting connections at several levels, even in small or remote towns.

According to the ESDP, city and countryside should be understood as a functional, spatial entity with diverse relationships and interdependencies. A clear division between city and countryside within a region does not take into account that labour, information and communication markets can be only formed at region level. It is, consequently, the appropriate level for intervention and analysis. Furthermore, small and medium sized towns form important hubs and links —especially for rural regions— in polycentric systems, since they are the only ones that could provide services and infrastructures for economic activities and enable access to the main labour markets in rural regions. In this regard, the towns in the countryside need meticulous consideration in the conception of integrated rural development strategies (European Commission, 1999).

A polycentric urban system includes connections between cities and smaller urban or rural areas, becoming an interesting scheme to address the limit between urban and countryside areas that have been created in last decades. Accordingly, DRLs, which can be part of the current polycentric network and connected urban and rural areas in the past, could have special importance in the new urban-rural relationship.

PARITY OF ACCESS TO INFRASTRUCTURE AND KNOWLEDGE

As the ESDP claimed, in the face of the current concentration and polarisation tendencies of mobility, policy should ensure adequate access to infrastructures for all regions in order to promote economic and social and, hence, territorial cohesion. Integral planning is presented as a strategy to reduce the transport drawback, creating integrated intermodal solutions which support environmentally friendly transport modes and a more efficient use of existing infrastructures (European Commission, 1999). DRLs are part of these existing infrastructures although they are not currently in use, in addition to present adequate features for some of the sustainable transport modes (non-motorised transports), such as very low slopes or high turning radiuses.

SUSTAINABLE DEVELOPMENT, PRUDENT MANAGEMENT AND PROTECTION OF NATURE AND CULTURAL HERITAGE

Natural and cultural heritage are increasingly important economic factors for regional planning: the quality of life of different areas plays an important role in the location of companies; and natural and cultural attractions are essential for the tourism development (European Commission, 1999). DRLs present several heritage elements in addition to the connections that could create between other cultural or natural heritage elements that are part of their surrounding areas, potentiating them and favouring the regional development.

After these initiatives, in 2007, the first Territorial Agenda of the European Union (TA 2007: Towards a more competitive and sustainable Europe of diverse regions) was adopted in Leipzig by the same group of stakeholders who elaborated and agreed upon the ESDP and, in 2011, the current Territorial Agenda of the European Union (TA 2020: Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions) was adopted in Gödöllő (Hungary). In the latter, six territorial priorities were established for the development of the European Union (Committee on Spatial Development, 2011), which are connected to the previously mentioned guidelines:

- Polycentric and balanced territorial development.
- Integrated development in cities, rural and specific regions.
- Territorial integration in cross-border, transnational functional regions.
- Global competitiveness of the regions based on strong local economies.
- Improving territorial connectivity for individuals, communities and enterprises.
- Managing ecological, landscape and cultural values of regions.

Furthermore, the last Territorial Agenda has been adapted to the Europe 2020 Strategy (the EU's growth strategy for the coming decade), but they are not coordinated. The Europe 2020 (A strategy for smart, sustainable and inclusive growth) was launched by the European Commission in March 2010 and approved by the Heads of States and Governments of EU countries in June 2010. It has replaced the previous European Sustainable Development Strategy adopted in Lisbon (2000) and Gothenburg (2001), and poses three priorities for European growth that are mutually reinforcing (European Commission, 2010):

- Smart growth: developing an economy based on knowledge and innovation.
- Sustainable growth: promoting a more resource efficient, greener and more competitive economy.
- Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

1.2.2. Regional planning at autonomous community level

Regional planning competence falls within the autonomous communities, so the Basque Autonomous Community and the Chartered Community of Navarre are of interest for this research. In this regard, each autonomous community has its respective law: the Act 4/1990, of May 31, on the Basque Regional Planning and the Act 35/2002, on Regional and Urban Planning (Navarre)[25].

The instruments for the regional planning defined in those laws are showed in table 1.3. The Navarre Regional Strategy (ETN) and the Basque Regional Planning Guidelines (LAG) have an Autonomous Community scale, but they are not comparable in their issues. The ETN defines objectives and issues that are necessary to take into account in future actions, while the LAG expose specific guidelines to resolve and improve problems and questions related to its territory. That is why the LAG are better comparable to the Regional Management Plans (POT) of Navarre, which are divided into regional subsystems (five). Nevertheless, the ETN and the LAG show a non-legally binding nature (guidelines), while the POTs present more specific strategies and actions than others.

NAVARRE REGIONAL STRATEGY (ETN)

The Navarre Regional Strategy (ETN) is a strategic planning instrument of the Chartered Community of Navarre. According

[25] The objective of the Basque law is "to define and regulate the regional planning instruments of the Basque Country as well as to establish necessary criteria and procedures to ensure coordination of actions with regional impact that correspond to develop to different governments" (Basque Country, 1990a). The objective of the Navarre law is "to regulate the activity of regional planning, urban development or land use regime, and intervention instruments in the land market in Navarre" (Navarre, 2002). The latter does not refer only to instruments, but to the concept of regional planning and its objectives.

to the legislation, it comprises the set of criteria, guidelines and action guides related to the physical planning of territory, natural resources, urban and spatial development, main infrastructures, residential activities, economic activities, main facilities and the protection of cultural heritage (Navarre, 2002).

The ETN was approved by the Navarre Parliament in 2005 (June 21) and it was the first attempt to apply the principles of the European Spatial Development Perspective (ESDP) in Spain. Accordingly, ETN follows the same three objectives of the ESDP in addition to the other three guidelines related to sustainable regional development of the EU (Government of Navarre, 2005), all of them mentioned above.

In this regard, the ETN supports a broader urban central area (called Polynuclear Central Area) that includes intermediate cities located within 30-40 kilometres from the main city (Iruñea). Furthermore, in the south, an economic area through the Ebro Axis with Tudela as the main centre is proposed, while in the north, the Atlantic influence is used in order to join the Atlantic Arc and take advantage of its opportunities (Government of Navarre, 2005). Hence, a polycentric or city-region scheme is presented, which is focused in the Navarre central area, but takes also into consideration the external areas, since extraboundaries developments are promoted integrating main cities, urban areas and rural areas (fig. 1.30). Four zones are created as a consequence: the city-region of Iruñea, the Ebro Axis, the northern area and the Pyrenean area (Zarraluqui, 2011). External zones are closely linked to the neighbouring provinces, but also to Iruñea in order to integrate all urban and rural areas in the polycentric system (5 and 6 in fig. 1.30).

This step can be difficult due to the existing low population level

INSTRUMENTS FOR REGIONAL PLANNING		
TERRITORY	BASQUE AUTONOMOUS COMMUNITY	CHARTERED COMMUNITY OF NAVARRE
GUIDELINE	Regional Planning Guidelines (LAG)	Navarre Regional Strategy (ETN)
BINDING	Partial Regional Plans (LPP)	Regional Management Plans (POTs)
SECTORIAL	Regional Sectorial Plans (LPS)	Territorial Action Master Plans (PDATs) Supramunicipal Sectorial Plans and Projects (PSISs

Table 1.3 Basque and Navarre instruments for regional planning

and the high economic inversion required. In this regard, DRLs could be part of the polycentric system, connecting different urban or rural areas depending on its geographical location. Furthermore, the former railways that cross these areas (the Vasco Navarro Railway, the Bidasoa Railway or the Tudela-Tarazona Railway) are of special interest for the polycentric network because they could take advantage of intermediate cities or towns, and could organise the rural areas located around them, which are far from the main city.

REGIONAL PLANNING GUIDELINES (LAG) OF THE BASQUE COUNTRY

The Regional Planning Guidelines (LAG) of the Basque Country comprise the general framework for the formulation of other regional planning instruments defined in the corresponding law and land management master plans (Basque Country, 1990a).

The LAG were approved in the Basque Parliament in 1997 (Decree, 28/1997) (Basque Government, 1997). At that time, regional and spatial planning issues were emerging, making necessary several reviews since then (none of them was approved). Some documents related to specific issues were

Figure 1.30 Steps to follow in order to integrate different zones in the proposed regional system of Navarre (Zarraluqui, 2011)

1 Expansion of the city-region.

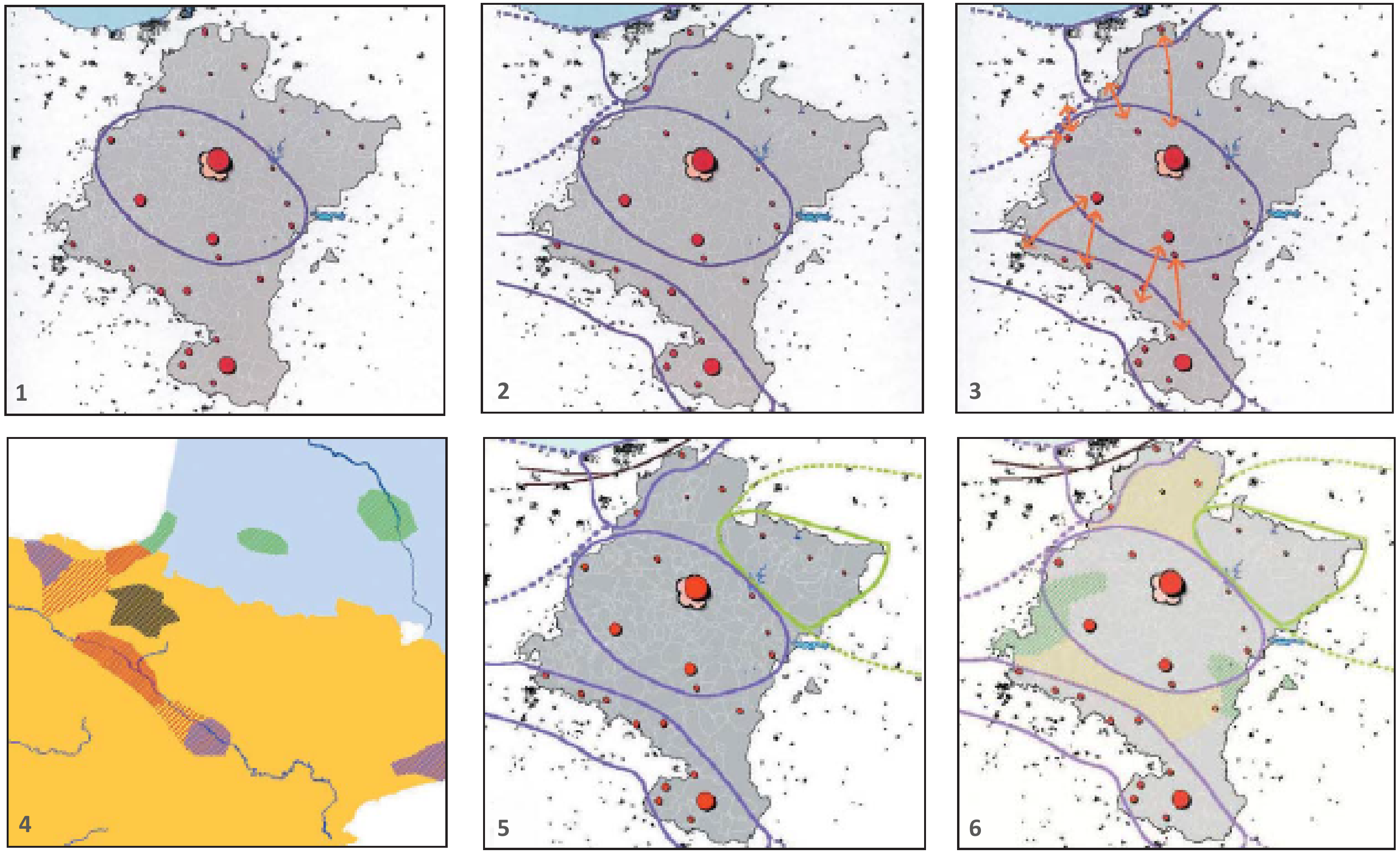
2 Proliferation of the city-region to different areas of Navarre.

3 Integration of all areas in the different city-regions.

4 Promotion of polycentrism with different regions.

5 Integration of isolated areas in the city-regions (Pyrenees).

6 Integration of remote areas in the city-regions (intermediate and transition areas).



published in 2008 and a general review document called "the Basque City" was available in 2012 (Basque Government, 2012). Since 2015, a general review process has been developed by means of a participatory process. In this regard, an initial specific document was presented in 2016 (Basque Government, 2016) or a general initial approval document in 2018.

The territorial model of the LAG is based on a Polynuclear System of Capitals, intermediate cities and the functional areas that are created around them; the management of the physical environment according to land uses and territorial capacity; and the relations that articulate functional areas between them and link the Basque territory with other areas. Nowadays, this model is still valid to manage territorial change processes (Basque Government, 2014). Nevertheless, and although the general model is valid, new concepts are included in the reviews in order to respond to the issues that have been obsolete due to the profound changes of last decades. Sustainable mobility, landspace, the recovery of built areas that could comprise new uses or the development of spaces for more knowledge-intensive economic activities are some of this concepts (Basque Government, 2012). DRLs could promote all these issues in addition to embrace them.

The LAG are not directly based on the ESDP and their objectives as Navarre, since it predates them. Nevertheless, the same concepts of polycentrism and city-region are included. The Basque Country is becoming a networked territory, which is composed of an urban polycentric system that includes metropolitan areas, intermediate cities and urban areas (Basque Government, 2012). However, at province level, the three territories have different polycentric structures, linked to their singular development features (see chapter 0.1.2). In this regard, Navarre and the Basque Country pursue a similar polycentric urban system (Basque Country have three metropolitan areas; Navarre has only one metropolitan area), creating a scheme composed of the four capitals and their surrounding urban and rural areas that interact beyond the administrative limits. Accordingly, the polycentrism reinforces each core from its own potential, but in turn, provides greater opportunities because it is a structure —that as a whole— is more complex, diverse, innovative and sustainable than each individual element (Basque Government, 2012). DRLs could be part of this polycentric system and might even strengthen it, creating links between different urban and rural areas.

Furthermore, the concept of transformation axis was created in order to answer a particular reality of the Basque Country. The urban networks of some municipalities join together due to the diffused developments that have been created around transport infrastructures. This is closely linked to the Basque geography, especially in the northern areas. The adaptation of these developments to the physical configuration of valleys results in linear structures that can articulate different urban areas in an effective way, allowing the existence of open spaces that maintain the permeability of the territory. In this regard, transformation axes are essential to articulate the Polycentric City-Region of the Basque Country, set up sustainable urban development processes or avoid territorial partitioning (Basque Government, 2012).

Although transport elements can be included, transformation axes are not infrastructural axes. They are articulation, renovation and development projects of urban areas, and protection and enhancement projects of open areas. They are integral territorial projects that seek to consistently address natural areas, urban spaces and infrastructural elements. Hence, they are composed by three principal elements: open areas that limit built areas and are structured as environmental corridors preserved from urbanisation; built urban areas that can be renovated and densified; and mobility corridors related to public transports and sustainable modes (cycling and walking paths) using existing infrastructures (Basque Government, 2012). Although not directly, this is one of the few times that the LAG could refer to the disused railway lines ("existing infrastructures"), comprising a general issue in which these lines could be inserted.

The different transformation axes show the territorial model of the Basque Country (fig. 1.31). Hence, the axes are radial in Bizkaia, only one axis appears in Araba/Álava and Gipuzkoa is structured in several axes creating a network. Moreover, several axes overlap with disused railway lines, making these lines particularly interesting for territorial structuring purposes: the Urola Railway and the Vasco-Navarro Railway in Gipuzkoa (Vasco-Navarro Railway does not coincide in Araba/Álava); and

Bilbao-Mungia in Bizkaia. In the case of the Urola Railway, the study of the old railway path as light rail or metric rail gauge train between Zumaia and Urretxu is proposed in the LAG. It should be mentioned on the one hand, that several sections of the infrastructure do not match the old path because different elements or roads have been built or the path goes through the city centre. On the other hand, one of the aspects for the viability of this train is the freight t transport between Azpeitia and Zumaia, which was related to a certain industry that is currently closed due to the economic crisis. In relation to the Vasco-Navarro Railway, a structuring axis of collective transport is proposed in the Deba Valley. It can be implemented by means of tram or train, but the recovery of the old infrastructure is not mentioned in this case. The connection to Vitoria-Gasteiz is proposed for the future, but all this implies the twinning of the existing axis instead of its reactivation or reutilisation.

In addition, and in relation to the transformation axis, ecological corridors that articulate protected areas are presented in the LAG. According to it, the consolidation of protected areas as essential elements for the biodiversity recovery and sustainability requires a better interconnection between these areas. In this regard, the set of ecological corridors will contribute to the creation of a green network that would increase the ecological variety of the territory and its landscape diversity and attractiveness (Basque Government, 2012).

Actions referred to the adequacy of soft roads along river courses are suggested in these corridors for pedestrians, cyclists or horse riders, preventing motorised access. Several interventions are included for that purpose: to plan and signal the routes and adapt the viewpoints for the users; to enhance singular isolated buildings near waterways that have patrimonial or traditional interest; and to adequate riverside singular areas close to urban areas including picnic, environmental education, sport or park areas, etc. (Basque Government, 2012). It is not known whether disused railway lines are taken into account in these actions. However, this link may result evident, since all of them could be applied in DRLs. In this regard, the former railway infrastructure would work as a non-motorised structuring element, while railway built heritage elements would supplement the touristic and leisure offer.

Figure 1.31 Transformation axes and natural areas of the Basque Country (Basque Gobernment, 2012)

Finally, sustainable mobility is linked to all previous concepts. According to the LAG, sustainable mobility is the one that permits increases in mobility, but limiting or reducing process costs and negative effects. It is aimed at increasing the importance of collective transports, facilitating intermodality or approaching the relation between transport and land uses (Basque Government, 2012).

Based on the conception that sustainable mobility arises from the interaction between urban structures that promote low environmental impact transport modes and availability of services or infrastructures that make it possible, several strategies have been defined for a more sustainable mobility (Basque Government, 2012). Although most of them are related to collective transport modes, one of the initiatives proposes to promote transport systems that are adapted to low population densities in rural areas. In this framework, a DRL reconverted into a non-motorised transport axis could operate as the adapted transport system. Furthermore, non-motorised transport modes included in DRLs could improve intermodal connections, since several of the Basque or Navarre DRLs go through the transformation axis already mentioned.

In contrast to the two presented guiding regional planning instruments and at a smaller scale, the Regional Management Plans (POT) in Navarre and the Partial Regional Plans (LPP) in the Basque Country are the binding plans that are related to specific supramunicipal areas or zones called subregions or functional areas.

REGIONAL MANAGEMENT PLANS (POTs), NAVARRE

The Regional Management Plans (POT) of Navarre are regional planning instruments whose action scope comprises the geographical areas characterised by their territorial uniformity, or the areas that need a coordinated consideration and integrated planning of their territorial aspects, because of their dimensions and functional characteristics (Navarre, 2002). These areas are called subregions and there are five in total: Pyrenees, Atlantic Navarre, Central Area, Middle Areas and Ebro Axis. Each of them is related to a different POT (fig. 1.32).

Four strategic axes are proposed for the structuration of the POTs, from which three of them are related to the three policy guidelines of ESDP, and hence of the ETN: natural and cultural heritage; urban system; communications, transports and infrastructures; and cooperation and coordination.

In the natural and cultural heritage axis, an intelligent management of cultural and natural resources is supported, i.e. their rational and responsible use and enhancement as part of the territorial organisation and development (Government of Navarre, 2011). In this regard, the railway heritage in particular, and the industrial heritage located near the disused railway lines in general, could comprise a set of interesting elements to take into account, in addition to the natural heritage around them.

Figure 1.32 Comprising areas of the different Regional Management Plans (POT) of Navarre. NASURSA, Government of Navarre

In relation to the urban system, a polycentric urban system is proposed, which is based on current settlements and integrated in a decentralised structure, composed of staggered urban cores and areas that give service to the whole region under equivalent conditions (Government of Navarre, 2011). The main network of urban areas is comprised of the Metropolitan Area of Iruñea and the structuring urban cores of the adjacent counties or districts, such as the urban areas of Altsasu, Lizarra, Tafalla-Olite and Zangoza (fig. 1.33). However, the challenge lies in achieving these equivalent conditions by means of county or broader nature proposals, because specific and isolated local actions cannot deal with some territorial problems, mainly related to rural areas. In this regard, the proposals should include territorial strategies that break the limit between urban and countryside, since sometimes the dichotomy between cities and rural areas makes no sense because both are part of the same reality (Alberdi, 2010). As mentioned before, DRLs could take an important role this urban/rural relationship.

According to communication, transport and infrastructure issues, public transports and non-polluting transport modes are supported in order to comprise a sustainable development

Tipos de Núcleos	POT 1 PIRINEO	POT 2 NAVARRA ATLANTICA	POT 3 ÁREA CENTRAL	POT 4 ZONAS MEDIAS	POT 5 EJE DEL EBRO
NÚCLEOS O ESPACIOS VERTEBRADORES A ESCALA SUPRAREGIONAL			ÁREA METROPOLITANA DE PAMPLONA Puerta de Navarra +Rótula +Empleo +Patrimonio +Polo		TUDELA - FONTELLAS Puerta de Navarra +Rótula +Empleo +Patrimonio +Polo VIANA – ÁM LOGROÑO Puerta de Navarra +Empleo
NÚCLEOS O ESPACIOS VERTEBRADORES A ESCALA REGIONAL o de "INTERÉS REGIONAL"	AOIZ<> AGOITZ Rótula +Empleo +Polo LUMBIER Rótula +Empleo +Polo AURITZ/BURGUETE – ESPINAL (ERRO) – ORREAGA/RONCESVALLES Puerta de Navarra +Rótula +Patrimonio	ALTSASU/ALSASUA – OLAZAGUTIA/OLAZTI – URDIAIN Área Urbana +Puerta de Navarra +Rótula +Empleo +Polo IRURTZUN Rótula +Empleo BERA – LESAKA Puerta de Navarra +Empleo DONEZTEBE/SANTESTEBAN Rótula +Polo	PUENTE LA REINA – OBANOS Área Urbana +Rótula +Empleo +Patrimonio +Polo	ESTELLA– AYEGUI- VILLATUERTA Área Urbana +Rótula +Empleo +Patrimonio +Polo LOS ARCOS Rótula +Empleo +Polo TAFALLA-OLITE Área Urbana +Rótula +Empleo +Patrimonio +Polo SANGÜESA – JAVIER – YESA Puerta de Navarra +Rótula +Empleo +Patrimonio +Polo	FUNES-MARCILLA-PERALTA Empleo SAN ADRIÁN – ANDOSILLA – AZAGRA Puerta de Navarra +Empleo
NÚCLEOS O ESPACIOS VERTEBRADORES A ESCALA POT O NÚCLEOS O ESPACIOS DE "RELEVANCIA SUBREGIONAL"	OCHAGAVÍA<>OTSAGABIA – EZCAROZ<>EZCAROCE Rótula +Polo ISABA<>IZABA Rótula +Patrimonio ARIBE-GARRALDA Rótula +Polo	AREA URBANA ELIZONDO – IRURITA – LEKAROZ – ARRAIOZ Patrimonio +Polo LEITZA Puerta de Navarra +Rótula +Empleo LEKUNBERRI +Empleo +Polo ETXARRI ARANATZ–ARBIZU–LAKUNTZA Área Urbana + Empleo	ZUBIRI Rótula +Polo LARRAINTZAR Polo URROZ – VILLA Rótula MONREAL Polo ETXUARI Polo	LARRAGA Rótula AIBAR<>OIBAR Rótula	CORELLA-CINTRUÉNIGO Empleo CAPARROSO Rótula +Empleo LODOSA Empleo CASTEJÓN Rótula +Empleo CARCASTILLO Rótula +Patrimonio
NÚCLEOS O ESPACIOS VERTEBRADORES A ESCALA INTERMEDIA O "NÚCLEOS O ESPACIOS INTERMEDIOS"	BURGUI<>BURGI Rótula +Empleo NAVASCUÉS<>NABASKOZE Rótula RONCAL<>ERRONKARI Polo ORBAIZETA Patrimonio ICIZ (GALLUÉS<>GORZA) Empleo	ORONOZ-MUGAIRI Rótula +Patrimonio URDAZUBI/URDAX Puerta de Navarra	OLAGÜE Empleo JAUNTZARAS Polo	ZUDAIRE Polo ANCÍN Polo ABÁRZUZA Polo ALLO Empleo BARÁSOAIN –GARISOAIN Área Urbana +Polo CÁSEDA Empleo UJUE Patrimonio ARTAJONA Patrimonio	CASCANTE Polo FITERO Patrimonio CORTES-BUÑUEL Empleo VALTIERRA –ARGUEDAS Área Urbana +Empleo +Patrimonio MILAGRO Empleo MENDAVIA Empleo

Figure 1.33 Structuring cores of the Navarre territory and their features. NASURSA, Government of Navarre

model (Government of Navarre, 2011). Several objectives and strategies are established for that purpose and two of them are of special interest for this research: improvement of local networks in order to facilitate their accessibility and the connectivity with structuring areas; and to promote sustainable mobility, based on public transports, less polluting transports and broader walking and cycling areas. Furthermore, a small reference related to infrastructures linked to culture and leisure can be found in the POTs. One the one hand, the Way of St. James is consolidated and recognised as cultural reference. On the other hand, cattle routes and disused railway infrastructures are inserted within the framework of trails and paths in natural areas.

Finally, the cooperation and coordination axis is the one that has been added in the Navarre regional planning in relation to the policy guidelines of ESDP.

In addition to these general axes, specific actions related to different areas are also included in the POTs. One of them corresponds to the reconversion of former railway tracks into cycling routes or greenways, which are included in both regional and subregional proposals. The reconversions are located under the Greenways Programme (the Association of Spanish Railways). In the POT nº4 (Middle Areas), for example, reconversion proposals for the Vasco-Navarro Railway and the Irati Railway are considered strategic. Furthermore, cycling should be promoted in the urban areas those have a structuring role in these routes. Accordingly, specific areas should be adapted and architectonic barriers removed, creating suitable areas for users. Moreover, connections between peripheries and urban cycling paths must be coordinated by the urban planning (Government of Navarre, 2011).

The reconversions of these former railway lines as greenways are inserted into natural and cultural heritage strategies and two of their guidelines (Government of Navarre, 2011):

- Guideline PN4 (natural heritage): creation of a network of routes composed by cattle routes, historic routes or former railway paths. The objective is to create a network of walking and cycling routes that connects urban and natural areas, and promotes ecological connectivity. Disused railway lines will be part of the network, since they will be used as greenways.
- Guideline PC2 (cultural heritage): restoration and enhancement of routes of interest. The objective is to adapt cultural routes and disused railway lines into walking and cycling paths that promote sustainable mobility and tourism or culture projects. It should be added that this guideline do not mention anything about railway heritage.

Finally, it can be said that Navarre regional planning is one step ahead of the Basque one in this regard, since there are specific proposals related to disused railway lines at territorial level, advocating the creation of a Supramunicipal Sectorial Plan (PSIS) for each of them. In addition, other interesting information is also presented in each POT: concerned regulations, such as heritage or sustainable mobility; data sheet of each area; or interesting annexes, such as the ones related to landscape or cultural heritage (Guidelines for systematisation in the development of heritage protection catalogues).

PARTIAL REGIONAL PLANS (LPPs), BASQUE COUNTRY

Partial Regional Plans (LPPs) develop the LAG in defined supramunicipal areas and determine for each area the specific planning criteria according to the guidelines (Basque Country, 1990a). In this case, the areas are called Functional Areas (there are 15 in total) and have been defined by the LAG in relation to geographic, economic and social criteria. Nowadays, not all the LPPs are definitively adopted. Although the main contents of the document are regulated by law, it should be mentioned that each LPP creates its own document with its own structure.

The LPPs analyse the territory and its current state in order to make detailed proposals. In this regard, several proposals concerning to disused railway lines can be found. Nevertheless, it should be emphasised that they can be inaccurate, since in several cases two different proposals that are incompatible or at least not viable are presented. One example is the reactivation of the Urola Railway and the cycling network of the Urola corridor. In this case, the cycling network that is currently being created goes through the old railway path in almost all of its sections. The reactivation of the railway will transfer the current cycling network or the railway line would need to be relocated, unless the cycling network is understood as a transitory use —which is not mentioned—. The relocation of the railway would not be a sustainable recovery of the old railway line, since enormous construction works should be made due to the orography of the valley. Furthermore, there are different proposals for the railway recovery (from Zumaia to Azpeitia or from Zumaia to Urretxu) that present ambiguities in the section between Azpeitia and Urretxu, where the valley is narrower.

Taking all the above into consideration, general proposals for disused railway lines have been presented in the supramunicipal areas taking into account the regional needs or interest and ensuring a broad approach. Accordingly, proposals related to non-motorised infrastructures or greenways have been presented. However, comprehensive actions that include the conservation or enhancement of the railway heritage have not been found. On the contrary, the following plans presented below are related to a specific sector or issue, presenting detailed proposals and actions, but losing the general character that supramunicipal general proposals could have.

TERRITORIAL ACTION MASTER PLANS (PDATs), NAVARRE

The objective of the Territorial Action Master Plans (PDATs) is to concretise, programme and coordinate the sectorial actions that come from a POT and are related to the development of big residential or economic activity areas, supraminicipal facilities and services, transport and communications systems or other territorial infrastructures (Navarre, 2002).

The Navarre Bicycle Master Plan is one of the PDATs, created by the Environment, Regional Planning and Housing Department through the Environmental Resources Centre of Navarre. This plan came in response to an increased use of bicycle as sustainable transport mode and a citizen demand. Although it was presented in 2007, it has never been adopted. The

Table 1.4 Types of bicycle users and trips Navarre (Government of Navarre, 2006)

TYPES OF USERS AND TRIPS			
TYPE OF USER	TRIP PURPOSE	TRIP LONG (km)	TRAVEL MODE
Daily urban	Work, school, shop, personal relations, etc.	3 – 8 (non-round trip)	Lonely trips
Recreational urban and suburban	Healthy exercise	5 – 12	Trips in couples or small groups
Recreational of not workdays	Nature and rural environment access and enjoyment	20 – 40	Familiar or small group trip
Cycle tourism of medium or long trips	Tourism with “saddlebags“	40 – 80	Trips lonely, in couples or small groups
Road cycling, sport	Intense exercise in nature	30 – 50	Mainly small group trips
Mountain cycling, sport	Intense exercise in open areas	50 – 120	Trips lonely, in small groups or pelotons

realisation of isolated past actions was accepted there, such as the recuperation of some disused railway lines (Plazaola, Bidasoa or Vasco-Navarro Railways). However, these previous actions have not been included in a global strategy of mobility (Government of Navarre, 2006).

In this regard, an analysis of the different type of users and trips was made (table 1.4) and a basic cycle path network was presented (Government of Navarre, 2006). This network was based on three different types of users (daily, recreational and sporty) and accordingly, foreseeable and potential routes were proposed in order to define a future cycle path network.

Furthermore, three layers or type of trips were summarised in order to create the final network: urban layer, recreational layer and sport layer. In the urban layer, information related to local or short trips between different urban areas, and different cycling initiatives were analysed. Urban areas with cultural heritage, interesting natural areas or landscapes and previous cycling routes (the Way of St. James, greenways, cattle routes,

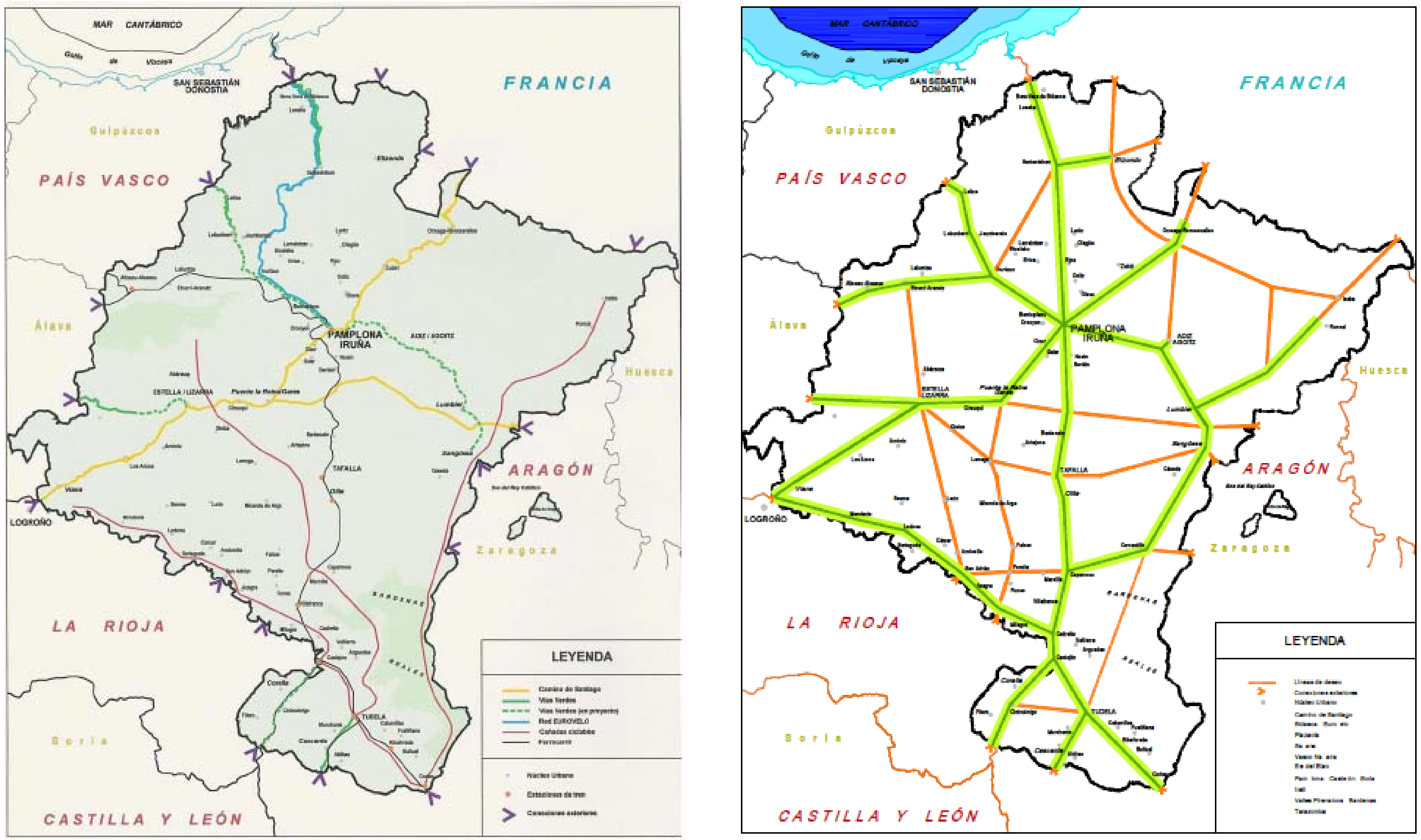


Figure 1.34 Existing (2006) (left) and proposed (right) cycling networks in Navarre (Government of Navarre, 2006)

etc.) were taken into account to create the recreational layer. In the sport layer, information from several public institutions and cyclist clubs had been collected. Thus, the final network was the result of superposing the three layers (Government of Navarre, 2006). It should be mentioned that greenways were located in the recreational layer, but it should be also included that the surrounding territory was taken into account in the analyses, which favours the creation of integrated and comprehensive proposals.

Moreover a priority network composed of 744 kilometres and 10 routes was created from the whole possible network (fig. 1.34). Five of them goes through disused railway lines, but some of them have not yet been realised.
- Bidasoa – Ultzama (79 km) and Doneztebe – Elizondo branch (11 km)
- Plazaola: Iruñea - Leitza (48 km)
- Vasco-Navarro: Lizarra – Zúñiga (25 km)
- Irati: Iruñea – Zangoza (43 km)
- Tarazonica: Tudela – Culebras (15 km)

REGIONAL SECTORIAL PLANS (LPSs), BASQUE COUNTRY

The Regional Sectorial Plans (LPSs) are regional plans that have a territorial impact, are created by the departments of the Basque Government or its provincial institutions and need to fulfil the guidelines and proposals of the LAG and the LPPs (Basque Country, 1990a). The LPSs related to this research are: the Regional Sectorial Plan of the Basque Cultural Heritage (not adopted); the Regional Sectorial Plan of the Basque Railway Network; and the Regional Sectorial Plan of the Cycle Path Network in Gipuzkoa.

The progress report on the **Regional Sectorial Plan of the Basque Cultural Heritage** was drafted by the Culture Department of the Basque Government in 2000 and adopted in 2001, however, any definitive document has not been adopted. This plan will form the general framework where all cultural heritage immovable assets will be included, enabling the simultaneous protection of this heritage. For that purpose the different type of assets are divided into two groups (monumental building and areas, and sets of monumental buildings) and several protection levels are defined (Basque Government, 2000). However, posterior cultural heritage laws (see chapter 1.1) have dismissed this sectorial approach and have presented a broader perspective of the issue, including new heritage categories.

According to the draft document of the Regional Sectorial Plan, the goals of the actions and interventions on cultural heritage assets are the protection, restoration, enhancement or maintenance of the cultural interest features that have been taken into account in their listing procedure. In this regard, the usage of the asset is considered positive for its conservation. However, any new use must respect the typological features and volumes, main spaces and elements that comprise the identity of the building. Hence, some of the uses could be denied because they have a negative impact in the architectonic values and elements. Accordingly, a classification of possible uses is made for each type of assets. The uses that could be included in a railway heritage assets in particular, are the ones related to its original use, allowing touristic visits and pedestrian access. When the building is not enclosed, cultural uses or open areas could be inserted, while in enclosed buildings the residence of the guard is permitted in addition to several uses with some restrictions, such as industrial uses or warehouses, offices or shops, services, garages or railway and bus stations. Interventions that damage or alter the typological singularities related to their valorisation are not allowed (Basque Government, 2000).

In the case of the individual assets that are listed, pre-listed or can be listed, the realisation of a complete analytical and documental study is necessary, and the intervention will be a scientific restoration. Meanwhile, in the case of the assets that are inventoried, pre-inventoried o can be inventoried, the analytical and documental study can be simplified and the intervention will be a conservative restoration. Finally, for local protection assets the intervention will be defined by the urban planning or will be a consolidation. In the case of assets related to a set, necessary studies and intervention types are quite similar, but depend on the general protection level of the set. In relation to this research, only three elements are listed (Oñati Station of the Vasco-Navarro Railway, Zumaia-Port Station of the Urola Railway and a bridge of the Leizaran Railway in Andoain) and according to the LPS, all of them would need a complete analytical and documental study.

The **Regional Sectorial Plan of the Basque Railway Network** was drafted by the Department of Transport and Public Works of the Basque Government and adopted in 2001. Its objective is to organise the railway infrastructures in the Basque Country and accordingly, to integrate and coordinate the actions involved. On the one hand, the activities in relation to the future High Speed Railway are included and on the other hand, actions in existing railway infrastructures are integrated and coordinated (Basque Government, 2001).

Therefore, although an extensive part of the document focused on the new High Speed Network (the Basque Y), an awareness of the need for action on the existing railway network is noticed. It should be noted that no important inversions have been made in the current network since its creation. Furthermore, this LPS assumes that any core connected to the network should not be left without service. This corresponds to the preservation of the railway assets for the future, when the road congestion becomes the railway transport essential to overcame mobility problems (not only in metropolitan areas) (Basque Government, 2001). According to the plan, this process has already happened in several northern European countries and reconversion costs are extremely high when railway was not a previous choice. It is necessary to point out two considerations in this regard. One the one hand, more sustainable transport modes are presented as the solution to increased road traffic. However, the problem is not in the solution, but in the approach, since transport demand, and consequently mobility, should be reduced increasing accessibility (Hoyos, 2010). One the other hand, the consideration about whether disused railway lines are part of the existing network or not. The answer could be "no", because several railway buildings and infrastructure sections are not currently owned by regional institutions, so they are not considered in this plan. They have been bought by different municipal councils or individuals, favouring the division of the systems. Nevertheless, disused railway lines are showed in a general diagram (fig. 1.35) presented in the description of the current state (they are not mentioned in the text).

Two proposals that considered disused railway lines are presented in this LPS. However, it may not be enough, since disused lines with railway use proposals are only mentioned and the future of the other DRLs is not mentioned. Conversely, the consideration of the whole life or process of these lines should be ensured, not only in the areas in which the railway activity wants to be recovered, but as a general strategy for their conservation (railway heritage conservation). In this regard, the Railway Infrastructure Administrator of Spain (ADIF) already manages several railway heritage elements, but they are isolated elements, and whole disused lines are not managed. Henceforth, the conservation of the railway heritage will be managed by the presented LPS of the Basque Cultural Heritage, but the LPS the Basque Railway Network could be the adequate instrument for management of the railway elements until their protection is ensured.

The two proposals that are concerned about disused railway lines are the reactivation of the Urola Railway and the rail proposal for the Deba Valley, both of them previously mentioned in the LAG. In the case of the Urola Valley (fig. 1.36), freight transport between Azpeitia and Zumaia is proposed, allowing the connection with the Port of Pasaia. In a first phase, the section from Azpeitia to the Station of Lasao (Azpeitia) will be realised and in a second stage, the section to Zestoa-

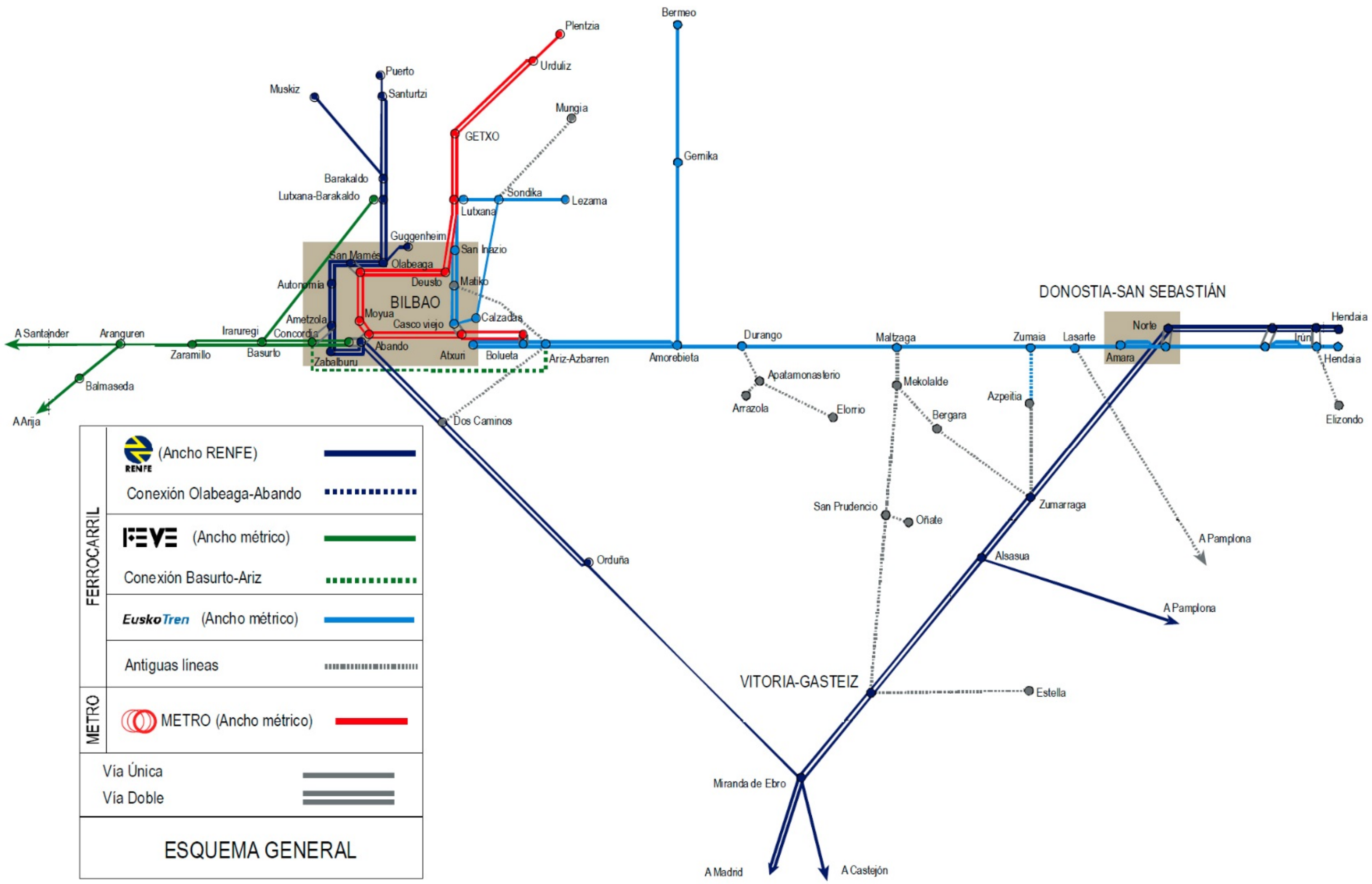
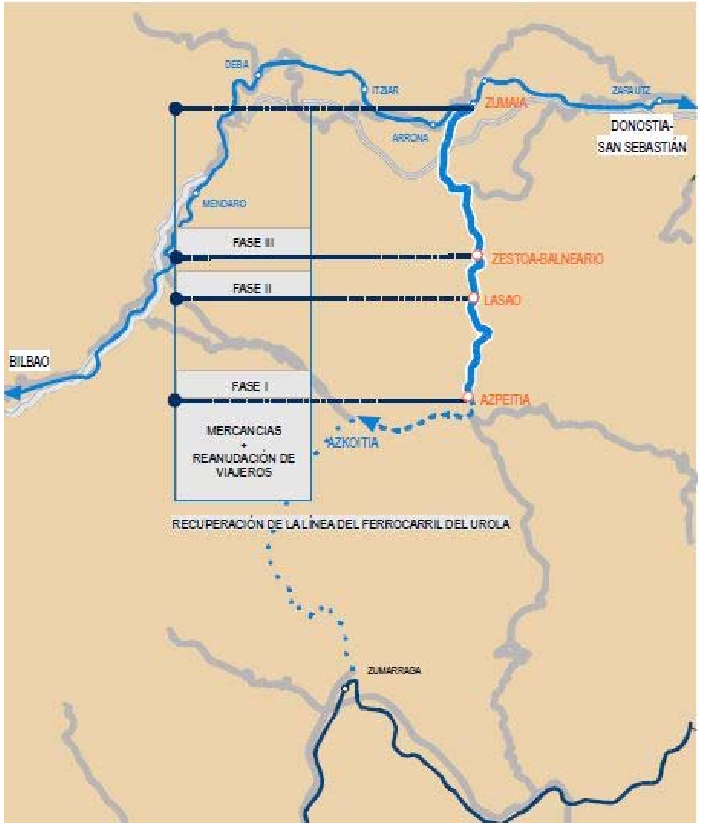


Figure 1.35 Current state of the railway network in the Basque Country (Basque Government, 2001)

Balneario Station. The reactivation until Zumaia-Empalme Station will create the connection to the current railway network, ensuring the movement and maintenance of the rolling stock. The section between Azpeitia and Lasao has been developed until today and only touristic trains run. However, the reactivation of the touristic steam and diesel trains until Zumaia is considered in the LPS. A future connection to Azkoitia is also considered in order to include this municipality again in the railway network (Basque Government, 2001). Comparing this proposal to the one presented in the LAG, a main difference can be concluded. The previous one refers to a rail connection between Zumaia and Urretxu, while the last one refers to the connection between Zumaia and Azkoitia.

In the case of the Deba Valley (fig. 1.37), a light rail that connects the existing railway network (Bilbao-Donostia) to the south of the valley is presented. The need of a communication corridor is considered between in this area, where the east-west axis is composed by a highway and the current railway (Basque Government, 2001). Although there was not any north-south main communication in the period of this LPS, nowadays, there is a highway there. In addition, the disused railway line



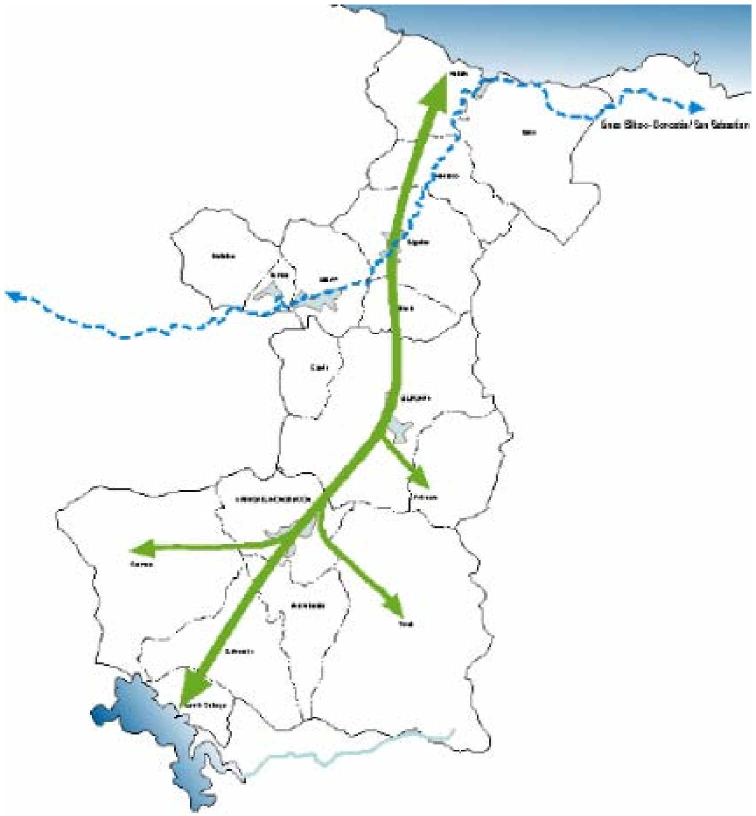


Figure 1.36 Rail connection proposal for the Urola Valley (left) (Basque Government, 2001)

Figure 1.37 Rail connection proposal for the Deba Valley (right) (Basque Government, 2001) that ran through this axis (the Vasco-Navarro Railway) is not mentioned in the document, questioning even more the feasibility and sustainability of the proposal. The project follows the guidelines provided by the LAG, where a tram or train is suggested, while a light rail has been chosen in the sectorial plan.

The **Regional Sectorial Plan of the Cycle Path Network in Gipuzkoa** was drafted by the Department of Mobility and Infrastructures of Gipuzkoa and adopted in 2013. Its objective is to create a cycling network in order to socialise the use of bicycle and cycling paths related to daily trips for urban and interurban active transport in Gipuzkoa (Regional Council of Gipuzkoa, 2013). Previously, the Act 1/2007, of January 24, on the Cycle Path Network in Gipuzkoa set up the concept of cycling path as a new type of trail, determining the need of creating a LPS related to this issue (Gipuzkoa, 2007).

Concerning the transport in Gipuzkoa, mobility has grown in the last decade due to the increasing use of the private car. Meanwhile, a slight increase has been observed in public transports and long distance trips have also increased. Moreover, travels that are not related to obligatory mobility have also risen (Regional Council of Gipuzkoa, 2013). All this has led to normalisation of mobility and increasing speed in transport planning and policies, creating more infrastructures in order to respond to the increasing demand and accordingly, increasing mobility in turn. In this regard, sustainable mobility should be based on focusing on the problem and diminishing mobility to increase accessibility (Hoyos, 2010).

In this LPS, the existing cycling paths (table 1.5) are analysed with the aim of characterise active transport and understand its tendencies. According to the analysis, almost half of the trips have leisure purposes (46%), nearly one quarter have sport purposes (23%), the same have work purposes (23%) and the rest have study or management purposes (8%). Furthermore, the 30% of the total trips are on a daily basis and work purpose trips are increased to 30% in cyclists. With the exception of the cycling paths that have leisure or nature character (Leitzaran

CYCLING PATHS IN GIPUZKOA, 2008-1010

WALKING-CYCLING PATH	LENTH (km)	EVOLUTION 2008	2009	2010	AVERAGE USERS/DAY	WALKING 2010	CYCLING 2010
Astigarraga-Martutene	1,1	342.000	365.000	363.000	996	66%	34%
Leitzaran Valley	19,4	167.000	175.000	185.000	508	65%	35%
Tolosa - Alegia	3,3	286.000	335.000	354.000	972	62%	38%
Idiazabal - Segura	2,0	54.000	50.000	54.000	149	88%	12%
Urretxu - Legazpi	3,1	282.000	300.000	290.000	795	85%	15%
Azkoitia - Urretxu	10,9	111.000	123.000	188.000	517	58%	42%
Azpeitia - Azkoitia	3,9	520.000	512.000	517.000	1419	84%	16%
Soraluze - Osintxu	2,3	195.000	200.000	208.000	572	86%	14%
Asteazu - Zizurkil	3,1	-	105.000	118.000	324	79%	21%
Elgoibar - Maltzaga	2,5	-	-	236.000	647	93%	7%
TOTAL	**51,6**	**1957.000**	**2165.000**	**2513.000**	**6899**	**76%**	**24%**

Table 1.5 The use of walking and cycling paths in Gipuzkoa, 2008-1010 (Regional Council of Gipuzkoa, 2013)

Valley and Azkoitia-Urretxu), they are starting to have relevance as daily purpose walking and cycling infrastructures, especially Urretxu-Legazpi, Astigarraga-Martutene, Azpeitia-Azkoitia and Zizurkil-Asteazu paths (Regional Council of Gipuzkoa, 2013).

The cycling path network proposed by the LPS is composed of 439 km and articulates the whole territory in addition to create connections to the adjacent provinces. The routes have been designed taking into account underused, disused or abandoned infrastructures in order to minimise the total impact produced by new infrastructures (Regional Council of Gipuzkoa, 2013). In this regard, the 22% of the network runs through former railway lines and 4 of the 9 proposed routes take advantage of some disused railway section (fig. 1.38 and 1.39).

- Deba Valley route, I–4 (yellow): It goes through the west part of the province, coinciding with the Deba River and linking the coastal route (I–2, green) with the boundary with Araba/Álava. The whole route has 81.4 km, 20.1 km of which were previously built.

- Urola Valley route, I–5 (blue): It matches with the Urola River in most of its sections and connects directly to the coastal route (I–2), and by means of the route Bergara-Beasain (I–6), to the Deba Valley (I–4) and Oria Valley (I–3, red) routes. The whole route has 48 km approximately, 27.8 of which were previously built.

- Bidasoa Valley route, I–7 (orange): It is from Irun to Endarlatsa (the boundary between Gipuzkoa and Navarra). It has 10.4 km and 8.8 km were previously built.

- Leitzaran Valley route, I–8 (light blue): It connects to the Navarre Plazaola greenway. It has 22 km and it is already totally built.

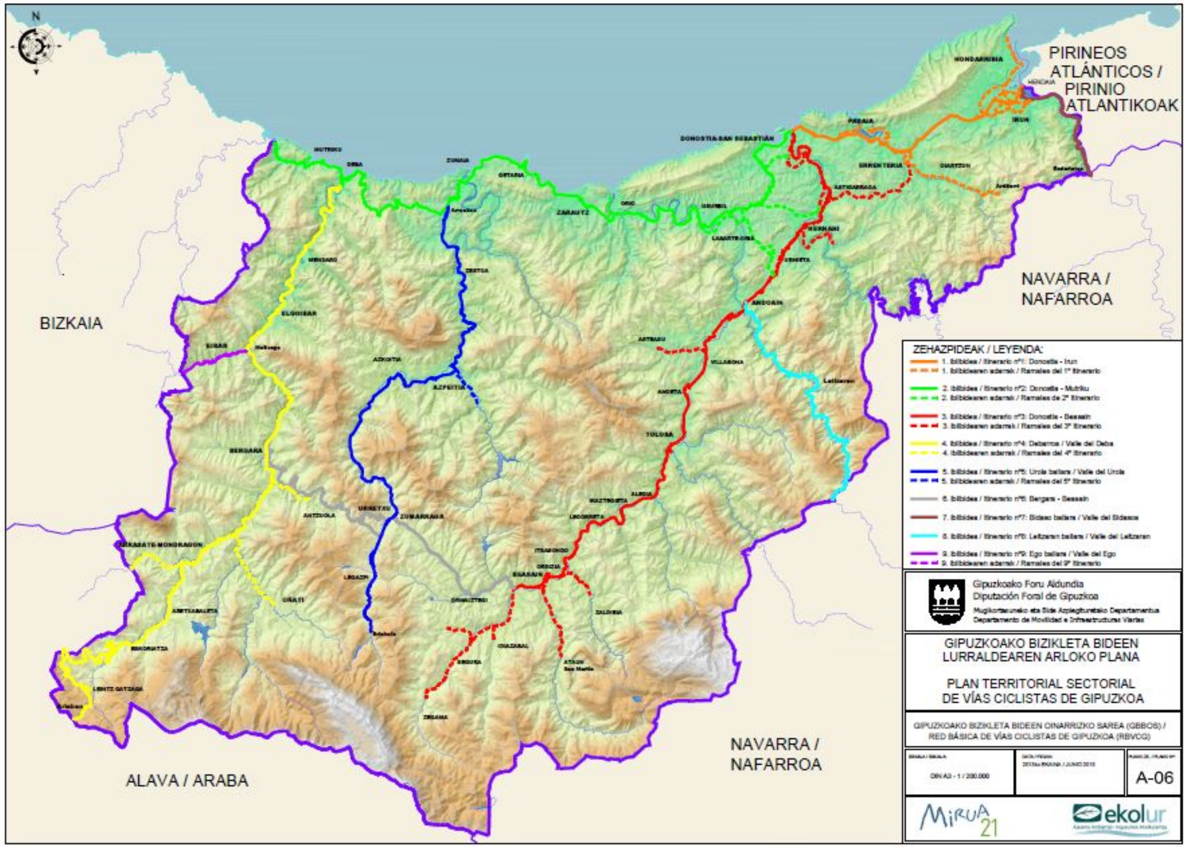


Figure 1.38 Proposed cycle paths network in Gipuzkoa (Regional Council of Gipuzkoa, 2013)

SUPRAMUNICIPAL SECTORIAL PLANS AND PROJECTS (PSISs), NAVARRE

The Supramunicipal Sectorial Plans and Projects (PSISs) are related to the actions on residential or economic activities or to the development of public plans or policies that have their influence beyond the municipalities. The objective can be also the implementation of infrastructures, transport, or other facilities that have their influence beyond the municipalities due to their importance or especial features (Navarre, 2002). They have the same character than the previous Basque sectorial

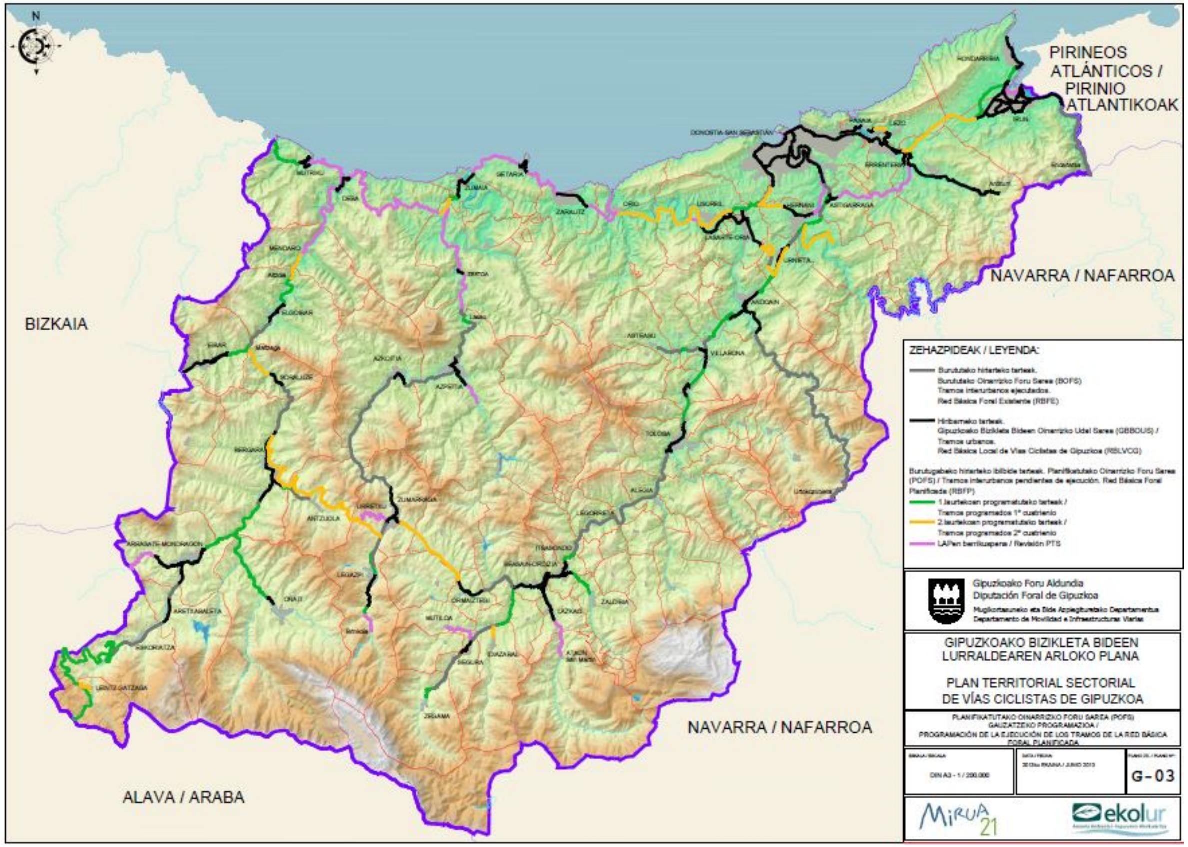


Figure 1.39 Proposed cycle paths network in Gipuzkoa. Management of the sections that are not built: first (green), second (yellow) and review (purple) phases (Regional Council of Gipuzkoa, 2013)

plans but at smaller scale, so they refer to specific elements. The creation of five PSISs has been established by the regional legislation in relation to this research: the PSIS of the Plazaola Railway Path Recovery; the PSIS of the Tudela-Tarazona Railway Path Recovery; the PSIS of the Endarlatsa-Doneztebe (Bidasoa) Railway Path Recovery; the PSIS of the Irati Railway Path Recovery; and the PSIS of the Vasco-Navarro Railway Path Recovery.

The **PSIS of the Plazaola Railway Path Recovery** was drafted by the Department of Industry, Trade and Tourism and adopted in 1991 (before the creation of the POTs) for the north section (until Irurtzun) and in 2010 for the south section (Irurtzun-Iruñea) (Government of Navarre, 1991; and 2010). A detailed description and analysis of the current infrastructure is made and an exhaustive proposal for a greenway is presented. Although the recovery of some of the stations is mentioned in the proposal, they are not previously described or analysed.

The **PSIS of the Tudela-Tarazona Railway Path Recovery** was drafted by the Association of Spanish Railways (FFE) and adopted in 2000, before the creation of the POTs (Government of Navarre, 2000). The PSIS is inserted within the Spanish greenway programme (called “Vías Verdes”). A detailed description of the infrastructure and its buildings is made and an exhaustive greenway proposal is presented. In addition to the recovery of the path, some actions related to the railway stations are included. However, it is exposed that they are not the aim of the plan.

The **PSIS of the Endarlatsa-Doneztebe (Bidasoa) Railway Path Recovery** was drafted by the engineering company LKS S.Coop. and adopted in 2012 (Government of Navarre, 2012). As the two previous plans, the description of the current state is included and a detailed proposal for the adaptation of the infrastructure as a greenway is presented. Nevertheless, railway buildings are not taken into account both in the current state and the proposal.

The **PSIS of the Irati Railway Path Recovery** has been drafted for the Lizoain-Zangoza section, but it has not been adopted yet. In this plan, two previous studies have been taken into account: Study for the recovery of the Irati (1994) and the Initial Approval of the Decree on Disused Railway Lines as Routes of Interest (1996). The objective of the plan is to protect the Irati Railway path and recover the infrastructure as cultural route related to leisure or sport, and as a linking route between cultural elements or natural areas. In this case, only the study of the path is made, without taking into account the railway heritage.

The **PSIS of the Vasco-Navarro Railway Path Recovery** has not been created yet, although the infrastructure has been already transformed into a greenway in several sections by means of the Spanish greenway programme.

All of the PSISs related to disused railway lines show greenway proposals, which are related to leisure and tourism, but not to daily trips or purposes. Furthermore, proposals have only focused on the infrastructure path and not on all railway elements.

As a conclusion, the development of the regional planning is mainly related to sectorial plans, focusing on specific issues and losing the broad approach that the proposal could have. In this regard, the planning between different issues or sectors —and in consequence between different departments— becomes essential for the creation of comprehensive proposals that are able to include all the aspect that a disused railway line could contain and provide. The relation between heritage and transport issues and their corresponding departments are the two main parts in this case.

1.2.3. Other mobility and transport plans

In addition to the regional planning instruments, there are several specific plans that deal with the issues mentioned so far, such as transport or mobility issues. Sustainable urban mobility plans, active transports plans or greenway programmes are taken into consideration below.

THE WHITE PAPER ON TRANSPORT AND THE MASTER PLAN FOR SUSTAINABLE TRANSPORT IN THE BASQUE COUNTRY

The White Paper on Transport (European transport policy for 2010: time to decide) was adopted by the European Commission in 2001 and revised in 2006. Its objective is to break the relation between economic growth and mobility growth. According to the White Paper, the solutions cannot be based on preventing mobility or imposing a redistribution of transport modes (European Commission, 2002). In this regard, sustainability is presented as instrument, but not as a change of mind, as it was presented before. According to it, preventing mobility is not the solution, but to become less necessary. Moreover, the document focuses almost entirely on motorised transport.

The Master Plan for Sustainable Transport in the Basque Country (2002-2012) has the same objective of breaking that relation, by means of favouring collective transports and more sustainable motorised transports, such as railways. Non-motorised transports are also included, since the creation of the Master Plan for Cycle Paths of the Basque Country is proposed and the need to free up urban areas for walking, cycling or public transport is exposed. However, these transports remain at a second level. Furthermore, the development of a Rural Accessibility Plan is also proposed in order to achieve a universal and sustainable accessibility (Basque Government, 2002). In this regard, disused railway lines could have an important role in rural accessibility of its surrounding territories, assuring the natural and landscape features and avoiding new landscape negative impacts, since they are existing and integrated infrastructures.

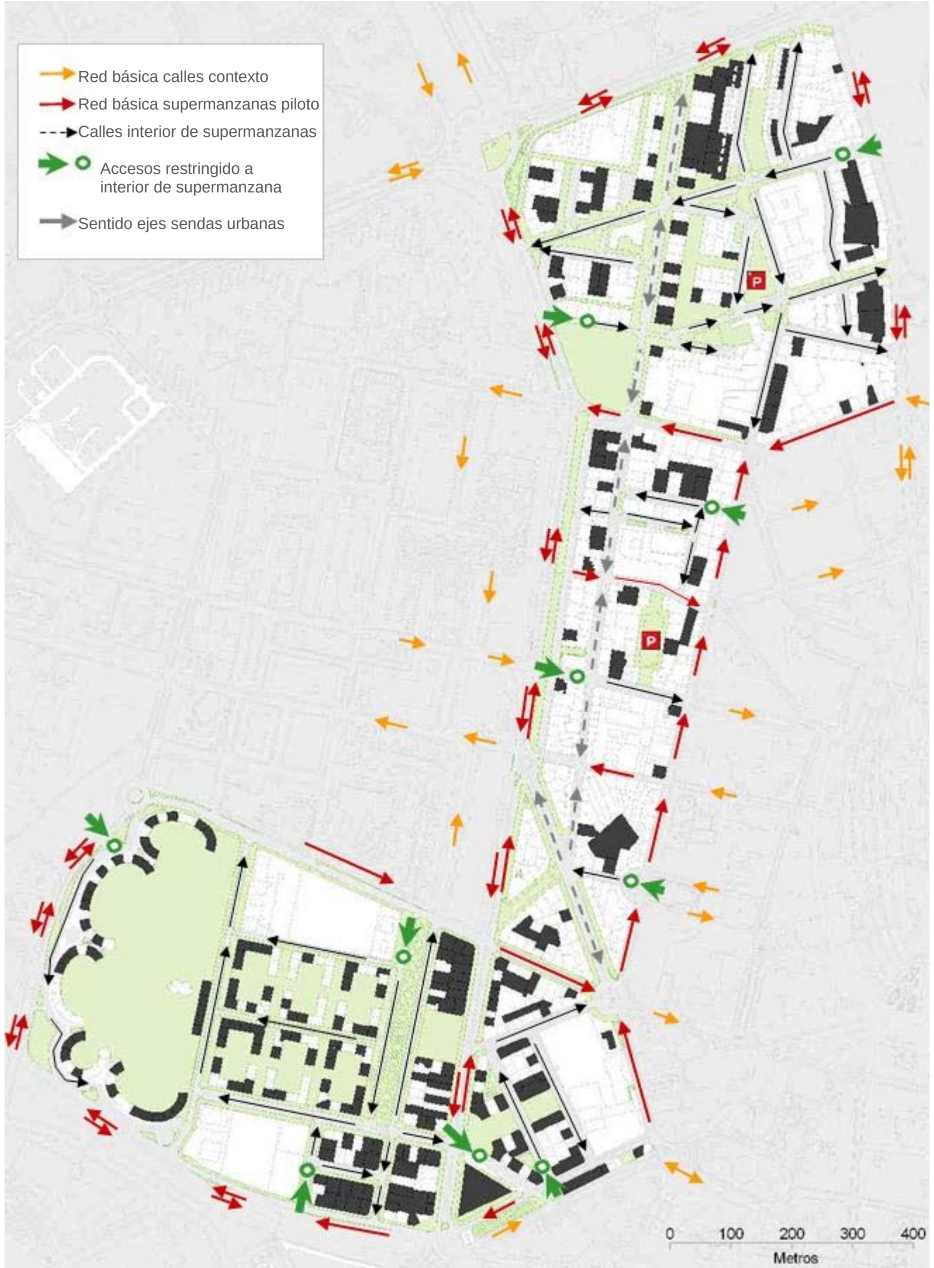
THE GREEN PAPER ON URBAN MOBILITY AND SUSTAINABLE URBAN MOBILITY PLANS

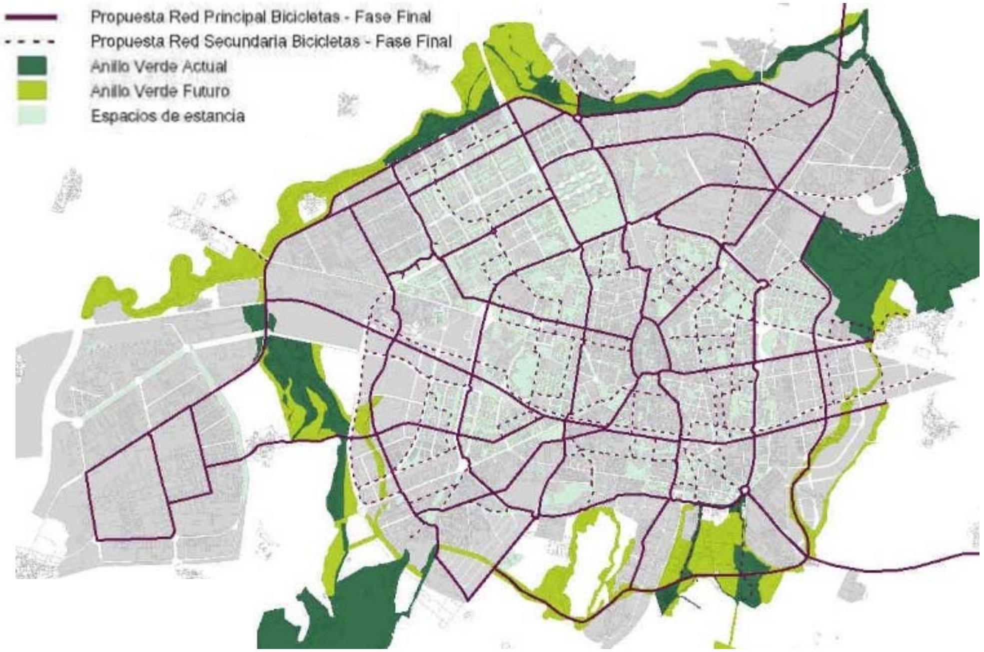
The Green Paper on Urban Mobility (Towards a new culture for urban mobility) was adopted by the European Commission in 2007. The objectives of the European transport policy cannot be achieved without a contribution from urban transport, so the Green Paper proposes to start the discussion of issues affecting urban transport and to find applicable solutions at European level (European Commission, 2007).

At Spanish level, Sustainable Urban Mobility Plans are proposed in this regard, which are created for municipalities with more than 100 000 inhabitants. A Sustainable Urban Mobility Plan is a set of actions that aims to implement more sustainable transport modes in a city, such as walking, cycling or public transports. These means of transportation reconcile economic growth, social cohesion and environment protection, increasing the quality of life (IDAE, 2006). In the case of the Basque Country and Navarre, only the metropolitan areas of the capitals could be included in this type of plan due to their size. However, it could be also interesting for intermediate cities or towns at a county or district level. Moreover, the areas covered in this type of plans are limited by daily trips, which in non-metropolitan zones could include different towns or small settlements located within few kilometres. Hence, the same plan could organise a supramunicipal area taking into account all type of transports and creating a more sustainable mobility. Accordingly, in addition to motorised transports, non-motorised transports could assume daily trips, moving away from the unique concept of tourism or leisure routes and creating an integral and intermodal network. Disused railway infrastructures are appropriate for the creation of the non-motorised network.

For instance, Vitoria-Gasteiz is one of the cities that has its Mobility and Public Space Plan (2007), whose main challenge is to change the increasing use of cars and free up public space in order to create high quality urban areas for citizens. Accordingly, the main objectives of the plan are to promote sustainable transport modes (public transport, cycling and walking); to create cycling and walking functional networks; to free up public traffic areas to create high quality urban areas; and to reduce CO_2 emissions. For that purposes, the mobility model is restructured by means of the implantation of "superblocks". The superblocks are basic urban units (400 × 400 m) where motorised transports (private vehicles and public transports) are moved to the perimeter streets and walking and cycling trips are only permitted in their interior —in addition to access for residents and services— (fig. 1.40). This type of unit enables to free up the 70% of the current traffic space and create new high quality urban areas. Based on this innovative model, different transport infrastructures are relocated and specific networks are presented (fig. 1.41 and 1.42) (City Council of Vitoria-Gasteiz, 2008).

Different variables are taken into account in order to analyse the current status and create the new proposals. On the one hand, urban factors are studied, such as urban compacity, urban complexity and social cohesion. On the other hand, specific variables related to mobility and public spaces are analysed.
- Mobility: private vehicles network; public transport network; cycling network; walking network; parking areas; and loading/unloading areas.
- Public space: volume of "green"; comfort; air and noise quality; relation between public space and accessibility; and urban livability (public space livability: morphology, attraction and comfort; and surrounding livability: proximity).
All these variables may be of interest to this research, since they


Red básica calles contexto
Red básica supermanzanas piloto
Calles interior de supermanzanas
Accesos restringido a interior de supermanzana
Sentido ejes sendas urbanas
0
100
200
300
400
Metros


Propuesta Red Principal Bicicletas - Fase Final
Propuesta Red Secundaria Bicicletas - Fase Final
Anillo Verde Actual
Anillo Verde Futuro
Espacios de estancia

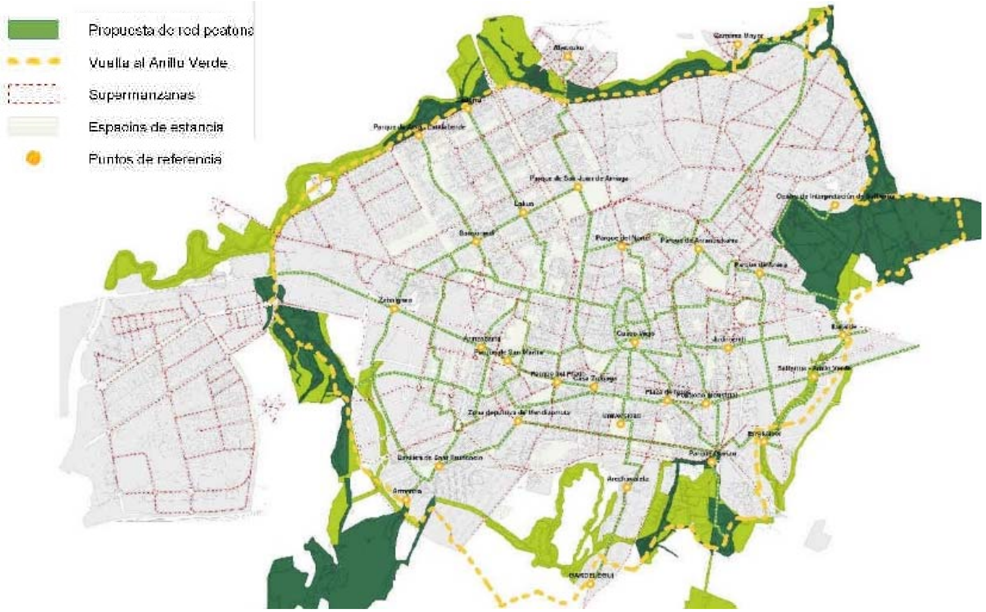

Propuesta de red peatona
Vuelta al Anillo Verde
Supermanzanas
Espacios de estancia
Puntos de referencia

Figure 1.40 Redistribution of streets and accesses of some superblocks in Vitoria-Gasteiz (left) (City Council of Vitoria-Gasteiz, 2008)

Figure 1.41 Cycling network proposed for Vitoria-Gasteiz (upper-right corner) (City Council of Vitoria-Gasteiz, 2008)

Figure 1.42 Walking network proposed for Vitoria-Gasteiz (lower-right corner) (City Council of Vitoria-Gasteiz, 2008)

are able to characterise an area in relation to its mobility and land use features.

In the case of Iruñea, a Cycling Plan was approved and a Sustainable Urban Mobility Plan has been created for the county area. However, they are not able to comprise a comprehensive transport plan, since the sustainable mobility plan is mainly focused on public transports, and walking trips, for example, are not taken into account. Furthermore, these plans are not as detailed and exhaustive as the previous plan of Vitoria-Gasteiz.

ACTIVE TRANSPORT PLANS AND GREENWAY PROGRAMMES

In accordance with the concept of sustainable mobility supported in this research, and according to Hoyos (2010), sustainable mobility should be focused in three main objectives: the reduction of mobility or transport need; the balance between different transport modes, favouring sustainable modes, such as cycling, walking, rail or sea transport; and the eco-effectiveness of trips. In this regard, non-motorised transports or the so called active transports are the basis of sustainable mobility, since they are the most sustainable modes although they are not competitive at large scale. They are characterised by high flexibility and capacity but low speed and spatial reach, so they are considered as an appropriate transport mode in short distances or high density spatial patterns. Active transports include mainly walking and cycling, but other compatible transports are also included, such as skating or horse riding.

In this framework, Active Transport Plans aims to create a system of integrated and connected on and off-road facilities to increase active transport levels for recreational as well as utilitarian purposes. This would permit to increase community safety, encourage healthy lifestyles and improve tourism attractions. They can be comparable to Sustainable Urban Mobility Plans, but they are created not only for metropolitan areas and are only focused on non-motorised transports, taking into account different type of users, routes or purposes.

In Canada, several cities and towns have created their active transport plan in recent years. The town of Georgina (Ontario), for example, drafted its Trails and Active Transportation Master Plan in 2014. As a general vision of the plan, on the one hand, they recognise the health, economic and quality of life benefits associated with Trails and Active Transportation. On the other hand, they support the connection of local communities with key destinations and surrounding municipalities through a continuous system of Trails and Active Transportation routes, and their use by residents and visitors of all ages and abilities (Town of Georgina, 2014). Routes are identified and selected taking into account several variables. Then, they are classified in different ranges depending on their location or nature and accordingly, users' necessities are defined. Disused railway lines are part of these routes, since they are suitable for active transport and go through urban and rural areas. According to the plan, destinations within 5 or 10 km from residential areas could be easily accessible by means of non-motorised transports. In case of the Basque Country and Navarre, these distances could comprise more than a town or a city, so non-motorised interurban trips would be achievable in addition to local trips.

In relation to non-motorised or active transports, Greenway Programmes should also be mentioned. The European Greenways Association was created in 1998 and its objective is to promote non-motorised transports using disused infrastructures, and coordinate information and experience exchange between different European organisations. In this regard, several international projects have been developed, such as the REMER-AMNO Project (England, Ireland, France, Luxembourg and Belgium) or the REMER-MED Project (Portugal, Spain, France and Italy).

The beginning of the Spanish Greenway Programme (called "Vías Verdes") occurred in 1993, before the creation of the European Association. That year, the programme was included in the Infrastructure Master Plan (1993-2007) by the Ministry of Public Works, Transport and Environment and in 2005, it was transferred to the Ministry of Environment and Rural and Marine Areas. In that first programme, infrastructures were not understood as heritage elements and their protection, conservation and enhancement was not an objective. However, they were considered of high potential for sustainable rural development. In 2007, the Natural Paths and Greenways Programme was created by the Association of Spanish Railways and in this case, the heritage and development approaches were taken into account for these infrastructures (Porcal, 2011).

The Spanish Greenway Programme aims to reuse disused railway lines as non-motorised infrastructures that connect towns, natural areas and elements of historic-artistic interest, by means of sustainable transport modes. The benefits that the greenways could offer due to their original use (railway) become them into the structuring axes of non-motorised transport networks (Aycart, 2010). Furthermore, greenways are able to combine the protection of high landscape value areas with the reutilisation of former transport infrastructures or valuable historical buildings that are located in their surroundings (Soria, 1997).

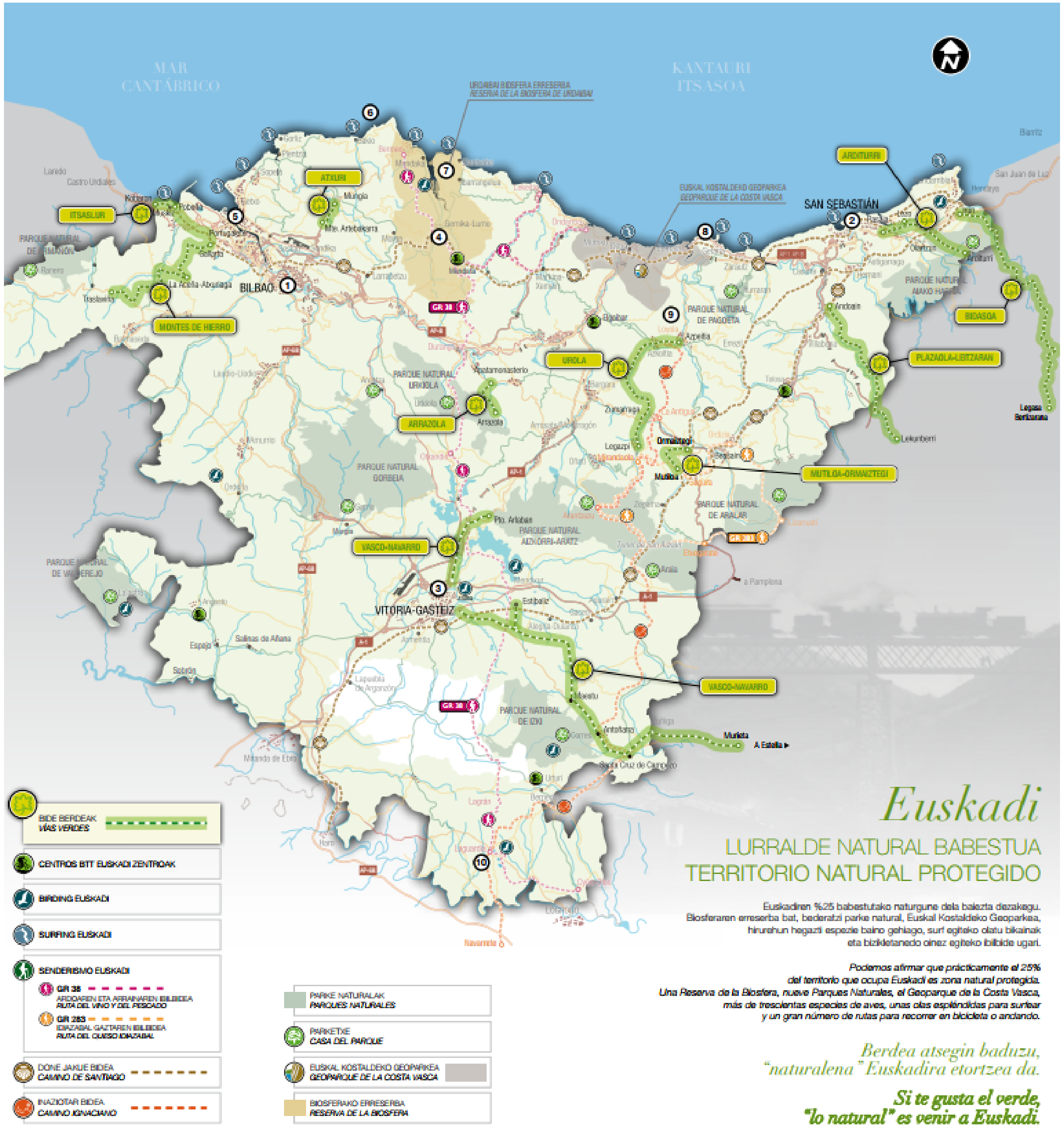
The actions taken in the United States or England were the background of the Spanish Programme (see chapter 1.1.4). Nevertheless, in those cases, greenways mainly benefited urban areas and their inhabitants, favouring sustainable mobility and bringing them closer to natural areas. In the case of Spain, disused infrastructures usually went through rural areas due to a different territorial model, so the creation of greenways throughout the country could represent an interesting contribution to rural development (Environmental Acitivities and Greenways Management (FFE), 2011). Meanwhile, in the Basque Country —specially in its northern territories—, greenways could improve the urban/countryside relation in addition to promote rural development because of the high population densities and the settlement distribution (organised in valleys). Accordingly, American and English greenway models should be taken into account in order to combine them with the Spanish model.

According to the Spanish Greenway Programme, in addition to the disused railway path reutilisation, refurbishment of railway heritage is also important to support rural development, since they are adequate to create local employment and attract investments. Hence, the creation of ecotouristic services, interpretation centres, leisure and sport facilities, etc. is proposed for the former railway stations (Environmental Acitivities and Greenways Management (FFE), 2011). Nonetheless, all the proposals are related to leisure or tourism activities.

2684.28 km of disused railway lines have been converted into greenways until 2014 in Spain —371.9 km in the case of the Basque Country and Navarre—[26] (fig. 1.43). However, 75 disused railway stations have been reused including new uses or

[26] Last seen 2014, in: http://viasverdes.com/itinerarios/principal.asp

Figure 1.43 Greenways of the Basque Country, in addition to protected natural areas and other non-motorised routes (right). Last seen November 2017, in: http://viasverdes.es/noticias/noticia.asp?id=446



services related to the greenways, few of them in the Basque Country and Navarre. One or two enhanced buildings per a line (as presented below) do not seem to be enough for their surrounding local development.

- Urola Greenway: the Basque Railway Museum in the railway station of Azpeitia.
- Vasco-Navarro Railway Greenway: a hostel in the railway station of Otazu and an interpretation centre in railway wagons in Antoñana.
- Plazaola Greenway: a tourist information point, coffee shop and bike rental area in the railway station of Lekunberri.

Finally, other actions are also promoted around the creation of greenways, such as the development of employment workshops or schools for refurbishment of railway paths and buildings; marketing of sustainable tourist products; or local enterprising actions (catering, education, bike rental, technical support for users, adventure sport, etc.) (Environmental Acitivities and Greenways Management (FFE), 2011).

In this framework, Mª Cruz Porcal (2011) presented the pros and cons of the actions that have been taken for the creation and promotion of greenways in the Basque Country and Navarre, which are included below:

PROS:

- Greenways have helped to recover, preserve and enhance cultural heritage that was traditionally unknown.
- Greenways have promoted bicycle use and outdoor activities, environmental education and heritage interpretation.
- Greenways have promoted contact with agricultural landscapes and important natural areas.
- Greenways have contributed to break the seasonality of tourism.

- Greenways have encouraged local and rural development by means of job creation.

CONS:
- Implementation of several kilometres of greenways without a management plan.
- Promotion of hiking in inadequate and not approved paths.
- Promotion of hiking without suitable tourist services or heritage interpretation plans.

According to her, the Basque Country is more advanced in hiking and cycling, while Navarre has better tourist amenities. Therefore, she recommends developing an integrated planning and management of heritage and tourist activities taking into account that linear infrastructures are not isolated elements, but part of a structured and dynamic territorial system.

1.2.4. Regional planning for sustainable development

All regional planning proposals aim to achieve a balanced territorial development. Development is known as the integrated process of economic, social and cultural growth of the inhabitants of a region, by training the society in order to respond to the demands of its citizens (Fernández et al., 1996).

Nowadays, heritage is understood as a factor for development. Accordingly, the concepts of conservation and development are compatible and heritage could be presented as active resource. In this regard, the development process from a heritage approach has two objectives: a development focused on a local approach, finding the growth, improvement and reinforcement of territorial resources; and a sustainable development (Fernández et al., 1996). These issues have already been addressed at the First Conference on Heritage as Development Factor (1996) in Andalusia (Spain). Railway heritage should therefore be understood as a system composed by elements that are able to encourage integrated and sustainable development.

SCALE: LOCAL, COUNTY AND REGIONAL DEVELOPMENT

In the above definition for development “the inhabitants of a region” are mentioned and the concepts of “city-region” and “polycentrism” have also been presented before. In this regard, an uncertainty about the adequate scale of planning and actions for development processes emerges.

Territorial realities at a local level, which were cancelled by globalisation until then, have increased in importance last years. Global and local approaches should be understood however, as the two ways to analyse and assess the same phenomenon. Both of them have different characters but both are necessaries. Just as it is necessary to think globally to understand the local level, it is also necessary to comprehend the local level in order to think globally (Precedo, 2004b). Local development conceptualisation has thus evolved from a fundamentally economic approach to a territorial development approach (Precedo, 2004a).

In this regard, Precedo (2004b) presented the county or district level as the suitable scale for territorial development planning. It provides an intermediate territorial scale that is more adequate than the municipal one to promote regional planning and local development actions, and moreover, is able to preserve their municipal identity. The latter contributes to maintaining a more democratic management by means of citizen participation. Furthermore, coordination between municipalities is necessary to achieve strategic planning levels, while preserving basic administration units. Regional, county and local scales are thus structured in a hierarchical system, where each level performs its specific functions while all levels interact between them. The county scale is the intermediate level in this hierarchy and hence, the level that better promotes ascending and descending interaction between the three scales (Precedo, 2004b).

In this framework, the County Development Theory bases its strategy on population´s sense of belonging to their county. As Precedo (2004b) claimed, county development adds a third component to the social management and planning, which is the recovery and reconstruction of the territorial historic memory, showing special attention to the revalorisation and reuse of natural and built heritage. In relation to this, disused railways present two aspects to take into account: their appropriate territorial scale (mainly at county level), in addition to their municipal and urban levels; and the distribution of cultural and natural heritage elements that could organise their environment, working as development assets. Accordingly, disused railway heritage should be understood as an element that is able to create territorial connections, by means of its revalorisation or reuse and using lineal urban developments that organise the surrounding settlements.

According to Precedo (2004b), these lineal urban developments could be green corridors or Territorial Identity Routes. The green corridors are development axes that work as connection or accessibility areas and promote territorial balance, integrating the metropolitan areas in continuous polycentric territorial systems. Meanwhile, Territorial Identity Routes use axes that have their own identity (cultural, natural, technological, historical, etc.) in order to create polycentric urban developments that are comprised of small towns and located in low density or rural areas (Precedo, 2004b). The disused railways of the Basque Country or Navarre could work as green corridors or Territorial Identity Routes, depending on the characteristics of the network in which each disused line is located and the different settlements that the network comprises. While some of the disused lines are located in axes that have high density urban areas, others go through rural and natural areas. Nevertheless, all of them have their own identity mainly due to the previous railway use, but also related to their current territorial organisation and surrounding landscapes, such as industrial, mining, natural, touristic, etc.

SCOPE: URBAN AND RURAL DEVELOPMENT

Urban and rural areas have usually their own independent developments, creating a division between these two areas that is reinforced by the same partition in their regulation programmes. In addition to the concept of urban development, the concept of rural development is also used in this regard.

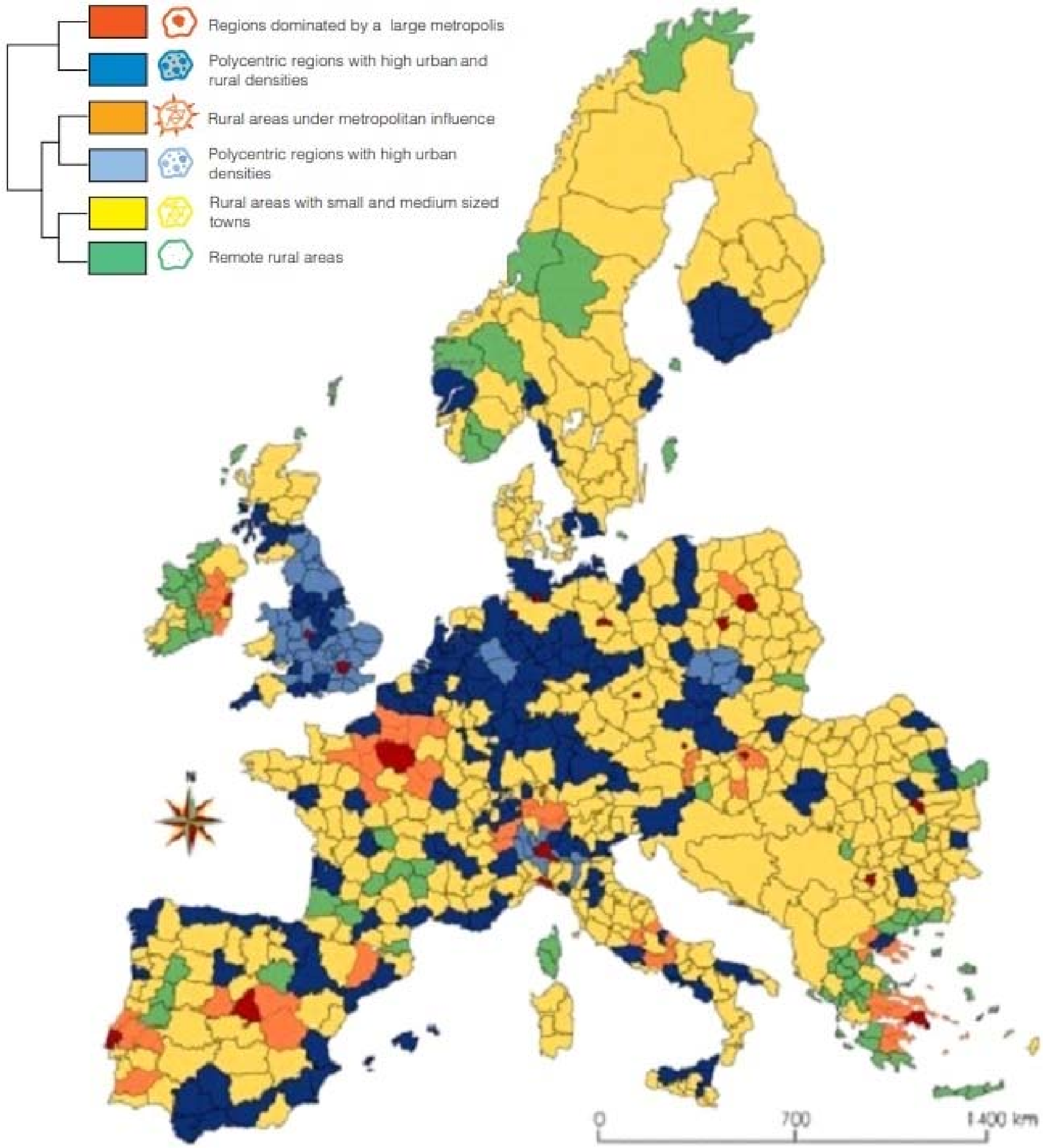
At the end of the eighties, the European Union was concerned about the situation of rural areas and several actuation programmes were established, such as Objective 5b, LEADER, Agenda 2000 or the Sustainable Rural Development Plan 2000-2006. At first, rural policies were predominated by agricultural matters and rural development was linked to one sector and social group (agriculture and farmers). However, the development of rural areas has gradually increased its policy area including a broader vision of development. Thus, rural development has evolved to an integral development view, which is characterised by the diversification of activities. In this regard, agriculture contributes to preserve a feasible socio-economic area and protect the surrounding environment and landscapes (Izquierdo, 2007).

On the one hand, these programmes have produced positive results, increasing the capability of these rural areas for development. The LEADER programmes insist on the promotion of new functions in rural areas, such as natural environments and leisure or recreation areas. Hence, environmental quality and rural facilities are taken into consideration in order to make these areas attractive for urban inhabitants, in addition to prevent local inhabitants from abandoning them (Rodríguez, 2005). As Izquierdo (2007) claimed, the improvement of living conditions and the increase of job opportunities in rural areas have encouraged the maintenance of the rural population, thus fulfilling the objective of these programmes in relation to this issue. Nevertheless, subsequent evaluations have demonstrated that these projects have created limited revitalisation at regional level (Izquierdo, 2007), since most of them are sets of specific actions that are disconnected from each other and do not have a defined strategy or a comprehensive approach (Rodríguez, 2005). These particular actions, not having a comprehensive nature, do not have any relation with the urban development processes of surrounding cities or towns. Accordingly, the limit between city and countryside is becoming even more pronounced.

In this regard, DRLs could be part of both urban and rural development. Disused urban railway areas and disused railway or industrial heritage elements of their surroundings could be the main assets for the regeneration of large spaces in urban areas. They could act as structuring open areas and provide built heritage elements that would ensure (by means of their refurbishment) the necessary activities, services and facilities. Meanwhile, in rural areas, disused railway heritage (including the disused infrastructure) could promote endogenous and rural development. On the one hand, it favours accessibility by means of sustainable transport modes, thus offering daily necessary services, and on the other hand, it brings them closer to tourism, creating local employment. The most interesting factor, however, refers to the connection or, rather, disconnection of the two development types. Benefits for both urban and rural development could be obtained by means of a combined planning and taking into account that DRLs can work as connecting elements. Consequently, a network structured by a former railway is able to regenerate urban areas and link small settlements or rural areas with more important cores. In this regard, the supply of different needs is guaranteed (from minimum services and facilities of rural areas to leisure and tourism demands of main cores) and uninterrupted built-up areas are avoided due to the creation of more sustainable links between the different towns, settlements or other areas.

A combined planning was already argued in 2000 by the Study Programme on European Spatial Planning (SPESP) proposed by the Tampere Council (European Commission, 2000b). The programme aims to activate the actions adopted by the European Spatial Development Perspective (ESDP) by means of new concepts and indicators, such as the concept of urban-rural partnerships in regions as points to strengthen. For Gipuzkoa, Bizkaia and Navarre, the urban-rural spatial pattern is defined as "polycentric regions with high urban and rural densities", while in the case of Araba/Álava it is defined as "rural areas with small and medium sized towns" (fig. 1.44). The programme claims that it is necessary to create actions that encourage both interrelations between cities and interrelations between a city and its surrounding areas (Méndez, 2005). Several case studies are presented in the programme, one of which refers to the routes of the Jubilee of the Year 2000 in Italy. In this case, the refurbishment of several buildings and monasteries that are part of the cultural heritage of cities is promoted and connection routes that are based on former pilgrimage routes

Figure 1.44 Regional types of urban-rural spatial patterns (European Commission, 2000b) Source: Moriconi-Ebrard (1994), Geopolis.



to Roma are managed. The case study focuses on the definition of the routes, identification of monuments and creation of a general support strategy, and institutional or information links. This case study is thus interesting for the current research of disused railways, since the reconversion of both infrastructures and built elements are involved.

APPROACH: SUSTAINABLE DEVELOPMENT

Regardless of the planning scale or scope, all development processes should be based on sustainability principles.

In 1987, Gro Harlem Brundtland recovered a definition that had been used in 1713 by the chief mining official Hans Carl von Carlowitz, for defining sustainable development in a socio-economic report of the United Nations (UN) called Our Common Future, in order to respond to the oil crisis of the 1970s. Sustainable development was thus defined as "the development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987). Furthermore, in 1992 the Rio Declaration on Environment and Development was adopted, which contains 27 principles of sustainable development (United Nations, 1992). Development is presented as a multilevel concept that includes several principles, such as the balance in the allocation of resources, quality of life, creative capacity, etc. In this regard, sustainable development leads to a dynamic balance between all forms of capital or asset (human, physical-natural, financial or cultural) (Caravaca et al., 1996). The objective of sustainable development is to create feasible projects that ensure a convergence between the three pillars of economic development, social equity and environmental protection.

However, Troitiño (1998) postulated that sustainable development requests a new interpretation of built heritage as territorial structuring element, understanding territory as a social construction. What is more, the Hangzhou Declaration has already recognised the value or impact of cultural heritage as a driver for sustainable development (UNESCO, 2013), so it is integrated as the fourth pillar of sustainable development (fig. 1.45) in order to develop a comprehensive approach to assess the impact of cultural heritage. Accordingly, investments in cultural heritage can contribute to the economic, social and environmental areas, in addition to enhance the cultural area itself. However, only integrated approaches can use the full potential of cultural heritage, maximising its impact and creating a more "upstream" perspective on cultural heritage impact (fig. 1.46) (CHCfE Consortium, 2015).

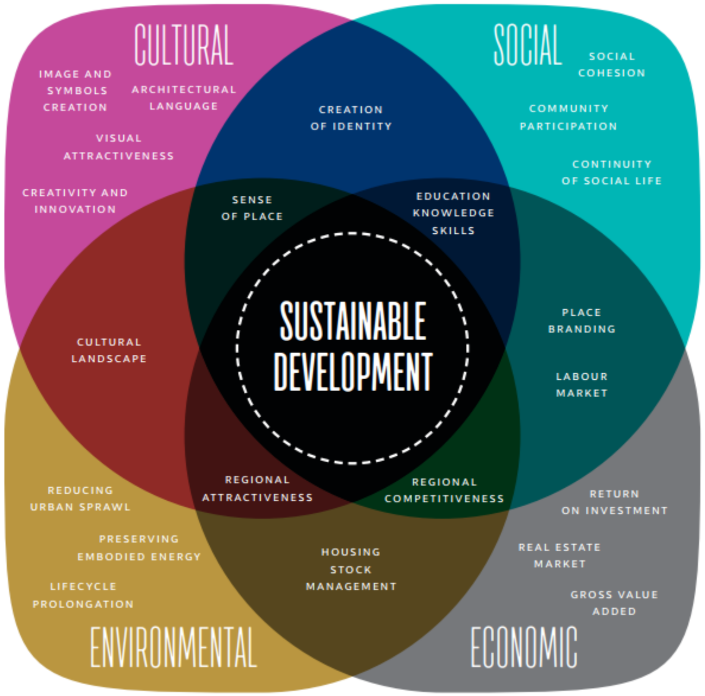


Figure 1.45 Holistic four domain approach to the impact of cultural heritage and the identified different subdomains (CHCfE Consortium, 2015)

Figure 1.46 "Upstream" perspective on cultural heritage impact (CHCfE Consortium, 2015)

Heritage is thus presented as an element to consider for sustainable development by means of its refurbishment and enhancement, reinforcing the compatibility between conservation and development. In this regard, disused railway lines could work as structuring elements to ensure sustainable development of urban and rural areas. On the one hand, they are used or can be used as non-motorised transports infrastructures advocating a more sustainable mobility. On the other hand, they have several disused heritage elements that are able to comprise new uses, leveraging the potential of existing resources but also ensuring the conservation of the elements.

To sum up, disused railway lines are mainly presented as infrastructures for non-motorised transport modes in regional planning, but they are mainly related to leisure or tourism activities. However, they could work as territorial structuring elements, since the potential of these systems goes beyond the use of the infrastructure. They also comprise a set of heritage elements and both together are able to support an active transport related to daily activities, advocating a more sustainable mobility. Furthermore, at a lower scale, railway heritage elements and their surrounding areas could also provide active resources for urban regeneration or development. All these should be properly inserted in the current polycentric network composed of urban and rural areas, favouring both urban and rural development and the interrelations between them.

1.3. Disused Railway Lines (DRL) as nodes in the interaction between transport and land uses

In addition to take into account existing heritage elements, a balance between transport and land uses is needed in order to achieve a sustainable urban development. A more sustainable urban growth involves more sustainable transport modes, such as public transports or non-motorised transports, but it also involves a more sustainable structuration of land uses, such as the use of mixed uses or higher densities. In this regard, several proposals have been developed over the years with the aim of creating the ideal land-use transport system.

1.3.1. Interaction between Transport and Land Use

It is generally well known that land use and transport patterns are related to each other (Chorus & Bertolini, 2011; Wegener & Fürst, 1999), since the increase in the distance between activities creates the need of travel. Nevertheless, the impact of transport in land use is less recognised. In this regard, the arrival of the railway and the expansion of the car ownership have enabled the evolution from foot based dense medieval cities to large metropolitan areas, although the influence of transport infrastructures on the location of destinations is not clear (Wegener & Fürst, 1999). Accordingly, there are three different theoretical approaches to explain the relation between transport and land uses: technical, economic and social.

In the fifties, the relation between transport and land use was first studied by the USA. According to Hansen (1959) locations with good accessibility had a higher development chance and at a higher density. From the recognition of the two-way interaction between transport and urban spatial development, and the assumption that a coordinated planning between them was necessary, the idea of "land-use transport feedback cycle" was created (fig. 1.47). Hence, allocation of activities defined by the land-use pattern creates a new transport demand and consequently a need for transport services. New infrastructures and resulting increase of accessibility in turn, determine the land use pattern, starting the cycle again. It continues until a balance is reached or some external factor intervenes (Meyer & Miller, 2001). The cycle implies the following relations:

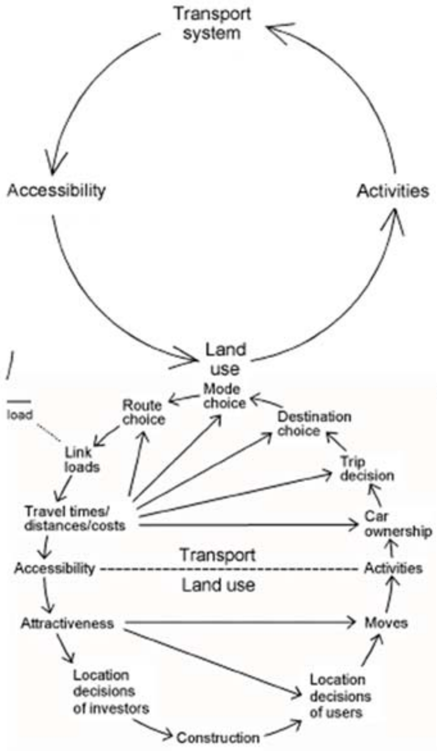
- The distribution of land uses, such as residential, industrial or commercial, over the urban area determines the locations of human activities such as living, working, shopping, education or leisure.
- The distribution of human activities in space requires spatial interactions or trips in the transport system to overcome the distance between the locations of activities.
- The distribution of infrastructure in the transport system creates opportunities for spatial interactions and can be measured as accessibility.
- The distribution of accessibility in space co-determines location decisions and so results in changes of the land-use system. (Wegener & Fürst, 1999)

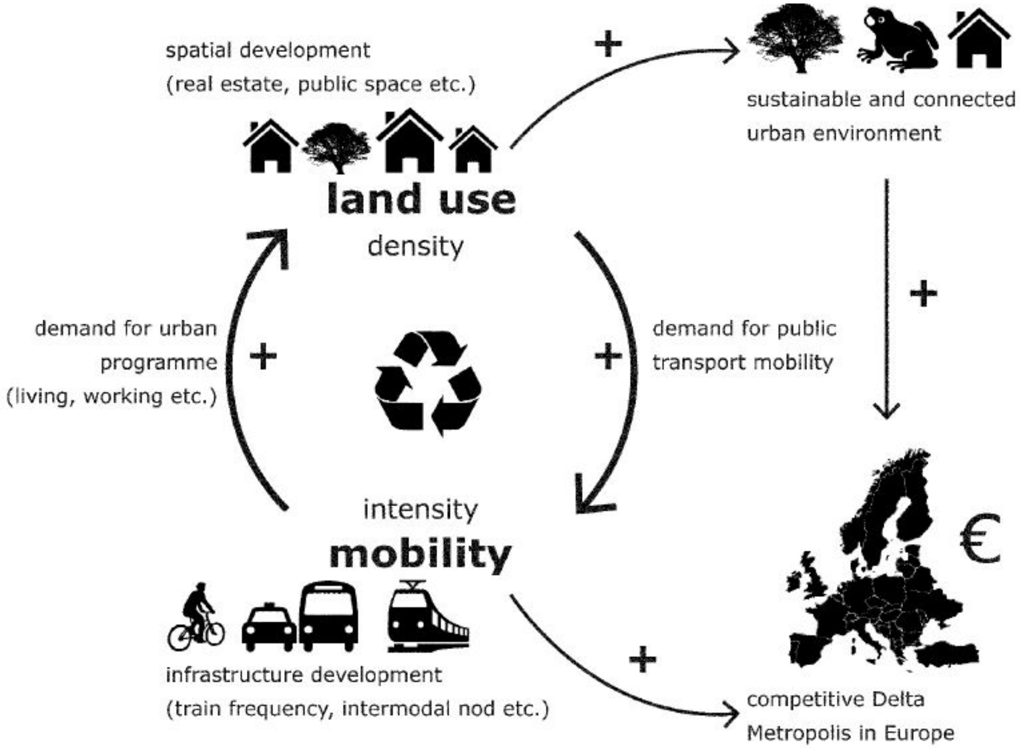
Technical theories, which are related to the urban mobility system, are based in the "land-use transport feedback cycle", such as many engineering-based and human-geography derived urban development theories.

Based on this cycle, interrelations between the two systems are not stable and are composed by quantitative (population, traffic volume, density, etc.) and qualitative (diversity of building types, social groups, mixture of uses, etc.) factors (fig. 1.48). Their implication in urban concentration-dispersion processes is necessary to asses in order to comprehend the matching between transports and land uses (Moreno, 2013).

Figure 1.47 The “land-use transport feedback cycle” (left) (Wegener & Fürst, 1999)

Figure 1.48 The interaction cycle of mobility (public transport) and land-uses in Netherland (right) (Nefs et al., 2010)





According to economic theories, cities are understood as markets, where the proximity between resources and activities minimises transport costs. That is why locations with good accessibility are more attractive and have a higher market value than peripheral ones. The liability of the city centres lies in the economies of scale. Production and distribution organisations prioritise a good access to the regional and local transport network, while the firms related to services and technologies prefer remaining in the city centre. The result is a general spatial distribution of economic activities and the progressive erosion of activities in the city centre, explaining the spatial polarisation observed within urban regions (Wegener & Fürst, 1999). In this regard, economic theories support a dispersion process of urban activities in the territory, without taking into account environmental and social consequences (Moreno, 2013).

Social theories are based on the concept of individual or collective appropriation of space in order to pursue urban and spatial development of cities. The city is the stage for social interaction (Goffman, 1959) and neighbourhood and urban levels are analysed in social ecology theories studying the spatial expansion of cities. However, social geography theories go beyond taking into account the spatial-temporal behaviour. Accordingly, individuals perform activities of different size and duration linked to daily mobility according to their social role, income and level of technology and subjected to capacity, coupling and institutional constraints (Hägerstraand, 1970). Moreover, new technological advances in speed increase do not minimise travel time or cost of daily mobility decisions, but instead maximize activities that can be reached within individuals travel time and money budgets, allowing new settlements in more remote territories (Zahavi, 1974).

Therefore, the increase in transportation speed contributes to the territorial expansion of activities and hence, to the increasing scale of the perception of urban elements. Urban growth has become dependent on transportation (mainly private vehicles) and hence, the system is susceptible to future local and regional mobility changes. Nevertheless, transportation is not a factor that ensures urban development, since several aspects are necessary to take into account, such as a proper planning of activities or the interaction between flows of different approaches and scales. Integrated land use and transportation planning permits to develop regional structures that are related to both regional and local transport axes (Moreno, 2013). In this regard, some of the transport and land use policy implications have been sketched by Bertolini for accessible and sustainable urban forms (fig. 1.49) but, in practice, land use and transport planning have tended to be separate operations (Cascetta & Pagliara, 2009).

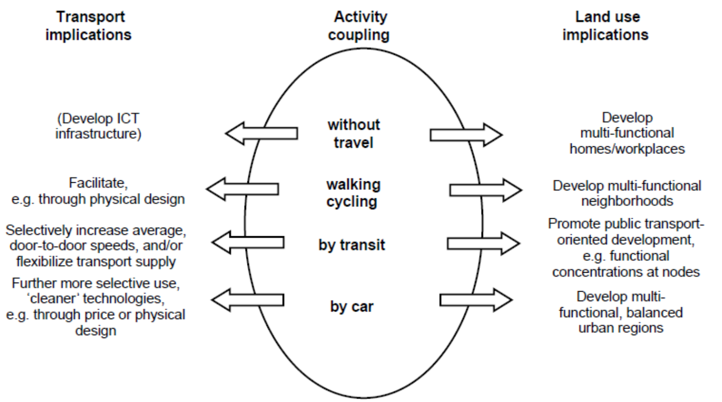


Figure 1.49 Policy implications of accessible and sustainable urban form (Bertolini et al., 2005)

1.3.2. Urban development models

HISTORICAL PROPOSALS

Since the 19th century several land-use transport system proposals have been developed in order to overcome the problems and deal with the changes produced by the industrialisation processes.

One of the proposals was the Linear City, which was first conceived by Arturo Soria y Mata in 1882 (Soria y Mata, 1882). He created a 400 m wide and 48 km long ring-shaped settlement in Madrid. A main axis with public transport and road infrastructures was the backbone of the plan. Residential buildings were located along the axis in order to provide easy access to both infrastructures and open areas. However, the allocation of higher-order city facilities was problematic. Brasilia is one of the examples of existing linear cities, which is composed by the intersection of two linear cities.

In contrast, Ebenezer Howard (1898) created the Garden City, which was a satellite urban system of 250.000 inhabitants, formed by a central city (58.000 inhabitants) and six surrounding towns (32.000 inhabitants each). The idea was to combine and take advantage of the characteristics of both urban and rural areas ensuring balanced spatial growth patterns (Howard, 1902). The connections to the central city and between the satellite towns were made by rail and the ideal distance between the towns and the city was limited by the travel time, thus depending urban development to the technological progress. Different land uses were located within walking distances in the towns, while industrial areas were separated to preserve the quality of life. Afterwards, his ideas have been adopted in other several concepts.

However, it has several critics about its incapacity to host additional population or land uses to deal with the continuously growing metropolitan areas, because of the defined growth limit. In this regard, the Axial City System is more flexible, since the urban development is focused on axes and green areas appear in the interstices, connecting the city centre parks with the rural areas and ensuring rapid access to open areas all around the metropolitan area (Wegener & Fürst, 1999). An axial system along commuter rail lines for Hamburg and Cologne had already been proposed in the 1920s by Fritz Schumacher. Several examples of the implementation of this axial system can be found, such as Copenhagen and Stockholm after World War II or Portland, Oregon and numerous towns in the Netherlands more recently. In these cases and with the construction of new commuter rail lines, high density residential areas and business and retail centres were developed around the rail stations, however, the city centre remains as the area of higher order facilities and densities of the system (Wegener & Fürst, 1999).

In 1904 Tony Garnier created the Cité Industrielle, where a functional separation between industrial areas and residential areas was proposed. This spatial separation of land uses (The Functional City) was after developed by Le Corbusier and other members of the Congrès Internationaux d'Architecture Moderne (CIAM) in the fourth CIAM of 1933, compiling its conclusions in the Athens Charter[27]. Le Corbusier previously defended (Ville Contemporaine in 1922) the increase of the density of the city centres and the improvement of the circulation, increasing thus the amount of open spaces. The construction of skyscrapers on a small percentage of the total ground area was proposed, with a distribution of land uses that followed a rigid scheme of functional and socio-economic segregation. In 1930, he proposed the Ville Radieuse, taking his vision of a functional city further and abandoning the spatial hierarchies in favour of homogeneous functional zones of commerce, business, entertainment, residence, etc. (Le Corbusier, 1933).

Facing the ideas of Le Corbusier, Frank Lloyd Wright proposed a settlement pattern of small pockets of low-density development, favouring the development of the individual lifestyle and opposing highrise buildings and dense cities. This idea was called the Broadacre City and developed in several of its publications since 1932: *The Disappearing City* (1932), *When Democracy Builds* (1945), and *The Living City* (1958). The proposal was characterised by a grid of street with one acre building plots, which was considered the minimum land area for each family, where preferably detached family houses would be erected. Wide-spread motorisation and adequate road infrastructures were necessaries for the scattering in order to work against overcrowding of cities, so large highway corridors were proposed.

[27] The Athens Charter was not actually published until 1942 by J.L Sert and Le Corbusier. It takes its name from the location of the conference, which took place on board the SS Patris II travelling from Marseilles to Athens and back.

After World War II, some ideas about spatial organisation were presented in order to rebuild destructed cities. Göderitz, Rainer and Hoffmann (1957) proposed hierarchically structured combinations of elements, where small neighbourhoods were aggregated to larger units and central facilities on each level. Several examples were planned in London and its surroundings (London City Council, 1961), where a linear central axis (city centre) was combined with adjacent different industrial and residential areas that were connected to it, creating a Comb-like Structure.

Mixed use areas and high density neighbourhoods were proposed as an alternative to the functional cities in the 1960s and 1970s. In the 1970s and 1980s, the New Urbanism[28] movement in the Unites States aimed to build neighbourhoods based on historic urban patterns, reinforcing city centres instead of constructing new suburban satellite towns. High densities and mixed uses decreased travel needs, while transit and non-motorised travel modes promoted sustainable cities.

CONTEMPORARY PROPOSALS

Urban development changes and transformations have been accelerated since the 1973 oil crisis and the industrial decline (Capel, 2003a). This has produced in turn, new urban realities that are mainly based on the previously mentioned land-use transport models.

The Compact City is probably the most efficient land-use transport system (European Commission, 1990). It is based on relatively high densities and mixed uses, reducing the expansion of urbanised areas and protecting the surrounding environment. Public transports and non-motorised transport modes are encouraged, favouring a less automobile dependency model with intensive land use patterns and a predominantly monocentric urban area.

At the opposite end, dispersed development is characterised by low densities, high consumption of land and high private vehicle dependency. This type of proposals were developed due to the continuous decentralisation processes that move population and industry to peripheral areas, terciarisation of city centres, highway constructions, etc. (Capel, 2003b). The background of this type of development could be found on the previous Howard´s Garden City or Wright´s Broadacre City.

Some other derived models of the dispersed development are the more recent Middle Landscape proposed by Peter G. Rowe (1991) as an optimal balance of the qualities of both urban and rural areas, or the Edge City of Joël Garreau (1991), characterised by the concentration of business and retail facilities around a highway intersection of a metropolitan area (Garreau, 1991; Rowe, 1991).

Land-use transport systems based on polycentrism are halfway between the Compact City and dispersed developments. Some of the late 19th urban expansion features lead to the emergence of this concept. The absorption that many cities had made in their peripheral municipalities, which in some cases could have

[28] The Congress for the New Urbanism (CNU) founded in 1993 created a charter of principles, called Charter of the New Urbanism, that reads as follows:

> We stand for the restoration of existing urban centers and towns within coherent metropolitan regions, the reconfiguration of sprawling suburbs into communities of real neighborhoods and diverse districts, the conservation of natural environments, and the preservation of our built legacy.
> We advocate the restructuring of public policy and development practices to support the following principles: neighborhoods should be diverse in use and population; communities should be designed for the pedestrian and transit as well as the car; cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions; urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice. (Congress for the New Urbanism, 1996; Congress for the New Urbanism, 2000)

a certain size and autonomy, hinted a polycentric expansion (Capel, 2003b). Polycentrism or decentralised concentration promotes densification of some suburban or high territorial accessibility areas, such as suburban employment and business centres. It is based on the fact that a compact city has high congestion levels, while a polycentric system permits to ensure the preservation of environmentally sensitive areas and promote non-car transport modes (Wegener & Fürst, 1999). The creation of new peripheral areas, where offices, commerce, leisure activities, etc. are located, has promoted the creation of peripheral subcentres and the polycentric structuration of the metropolitan area, without questioning the central hierarchy (Capel, 2003b).

IDEAL LAND-USE TRANSPORT SYSTEMS

Since the late 19th century, several ideal proposals were presented as optimal solutions for the land use and transport problems. These ideal land-use transport systems were different depending on density, spatial structure, land-use distribution or transport modes (Wegener & Fürst, 1999). Some of them evolved from earlier proposals and all of them were based in one of three different basic geometric structures: nodal, oriented towards a point or centre (Compact City); linear, built along an axis (Linear City); and surface, with low densities and without any predominant centre (Broadacre City). From these three basic types several hybrid models were created, such as the middle landscape, decentralised concentration or axial system. Albers (1974) represented the relations between the previously presented land-use transport systems (fig. 1.50) and Moreno (2013) also created an interesting diagram (fig. 1.51) based on Albers.

In this framework, the dispersed development and its variations are commonly presented as the less favourable in relation to the land or energy consumption, average trip length or greenhouse gas emissions. However, there is no clear evidence referring to the compact city or decentralised concentration models. Furthermore, the suitability of each land-use transport system depends on several specific issues of each case, such as population or pre-existing spatial structures (Wegener & Fürst, 1999).

Finally, another distribution of cities was made by Newman and Kenworthy (1996) depending on transport modes, defining the characteristics on each of them:

- The walking city: This type of cities still exists today and are characterised by high density, mixed uses and organic structure.

- The transit city: In the case of trains, sub-centres that are based on walking distances are usually created around the railway stations, while in the case of trams linear developments that followed the routes are created. They are characterised by medium density and mixed uses and they are centralised and grid based.

- The automobile city: The urban settlement can be developed in any direction by means of private vehicles (and buses). This type of city is characterised by low density and separated uses, and it is decentralised and arterial grid or dead end based.

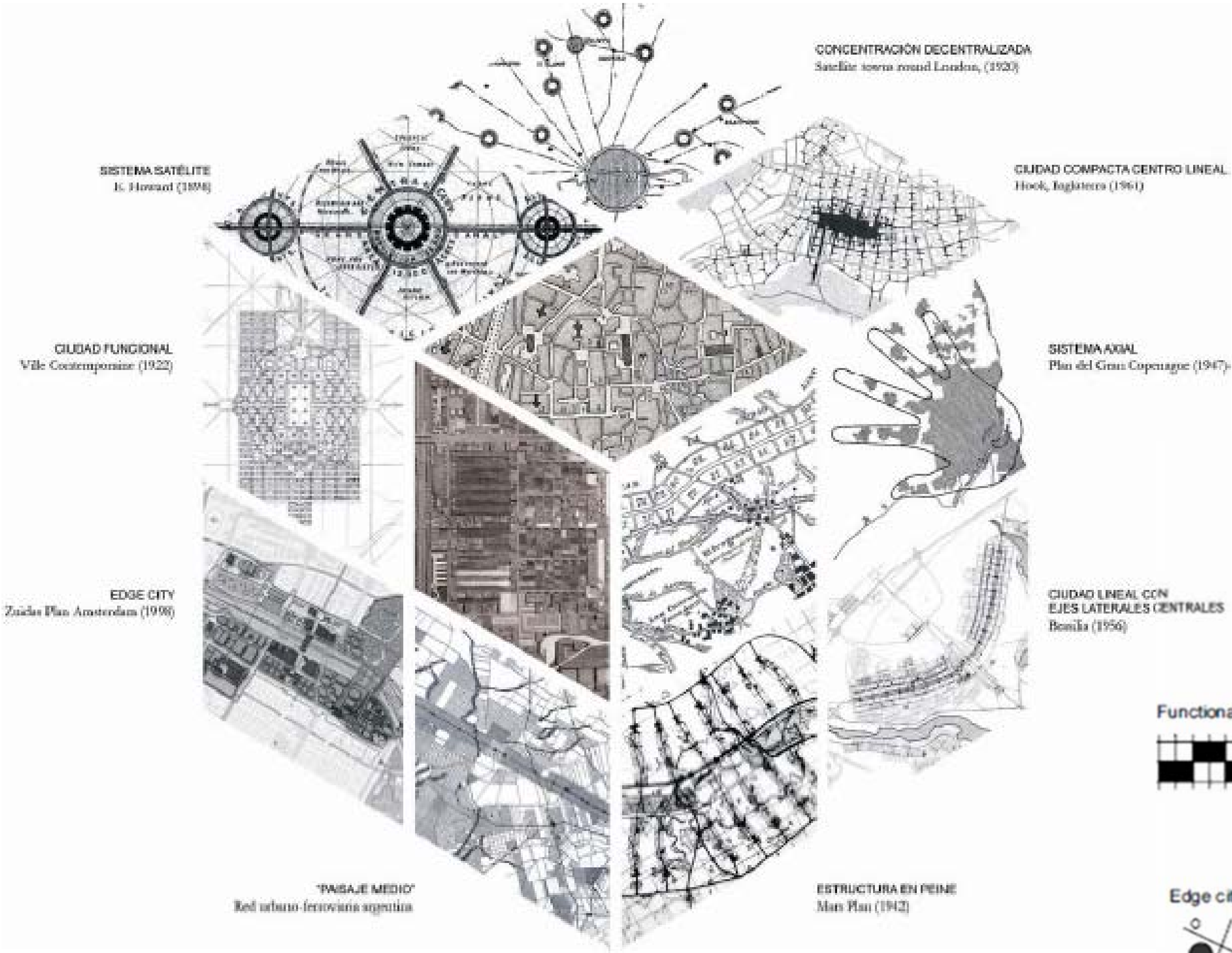
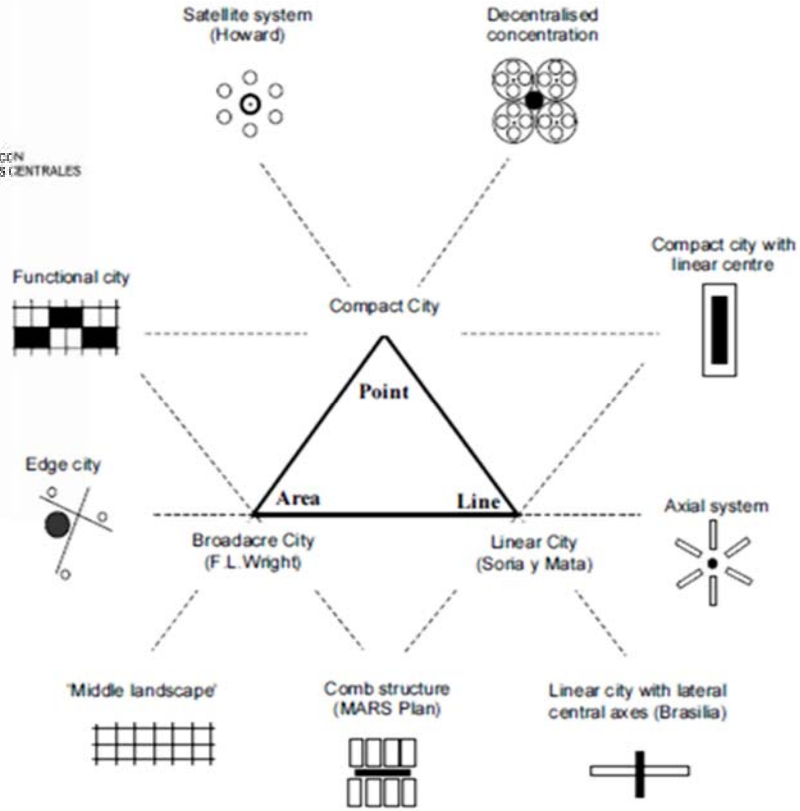


Figure 1.50 Diagram of the typologies of land use organisation patterns (below). (Albers, 1974)

Figure 1.51 Diagram of the typologies of land use organisation patterns (left). (Moreno, 2013) based on Albers.



1.3.3. Transit Oriented Development (TOD)

The compact city seems to be sensible in structurally limited urban systems but otherwise, developments based on high accessibility to transportation nodes seem to be adequate in order to cluster current urban deconcentration processes (fig. 1.52). This kind of model is called deconcentrated clustering (Bertolini, 1999) or Transit Oriented Development (TOD).

A public transport-oriented development at the scale of the urban region has been frequently suggested in literature (Bertolini, 1999; Breheny & Rookwood, 1993; Calthorpe, 1993; Curtis et al., 2009; Hall & Ward, 1998; Owens, 1992). Nowadays, TOD policies have been implemented in several cities and metropolitan areas all over the world: Curitiba, Arlington (fig. 1.53), Portland, Calgary, Vancouver, Zurich, Stedenbaan in Randstad, Stockholm, Perth, Singapore, etc. All of them are based on the concentration of urban developments around transit stations in order to support transit use and the development of transit systems to connect different urban developments (Curtis et al., 2009).

The term TOD was coined by Peter Calthorpe in his book *The Next American Metropolis: Ecology, Community, and the American Dream* (1993). According to Calthorpe "a Transit Oriented Development (TOD) is a mixed-use community within an average 2,000-foot walking distance of a transit stop and core commercial area. TODs mix residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot, or car." He claimed that a walkable environment is able to control urban sprawl and reduce car trips, becoming a key characteristic of TODs. In this regard, TOD is understood as an alternative to car dependent sprawled realities (Bertolini, 2006).

Using the same approach, Cervero (2009) defined the concept of TOD as follows: "concentrate a mix of moderately dense and pedestrian-friendly development around transit stations to promote transit riding, increased walk and bicycle travel, and other alternatives to the use of private cars". He mentioned that historically, Asian cities have been transit oriented in a way, characterised by mixes of land uses, and high amount of pedestrian or cyclist pathways and transit services.

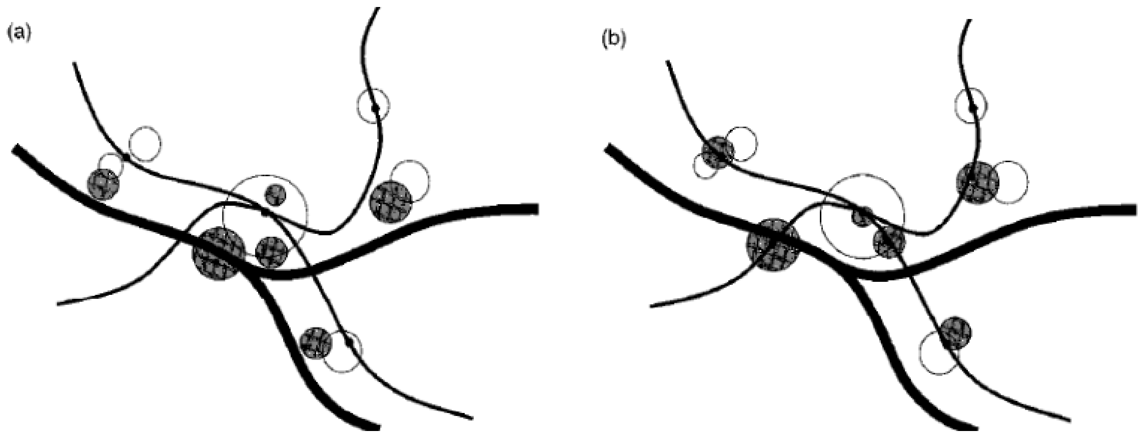


Figure 1.52 Compact city policies versus public transport oriented development policies (Bertolini, 1999)

(a) Compact city policy: build in or next to the existing city
(b) Public transport-oriented development built within walking/cycling distance of station.

existing urban area
future urban area
railway
motorway

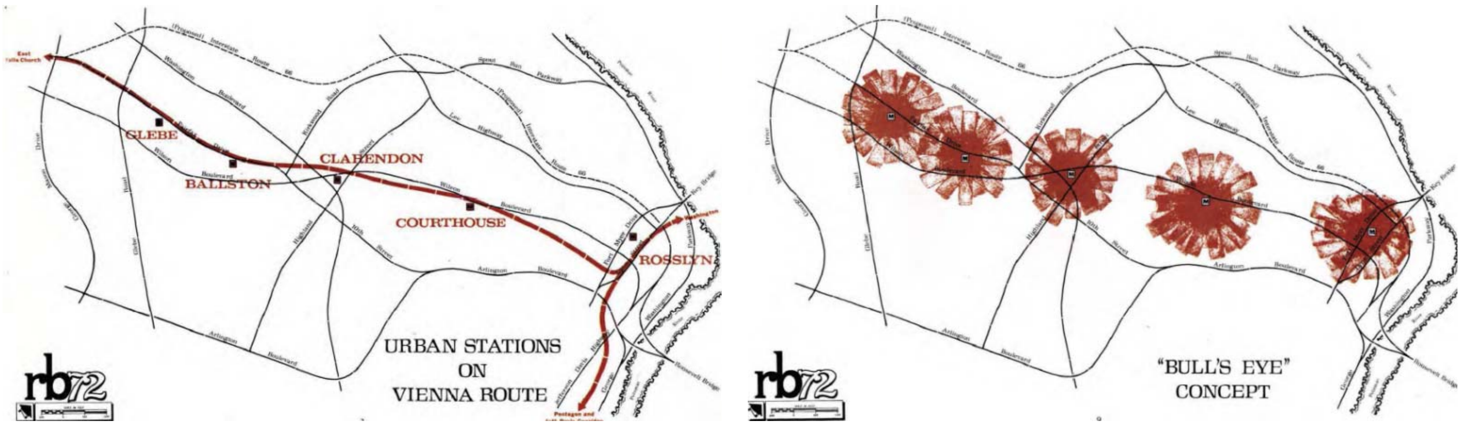


Figure 1.53 Arlington bull´s eye concept. They were practicing TOD before this term even existed. Arlington County, Department of Environmental Affairs Planning Division: Rosslyn Ballston Commercial Corridor Study (1974)

In contrast to the definitions focused on physical characteristics, Dittmar and Poticha (2004) claimed that TOD concept should be used in the projects that are able to achieve the following five goals: location efficiency, rich mix of choices, value recapture, place making and resolution of tension between node and place.

In general terms, TOD is an integrated approach to transportation and land-use planning (Schlossberg & Brown, 2004). At a regional level, they are nodal systems that, in contrast to linear corridors, support the development and efficiency of regional transport infrastructures (Moreno, 2013). A main rail corridor creates the connection with the surrounding territory, while a secondary distribution network enables the access to TOD neighbourhoods (fig. 1.54). Land use features have been also defined for the different sectors of the TOD model (Calthorpe, 1993; Moreno, 2013):

- Urban TOD: It is organised around a railway station of the main transport corridor and it works as an employment cluster with moderate residential density.
- TOD neighbourhood: It is located 4.6 km from the main transport corridor and connected by a distribution transport network. It has public facilities in addition to moderate residential density.
- Commercial core: It is located close to the intermodal station and is provided with local or regional public facilities and local commerce.

-TOD residential area: It is located 600 m from the accesses of the transport network and it has high density and mixed uses. Secondary residential areas are located 1.6 km from the commercial core and have low residential densities or production areas.

In that framework, there are several arguments that support the use of TOD models, such as the increase of accessibility, the promotion of more sustainable urban transport modes (transit and non-motorised modes) and the increase of quality of life (a degree of human interactions in the public domain) (Bertolini, 2000; Curtis et al., 2009).

In the interaction between transport and land uses two correlations need to be taken into account for TOD proposals according to Curtis et al. (2009) (fig. 1.55). The first one is related to the correlation between transportation speed and its

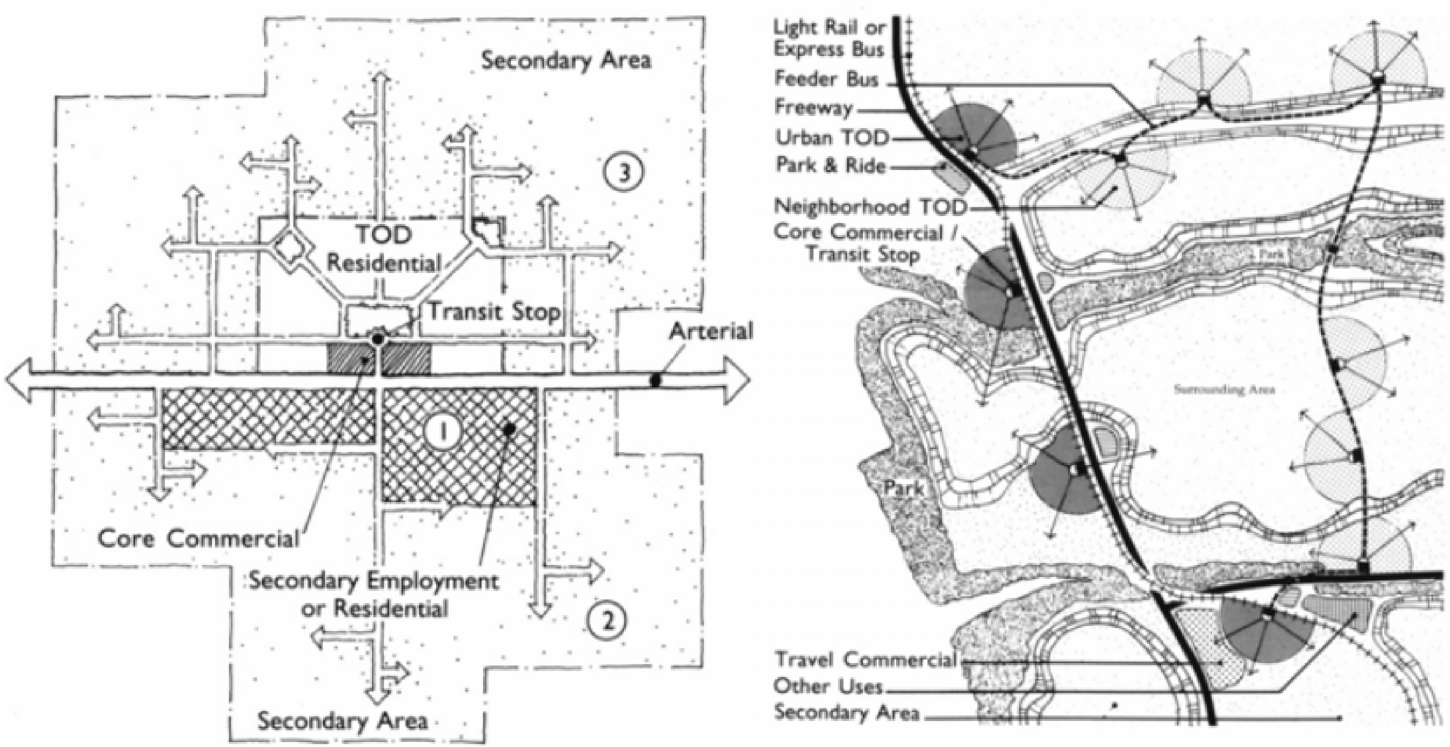


Figure 1.54 Conceptual Design schemes for TODs. TOD as a walkable scale community (left) and TOD as part of a regional network (right) (Calthorpe, 1993)

spatial extent. The second one refers to the flexibility and capacity of the transportation and the degree of spatial concentration of activities. Different transport modes are classified in reference to these correlations and TOD proposals follow a combination of transit and non-motorised transport environments. Transit modes have similar speeds than car, higher capacity, but lower flexibility, while non-motorised modes have lower speed and spatial reach but higher flexibility. The combination between them needs short distance or high density spatial patterns in order to be successful. Accordingly, TODs aim the increase of densities and mixed uses in terms of land use. Higher flexibility in transit modes and effectiveness in non-motorised modes (speed) are pursued in terms of transport challenges (Curtis et al., 2009). In this regard, railway stations and their surroundings are understood as strategic elements to achieve a sustainable development. The spatial implications of the strategy of land use and transport integration are represented in fig. 1.56.

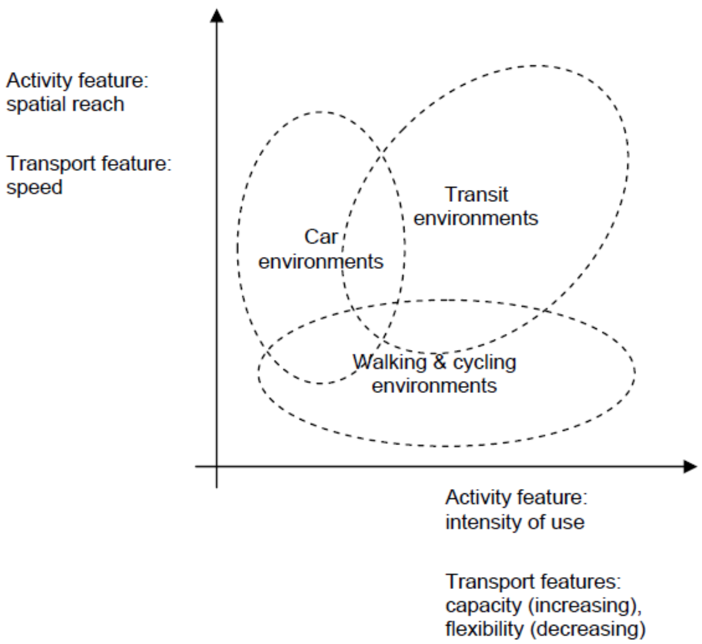
As integrated transport land-use projects, TODs take into account and can achieve different types territorial interactions, such as:

> the market-driven changes in activity location and land values around the stations; contributions of stations to the *urban quality* of the surrounding area; the *branching out* of the rail network to connect existing major concentration of activities; the location of

new activities around existing lines/stations and the proposal of new area development plans in connection with infrastructure developments. (Cascetta & Pagliara, 2009)

Hence, TODs aim sustainability and accessibility principles. Moreover, TOD supporters have strong sense of community, promoting social interaction and multicultural and socio-cultural diversity. According to Rice they are people who appreciate that it:

- Reduces reliance on cars, which has substantial environmental and social benefits.
- Improves the viability of public transport and so facilitates the provision of better public transport services.
- Enables a more compact city, providing housing and development opportunities without adding to city sprawl.
- Enables more affordable housing. A basic apartment in an activity centre takes up less land and should be able to be provided more economically than an outer suburban greenfield development.
- Creates more activity and vibrancy and community life in a centre by having more people living closer together, who are walking, cycling, catching public transport and generally interacting with each other much more than if they lived further apart.
- Improves the economic viability of businesses in the centre by creating a bigger market with easy access for their products.
- Can revitalize older centres and shopping strips that have struggled to complete with car based shopping malls.
- Brings new development to replace areas which are perceived as being old and rundown.
- Offers more intensive development that would otherwise be considered as inappropriate if it was car dependent. (Rice, 2009)



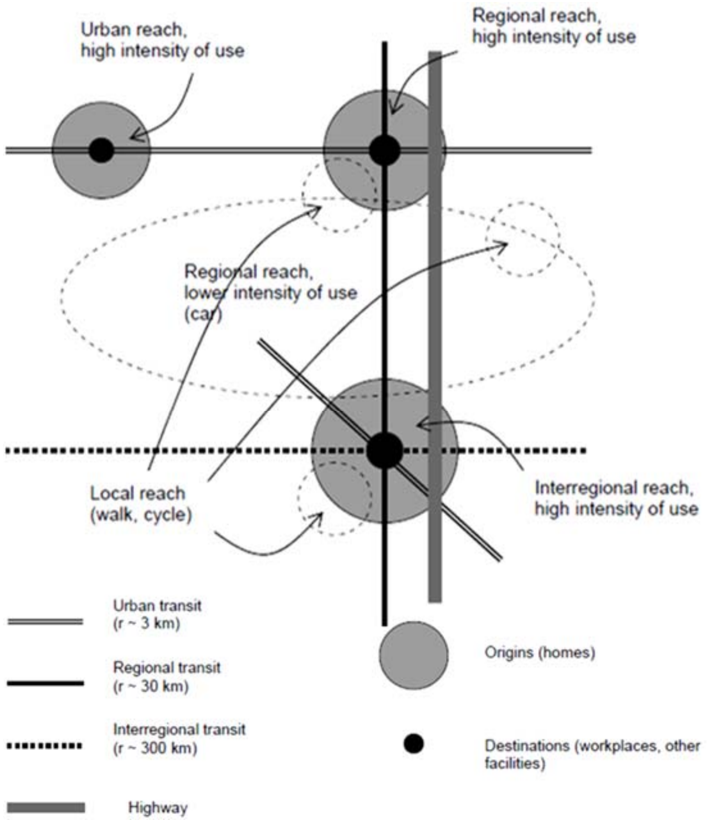


Figure 1.55 Transport and land use correlations (left) (Curtis et al., 2009)

Figure 1.56 Representation of implications of land use and transport integration strategy (right) (Curtis et al., 2009)

Finally, in the integration of land use and transport issues, TODs are presented as dual nature elements (node and place) (Bertolini & Spit, 1998; Bertolini, 1999). The public transport station aims to connect people with other destinations as a node. Meanwhile, the same area becomes a destination itself as a place where activities occur. Hence, a node-place model is presented by Bertolini (1999), where two typical scenarios are identified. On the one hand, in the strong node and strong place situations, the demand for both urban activities and transportation services is high. On the other hand, in the weak node and weak place situations, although both demands are low, the struggle for space is minimal, so it is also considered an ideal scenario.

With regard to the research framework, disused railway lines and their stations could have an important role in the previously mentioned balance between transport and land uses in order to achieve a more sustainable development. On the one hand, the disused line could be part of the current transport network, creating a secondary non-motorised network that is able to structure the territory around it in a local or territorial level, but is out of reach of other large infrastructures of regional or global nature. On the other hand, each disused railway station or area could be part of the new network while an activity destination itself. In this regard, a disused railway system could be analysed in a similar way of a TOD, where each former station area is defined taking into account its node and place characteristics. The main difference is presented in the scale of action.

1.4. Conclusions and definition of objectives

1.4.1. Conclusions

Conclusions referred to both the three studied sections and a general approach of the future of disused railway lines are presented below. The first studied section focuses on the definition of the subject of study and the study of the existing proposals, while the other two focus on the definition of the future approaches and opportunities that disused railway lines can include.

HERITAGE SYSTEM

The broad nature of the concept of heritage has been recognised in the last decades. Moreover, its territorial character has been also assumed in several cases. In this framework, this research focuses on the study of a specific type of heritage (railway heritage) that is nowadays identified as industrial or public works heritage. Its territorial approach (territorial system) has made possible, besides, its recognition as linear landscape and its proposition as cultural route. As a result, disused railway lines have been defined as heritage systems, where the each heritage element is part of the same territorial complex.

The broad concept of heritage and its territorial character are clear steps for a comprehensive vision of this heritage. Nevertheless, the actions taken for their protection, restoration and enhancement, are fulfilled in some isolated elements. Accordingly, it is necessary to understand this heritage in its broadest and comprehensive concept, taking into consideration both the value of the heritage elements themselves and the relations with their surrounding territory and the society they can serve. Only then, an integrated view and, hence, an integrated and crosscutting management may be obtained, and the mismatch between theoretical and practical achievements may be reduced.

NON-MOTORISED AXIS

On the one hand, as transport axes, disused railway lines have been presented as an opportunity for the insertion and promotion of sustainable mobility models based on active or non-motorised transports. Active transports can include trips related to both everyday uses of daily necessities and leisure or recreational occasional activities. In this regard, greenways or rail trails based on old rail infrastructures are already well known, which are non-motorised transport infrastructures mainly related to leisure and tourism.

On the other hand, as territorial axes, the regional planning has shown several territorial opportunities related to disused railway lines. In general, railway lines are able to structure their surrounding territory and disused railway lines could recover this capability, being interesting for regeneration of areas at different levels. In particular, connections between urban and rural areas can be reinforced by means of the reconversion of disused railways. In this regard, DRLs located in the Basque-Navarre territory —a varied territory composes of urban and rural areas— are inserted in a polycentric territorial structuration where urban/rural links encourage both areas, so special attention should be paid to the urban/rural limit. Furthermore, transformation axes of the Basque regional planning are also considered interesting for reconversion of disused railway lines.

Accordingly, disused railway lines can be understood as elements that can promote connections in the territory they go through, creating linear development axes that structures the settlements located around them (both urban and rural). This is possible by means of the reconversion and reuse of the railway heritage and based on sustainable development principles.

INTERACTION BETWEEN TRANSPORT AND LAND USES

The interaction between transport and land uses, and a need of balance between them have been presented in the theoretical framework. In this regard, historical and current development proposals have tried to create ideal land-use transport systems. In the latter, the compact city or partially compact proposals —such as polycentrism or Transit Oriented Development (TOD)— have been favoured looking for a more sustainable development.

In this regard, disused railway lines can work in a similar way than a TOD, although based on other type of transport (active or non-motorised transport) and scale (local or interurban scales). Built railway heritage elements, in turn, can operate as the central node of each development area.

DRLs AS ACTIVE TRANSPORT SYSTEMS IN A SUSTAINABLE DEVELOPMENT FRAMEWORK

On the one hand, disused railway lines should be considered as heritage systems in order to develop their study in a comprehensive way and propose actions in the same way. A comprehensive analysis is essential to come up with integrated reconversion proposals. On the other hand, disused railway lines are considered suitable axes to create non-motorised infrastructures, which are conducted by the regional planning.

Nevertheless, new analysis methods are necessary for the comprehensive study of disused railway lines, taking into consideration the territorial scale of the railway path, but also the local scale of each railway node. The latter should be understood as catalysts for development in their surrounding areas, both as transports and land uses.

Therefore, a methodological proposal should be created to comprehend DRLs as active transport systems in a sustainable development framework, based on facts that disused railway lines 1) must be understood as complex heritage systems, 2) may have potential as non-motorised transport systems and 3) must ensure a sustainable development, keeping a balance between transports and land uses.

1.4.2. Main hypothesis and objective

Taking into consideration the initial problem and the conclusions of the theoretical framework, this research hypothesizes that disused railway lines could operate as non-motorised transport infrastructures, attending both leisure and daily activities, and structuring its surrounding territory, giving rise to more sustainable development models.

Accordingly, the main objective and two requirements are defined:

- Creation of a methodological proposal for the analysis of disused railway lines as complex systems in order to show their potentiality in their territory (territorial heritage axes), covering new uses beyond the current greenways while promoting the preservation of the railway heritage.

- The method should be applicable to other disused railways or even adaptable to other linear elements. In this regard, same variables and indicators may be maintained or they may be adapted depending on the conditions of each case.

- The method should be open, i.e. it should be easily updatable in order to represent the overall perspective of the railway line and its territory at any time, and to show the next step to be taken. On the one hand, disappeared elements should be easily included in the method, since passage of time is one of the enemies of this research. On the other hand, investments undertaken could also change the future approach of the disused railway, being necessary to include each of these actions.

2. METHODOLOGICAL FRAMEWORK

This framework comprises the methodological aspects that each of three the theoretical approaches could include for the analysis of disused railway lines. Accordingly, the concept of system and its analysis are looked through, the concept of accessibility and its analysis are studied in literature and the node/place model and its variants are presented.

2.1. DRLs as systems in the territory: multiple analysis areas and scales

The railway has already been presented as a territorial system. However, it is interesting to define the concept itself and to study the necessary analysis models in order to address properly this research.

2.1.1. The concept of system

The General Theory of Systems was originally proposed by the biologist Ludwig von Bertalanffy in 1928, and developed and published in 1968. He proposed that two assumptions related to the "scientific method" were wrong. One was that a system could be broken down into its components and each of them could be analysed independently. The other says that these components could be adjoined linearly to describe the whole system. According to Bertanlanffy, a system cannot be defined or characterised from its elements in isolation, but from the parts and the interactions between them, hence the phrase "the whole is more than the sum of parts" (von Bertalanffy, 1968). The same statement was used by Joaquín Sabaté to claim that cultural landscape is a key element in effective regional development, since using a regional approach to cultural landscapes can create more opportunities (Sabaté & Schuster 2001). The understanding of the broad concept of heritage and its comprehensive study, hence, are essential to create future proposals that, in addition to preserve the heritage elements, promote territorial goals.

According to Josep Maria Montaner, too much emphasis was historically placed on objects in architecture, leaving the relations between them in the background. Hence, it would be interesting to analyse the organisation of each system and the interactions that are created with its surrounding environment in architecture or urban planning. As Montaner claimed, a system is a set of interrelated heterogeneous elements of different scales that have an internal structure that adapts strategically to the complexity of the context. Together they constitute a whole, which is not explained by the mere sum of its parts, since each part of the system is based on another, so there are no isolated elements (Montaner, 2008). Therefore, it might be said that a system is a complex set of interacting elements.

In this regard and referring to disused railways, it is necessary to know and comprehend the elements which were involved to achieve the interconnection, in order to understand the whole system (Ferrari, 2010), since each element becomes meaningless outside the set to which it belongs. Hence, it is not possible to analyse railway heritage elements by the sum of the different buildings and elements, since they are part of a bigger group or system. The small railway elements, buildings, settlements and even the railway tracks are part of the same system. What is more, the set of built railway heritage acts as part of the system, where the line gives meaning to all elements, being its connection ability the most favourable feature to consider (Llano-Castresana et al., 2013). As Ferrari said, a bridge is part of a territorial system rather than an isolated element and that is where the linear infrastructure takes value (Ferrari, 2012). In the same way, Soria claimed that a road traffic bridge, in addition to be analysed as a heritage element, should be analysed as a singular point of a road that is in turn, part of a specific network (Soria, 1997). This last statement could be easily extrapolated to disused railway elements.

As a result, a system in which the value comes from the existence of a structured set with a global significance is formed (Porcal, 2011) and the principal value of its set of components is being an integral part of a whole (Ferrari, 2011). In this regard, José Ramón Fernández Molina presented historical industrial enclaves as Territorial Heritage Systems, which are defined as integrated heritage bodies of cultural interest elements in order to achieve a comprehensive management at territorial level (Fernández, 2010).

Taking all the above into account, the considering of the railway heritage as a whole is a way to enable these enclaves to be integrated effectively into urban and territorial dynamics (Tarchini, 2010).

2.1.2. Application of the system approach

The General Theory of Systems has been applied in several scientific fields, such as systems engineering, information theory, computing or biology and has been used to analyse a broad field of practical issues, such as environmental systems or Neuro-Linguistic Programming. The same theoretical approach could be used to study a railway system or a disused railway system of a territory. For that purpose, the elements that are part of the system and the relations that are created between them need to be analysed.

In this regard, first initiatives have already been created for the development of a methodology to encompass heritage linear infrastructures from a territorial approach and, hence, taking into consideration their system nature.

On the one hand, Ferrari (2010) analysed a former Argentinean railway and its organisation model assuming the concept of system and defining three different systems at different scales: territorial system (railway track), settlement system (towns) and architectural system (buildings and support facilities). All of them are, in turn, part of the whole railway system and could be presented as subsystems. Historical method was used to create a three level model, and analytical and synthetic method was used for the analysis of the railway heritage, taking into consideration both the elements that are part of the system and the relations that are created. This relations however, refer to ones that the railway had when it was in use. Conclusions obtained for this analysis are summarised in table 2.1.

The research carried out by Ferrari focused on the impact that the railway had on its surrounding in its creation and development. The current disused railway system and its main features are the result of all these implications. For the creation of future comprehensive enhancement proposals however, the existing elements of the system and the relations that can be created between them need to be studied. These relations should include the ones that are created in their environment. A disused railway system (if it is totally disused) does not create any relation in its surrounding territory, but potentiality of the system can be measured.

In this framework, Llano-Castresana (2017) proposed a methodology for the assessment and reconversion of former railway stations, based on the one hand, on the analysis of the heritage value, conservation state and current use of the building itself, and on the other hand, on the possibilities that their surrounding territories could provide. A wide range of criteria are considered for measuring the heritage value, such as the architectural interest in the railway area, the historical and technological value, the value of the constructive systems, the authenticity and attractiveness, the system value or the maintenance of the original identity. Nonetheless, the analysis of the territorial approach is mainly limited to the identification of the social identity level related to these heritage elements.

On the other hand, methodologies for the identification, classification and assessment of road heritage (Ruiz, 2016; Ruiz et al., 2014) and the characterisation and visualization of those heritage roads (Loren-Méndez et al., 2016) have been created. Assuming the territorial and system nature of these linear infrastructures, the whole corridor is considered as heritage area and, assessing the different elements of the system, both the natural environment and heritage assets created by human activities (Loren-Méndez et al., 2016). The study focuses on the heritage element and their protection aspects, or on the identification of different integrated heritage configurations or "heritage sequences", but it does not consider any other transport or land use features of the heritage area that can result interesting for the future of the heritage roadway corridor.

In this regard, disused railway studies are mainly focused on the heritage elements of the system itself or the historical relations that the railway create, while road infrastructure studies include territorial features that are able to comprise the whole heritage corridor. Nevertheless, there is a lack of studies where the system nature of the heritage linear infrastructures is considered, taking into consideration the element of the system but also the relations that can be created in the territory, in order to measure the possibilities they offer in the future.

TERRITORIAL RAILWAY MODEL	MODEL OF SETTLEMENT SYSTEM	MODEL OF ARCHITECTURAL SYSTEM
Planning and implementation of railway lines that structure the territory linking some existing urban areas	Station location planning	System components planning depending on the needs of each station
Establishment of strong and dynamic relations between towns or extraction/production centres that are linked to the railway	The search for additional relationship in the extractive-productive chain	Functionality and rationalisation of system components
Planning and establishment of strategic economic points	Railway stations and their dwellings and neighbourhoods as first settlements	Methodological spatial design of the station area
Adaptation of topographical constraints to strategic points	Consideration of the resources for subsistence in addition to the topographical constraints.	Accurate rationality in the architectural forms
Repeated spatial planning	Repeated spatial planning to conceive a village	Repeated spatial planning: the use of typologies
Connection between extraction/production centres and ports	Diachronic urban growth	Design criteria: modulation and repetition
Conception of nodes	The railway line is an structuring element of the city while the passenger building is an emblematic element	Means of expression: standardisation and industrialisation
Establishment of international linkages	Grid based development	Tradition is sustained in parallel with new architectural concepts
Regulation and control	Central location of the station	Rational use of materials
Construction of a country	Creation of new squares	Creation of new symbols and significances

Table 2.1 Analysis of a railway system taking into consideration three subsystems at different scales. Prepared by the author on the basis of the conclusions of Ferrari (2010)

Finally, linear cultural landscape studies and proposals, such as the ones related to river corridors, have been created in the last decades. In this regard, the Polytechnic University of Catalonia (UPC) and the Massachusetts Institute of Technology (MIT) proposed a two vision methodology for the development of a cultural-resource-based planning framework for a region, in that case, the Llobregat River Corridor in Catalonia (Sabaté & Schuster 2001). For that purpose, they previously analysed several precedents of regional development initiatives along river corridors or focused on industrial heritage and agricultural heritage resources in Unites States and Europe.

The UPC vision was based on the study of the natural and cultural heritage structures in order to propose thematic units along a heritage route (Sabaté & Schuster 2001). As a natural corridor the topography of the valley and the water characteristics are studied, while as a cultural corridor urban systems, resource distribution and local and regional accessibility are considered. Accordingly, several thematic units that represent the history of the area and the comprehensive interpretation of the river are proposed (fig. 2.1) taking into consideration several selection criteria: uniqueness of the heritage, supramunicipal scale, consistency of local promotion and connection between the thematic unit and the river. Interventions in these units are developed by project units (zones or articulations depending on the supramunicipal or local scale) that are identified after an exhaustive study of each thematic unit (fig. 2.2). This study focuses on the one hand, on the area and consistency of the unit, and on the other hand on the identity and connections that exist in the unit.

Meanwhile, the MIT vision defined several principles for regional development (based on previous experiences) and studied the existing resources in order to propose geographic and thematic areas along the river (Sabaté & Schuster 2001). As resources, natural resources, cultural resources, and transportation infrastructures and waterways are considered. The thematic areas are able to represent the "Story of the

Figure 2.1 Thematic units of the Llobregat Corridor according to the UPC vision (below). (Sabaté & Schuster 2001)

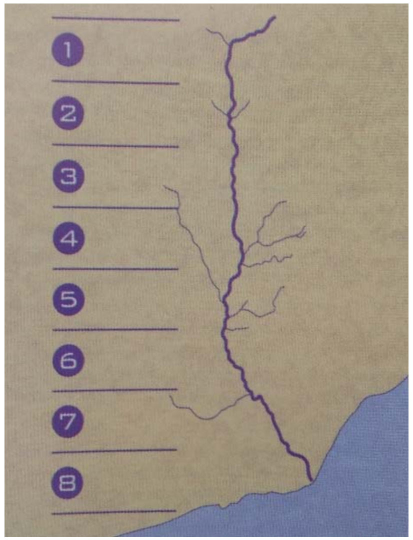
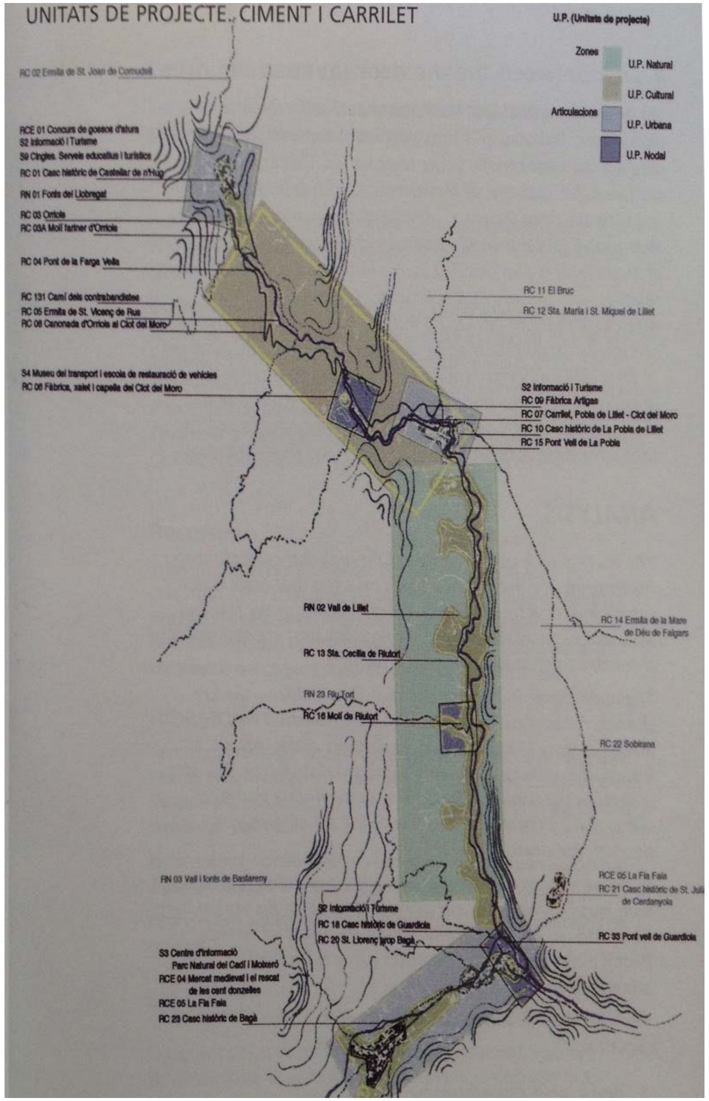


Figure 2.2 Analysis of a thematic unit of the Llobregat Corridor according to the UPC vision (right). (Sabaté & Schuster 2001)



River” and are grouped in broader tiers that refer to the different natures of the river and show different potential for regional development (fig. 2.3).

The two visions present a comprehensive approach of the corridor but, in turn, identify areas that represent singularities that need to be taken into consideration and that could support similar intervention guidelines for their future approach. Similarly, in the case of the DRLs, the identification of different zones and subzones may be necessary for the development of different approaches and scales of future interventions.

Figure 2.3 Thematic units and the three tiers of the Llobregat Corridor according to the MIT vision (Sabaté & Schuster 2001)

2.2. DRLs as non-motorised axes: accessibility analyses

As presented in the previous point, relations between the elements of a system or with the surrounding territory need to be analysed in order to comprehend the whole system. Accessibility analyses permit to study the relations between the disused line (old railway path) and its surrounding environment. In this case, this accessibility is related to non-motorised transport modes, since it has been assumed the appropriateness of disused railway infrastructures as non-motorised transport elements.

2.2.1. The concept of accessibility

Accessibility has been studied from decades ago in geographical studies and urban planning issues (Stewart, 1947; Wickstrom, 1971) and Lynch (1981) considered accessibility as one of the main factors of the urban spatial form. Although it is a frequently-used concept in a number of scientific fields, its definition could differ depending on the goal of the study or its perspective. In this way, several definitions of accessibility are found in literature depending on the combination of the number of elements or components that it includes.

Accessibility is commonly defined as the ease, with which any land-use activity can be reached from a certain location and with a certain transport system (Dalvi & Martin, 1976; Morris et al., 1979), thus including two principal elements: transport element and activity element or destinations (Burns, 1979; Vickerman, 1974). Although many other components have been included in order to offer a broader theoretical view of the concept, such as users viewpoint (Halden et al., 2003), characteristics of the destination or the objective of the trip (de Jong & Ritsema van Eck, 1996), they might also difficult the practical results. One of the best known and complete definitions was given by Geurs and Ritsema van Eck (2001) taking into account four different factors (the land-use component, the transportation component, the temporal component and the individual component[29]) and explaining the relations that are between them, (fig. 2.4). They defined accessibility as "the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)" (Geurs and Ritsema van Eck, 2001).

There are two main factors that are needed to take into account in this research regarding accessibility issues: transport mode (non-motorised) and analysis scale (multilevel approach). On the one hand, specific means of transportation studies, such as transit or non-motorised, has increased in recent years due to their importance as sustainable transport modes. Active-transport behaviour has been analysed by Millward et al., (2013) focusing on distances, durations, purposes and destinations, while Iacono et al., (2010) focused on the difficulties in calculating non-motorised accessibility making a distinction from motorised transports. Furthermore, Coutts (2008) applied a walk and bike model in an accessibility analysis of a greenway, claiming that a balance between how accessible

[29] - Transport component refers to "the disutility that individuals or groups experience in bridging the distance from their origin to destination using a specific transport mode, expressed in amount of time, cost and/or effort".
- Land-use component refers to "the magnitude, quality and character of activities found at each destination (e.g. jobs, homes, recreational facilities) and this component´s distribution in space".
- Temporal component refers to " the availability of opportunities at different time of the day (e.g. opening hours of shops) and the times at which individuals participate in certain activities (e.g. work, recreation).
- Individual component refers to "the needs, abilities and opportunities of individuals". (Geurs & Ritsema van Eck, 2001)

a greenway is and how accessible the greenway makes other destinations is needed. However, a multilevel approach is necessary in order to achieve a suitable characterisation of a linear infrastructure in a territory, particularly when the territory under study is diverse, from main cities to rural towns or protected natural areas. In this regard, on the other hand, multilevel accessibility analyses have been developed in literature, such as regional and local motorised accessibility by Handy (1993) or high speed railways accessibility by Ortega et al. (2012) at national, corridor and regional levels. Likewise, Garmendia et al. (2012) or Ureña et al. (2009) developed a multilevel analysis of high speed railways, while Ferrari (2010) developed a multilevel analysis of a disused railway system defining both, three different analysis scales, even though accessibility issues were not considered.

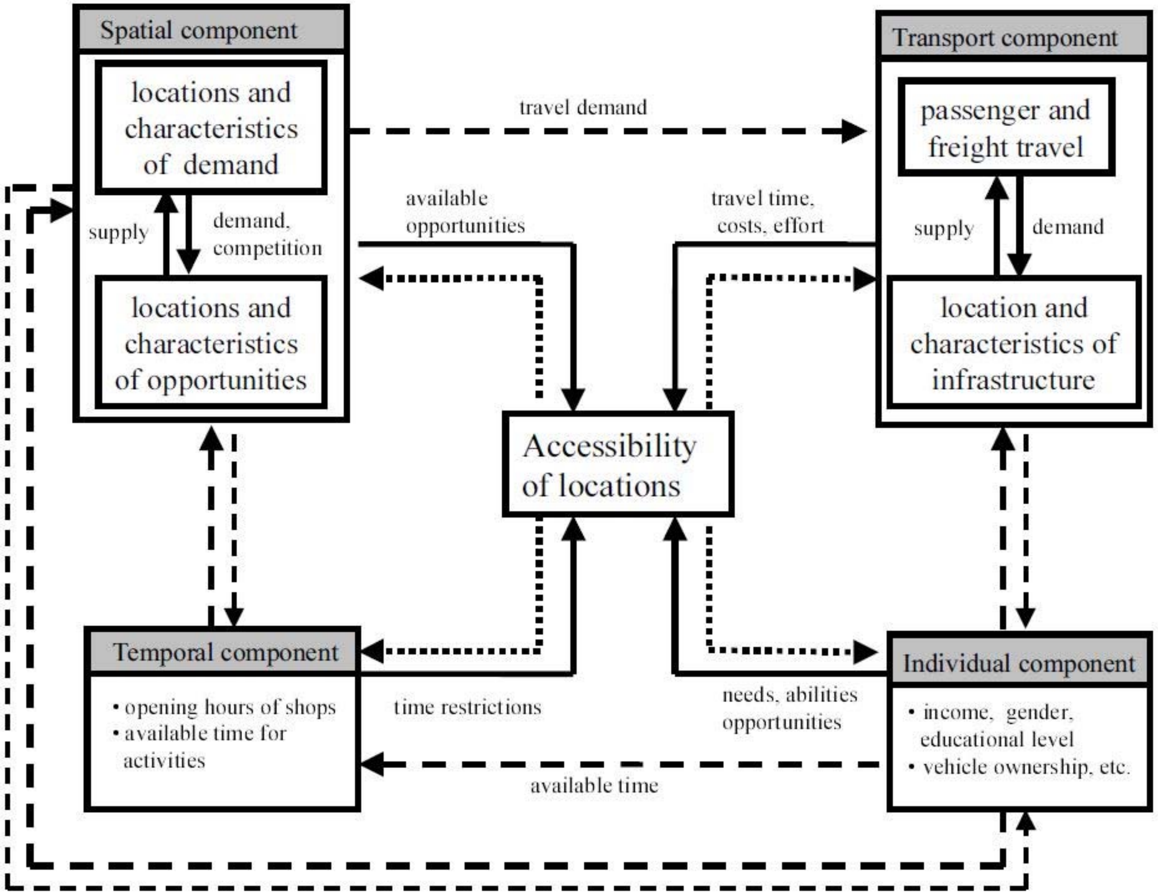


Figure 2.4 Relations between components of accessibility (Geurs & Ritsema van Eck, 2001)

2.2.2. Accessibility measures

The measures analysed in accessibility studies would depend on the perspective and components taken into account and have been deeply analysed in literature. Four measures have been defined as the most common by several authors: gravity potential, average distance between each origin and all facilities, minimum distance (the distance from an origin to the nearest facility) and the number of facilities within n metres (Handy & Niemeier, 1997; Talen & Anselin, 1998). Nonetheless, Geurs and Ritsema van Eck (2001) created the broadest classification based on the previously defined four factors and dividing the available measures in four perspectives: infrastructure-based measures, location-based measures, person-based measures and utility-based measures. In the following table (fig. 2.5), the different accessibility measures are presented in relation to the components.

Infrastructure-based measures are commonly used in transport planning and their target is to analyse the service level of transport infrastructures. Travel times, congestion level or operating speed on the road network, for example, are used to understand the operability or performance level. Although these measures do not satisfy most of the theoretical criteria,

measure \ component		transport component	land-use component	temporal component	individual component
infrastructure-based measures		average travel time; travelling speed; vehicle hours lost in congestion		peak hour period 24-hr period	trip-based stratification (e.g. home-work, business trips)
activity-based measures	geographical measures	travel time and/or travel costs between locations of activities, typically using a distance decay function	distribution of opportunities in space (e.g. number of jobs per zone or grid)	travel time and costs may differ between hours of the day, between days of the week, or seasons	stratification of the population (e.g. by income, educational level)
	time-space measures	travel time	distribution of opportunities in space	temporal constraints for activities and time available for activity participation are accounted for	accessibility is analysed at individual or household level
utility-based measures		travel costs between locations of activities, using a distance decay function	distribution of opportunities in space	travel time and costs may differ between hours of the day, between days of the week, or seasons	utility is estimated for population groups or at individual level

Figure 2.5 Type of accessibility measures and components (Geurs & Ritsema van Eck, 2001)

such as the land-use component, they are easy to interpret and operate.

Location-based measures are mainly used in urban planning and geographical studies to analyse accessibility at locations, i.e. the level of accessibility of a range of spatially distributed activities. Contour measures and gravity-based measures are two of the principal measures of this group. The simplest location-based measure (distance measure) was developed by Ingram (1971) and is defined as the connection level between two places or points on the same surface. When several destinations are analysed, a contour measure (Geurs & Ritsema van Eck, 2001) or cumulative opportunity model (Bhat et al., 2000) is derived, where the number of opportunities reachable within a given travel time, distance or cost are analysed by means of drawing one or more travel areas around a node (catchment areas). Meanwhile, gravity model (Bhat et al., 2000) or potential accessibility measures (Geurs & Ritsema van Eck, 2001) assess the accessibility of opportunities in a certain zone to all other zones where the size of the opportunity and/or the distance to the opportunities provide influences (Hansen, 1959). In this case, the catchment area is measuring the travelling impediment in a continuous scale. Distance and contour measures are easy to interpret but do not satisfy most of the theoretical requirements. Meanwhile, potential accessibility measures satisfy more theoretical criteria, although the interpretation and communicability become more difficult.

Person-based measures are originated in the space-time geography of Hägerstraand (1970) and their target is to analyse accessibility at an individual level. Spatial and temporal limitations are included, analysing accessibility from the viewpoint of individuals. This type of measure satisfies the theoretical criteria, but its operationalisation and communicability are quite difficult thus far.

Utility-based measures are typically used in economic studies and their objective is to analyse the economic benefits that people derive from access to spatially distributed activities. Accessibility is understood as the result of a set of transport choices. As in the case of person-based measures, utility-based measures are difficult to interpret because they fulfil most of the theoretical approaches (excluding the temporal characteristics). [30]

Finally, walkability or walk score-type measures were also included by Vale et al. (2016) in order to assess active accessibility, where in addition to features of origin or destination areas, route characteristics are considered.[31] In this regard, built environment characteristics can be included, which is closely associated to active accessibility (Vale et al., 2016).

As Bertolini et al. (2005) previously concluded, a balance is needed between a measure that is theoretically and empirically sound and one that is sufficiently plain to be usefully employed in interactive, creative plan-making processes. This research gets this balance using different measures in order to fulfil the requirements of each necessary approach.

2.2.3. Methods or tools for measuring accessibility

Network Analysis and Space Syntax are the two main techniques for assessing accessibility. The first one is based on distance measurement between elements, while the latter is based on

[30] Literature reviews made by Geurs and van Wee (2004) or Curtis and Scheurer (2010) could provide further information about different types of accessibility measures.

[31] Literature review of active accessibility made by Vale et al. (2016) and the theoretical-methodological evaluation framework proposed could provide further information about different types of accessibility measures.

spatial or network configuration (Abubakar & Aina, 2006). Accordingly, the Network Analysis (geographic approach) has been criticized for not considering the network configuration and the Space Syntax (geometric approach) has been criticized for failing to take account metric distance (Steadman, 2004).

GIS based methods are well known in accessibility measures and have been developed from container and buffer methods to network approaches (Larsen & Gilliland, 2008). In this regard, the type of distance or distance metric choice becomes essential, where the most common ones are: Euclidian distance (straightline), Manhattan distance (distance along two sides of a right-angled triangle, the base of which is the Euclidian distance) and Network distance (shortest time or distance) (Apparicio et al., 2003; Cromley & McLafferty, 2002). Network Analysis is usually developed by GIS, using tools such as Network Analyst (in ArcGIS) or PgRouting (in QGIS). Different algorithms are included in order to analyse several accessibility issues, such as dijkstra (optimal route), astar (the lowest cost route), driving distance (nodes within a certain distance), alphashape (the shape of a point set, based on driving distance), apspJohnson (total cost of each pair of nodes), Kdijkstra_cost (the cost of k shortest ways, based on dijkstra), Kdijkstra_path (k shortest ways based on dijkstra), etc.

Space Syntax[32] research advocates that vehicular and pedestrian flows have a strong relationships with the configuration of transport network (Penn et al., 1998). A software called Depthmap is commonly used to develop Space Syntax analysis (Hillier et al., 2007) and the following accessibility measures are generally used: step depth (the catchment area from an origin), node count (the points that could be reached up to a certain constraint) and angular segment integration (closeness, centrality). The step depth could be metric step depth, angular step depth (the sum of angular changes considering the angle of incidence) or topological time step (number of changes of direction). Previous literature illustrates on the one hand, that angular distance could provide a more accurate representation of urban movement patterns than metric distance (Bill Hillier & Shinichi Iida, 2005). On the other hand, angular and topological distances best suit the global scale route choices, while metric distance best suits local scale (Hillier et al., 2007).

In this research, since urban and rural networks are taken into account, GIS based methods seem to be more suitable. Angular or topological distances could not offer accurate results, in the cases that the principal component of the analysed network is the disused railway infrastructure and there are few intersections.

[32] In Space Syntax, accessibility commonly known as integration in the literature, is a measure of shallowness or closeness centrality from every space to every other space within the network where the cost is calculated as a function based on the configuration or geometry of the grid. This measure is often times related to pedestrian flow where higher accessibility is related to higher pedestrian flows and lower accessibility is related to lower pedestrian flows. (Law et al., 2012)

2.3. DRLs in the interaction between transport and land uses: node-place models

The different railway nodes of the disused railway lines (mainly station areas) have also influence in their surroundings. Taking into consideration a similar model to the TOD, the analysis of each station area in relation to its surrounding territory should comprise both node and place approaches. Hence, the balance between transport and land-use is taken into account. This balance is not stable and the success of future proposals will depend on their capability to integrate both approaches: flow dynamics and architecture statics (Moreno, 2013).

2.3.1. Railway station areas as nodes/places

As Bertolini claimed, developments based on public transportations (as TODs) look for physical human interaction at and around public transport nodes. These nodes and their surroundings are part of the transportation system, which has more nodes that complement and compete. Hence, they create potentials at different scales, creating a hierarchy (Bertolini, 1999).

Railway station was presented as a node/place geographical entity, comprising two partly contradictory natures (Bertolini, 1996a; Bertolini, 1996b). On the one hand, it is the access point of a network, while on the other, it is a segment of city formed by infrastructures, buildings or open areas (Bertolini & Spit, 1998). Accordingly, railway station areas are defined as current or future important nodes in both transport and non-transport heterogeneous networks, but they are also defined as places, temporarily and permanently populated areas of a city that have different forms and uses (Bertolini & Spit, 1998; C. Curtis et al., 2009). As a node, a station aims to connect people with other destinations, while as a place of activities, the station area becomes a destination itself (Bertolini & Spit, 1998; Bertolini, 1999).

A network is composed of lines and nodes, where the latter is the point where the lines are connected or related to each other. These lines are referred to transport infrastructures or other type of networks, such as business, trade, consumption, etc.

The place in the city is comprised of the node and its influencing area, which goes far beyond immediate surroundings. This area can be delimited by different approaches, such as the four defined by Bertolini and Spit (1998): walkable radius, functional-historical elements, topographic approach and a development perimeter. Thus, they defined the concept of place as “all the built and open spaces, together with the activities they host, contained within the perimeter designed by a “walkable radius” centred on the railway station building, as amended to take account of case-specific physical-psychological, functional-historical and development features”. In opposition, the area and elements located near the station may not show any relation to the node or share in the life of it (Bertolini & Spit, 1998).

In this regard, Bertolini (1999) presented a node-place model, which was focused on station areas and based on the “transport land use feedback cycle” (see chapter 1.3.1). According to the model, improvement in transport provision or accessibility, i.e. improvement of the node value of a location, could promote development in the area, since favourable conditions are created for it. Consecutively, the new development, i.e. improvement of the place value of a location, could promote further development of the transport system because of a growing demand and the favourable conditions created for it (Chorus & Bertolini, 2011).

In the case of disused railway lines, the old railway stations are neither nodes nor places. However, they have the potential and infrastructure to become both of them. That is why, they could be essential in redevelopment and regeneration processes.

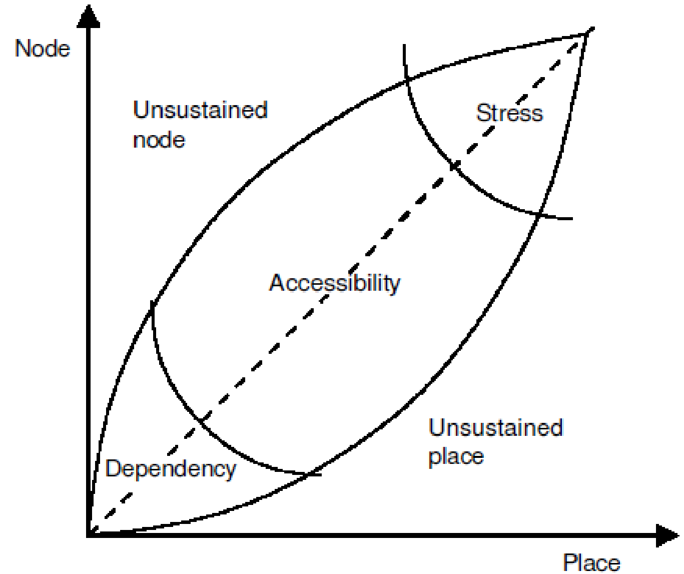
2.3.2. Node/place models

The node/place model and other similar models are presented below in order to create after a suitable model for the analysis of the disused railway nodes. The main difference between these models lays in the number of variables that are taken into consideration and the diagrams that each of model creates (the number of axes of the diagrams are related to the number of variables).

BIAXIAL MODELS: NODE/PLACE

The node/place model of Bertolini is based on the definition of the elements and their combination, which are represented in a biaxial diagram. The node component or element is located in the y axis of the diagram and it refers to its accessibility or "its potential for physical human interaction". Meanwhile, the place value is represented in the x axis and it corresponds to the amount and variety of activities that take place in the area or "the degree of actual realisation of the potential for physical human interaction". The two parts derived from the fact that the more people can get to the area or the more activities happen in the area, the more interaction can occur or occurs (Bertolini, 1999).

Four "ideal-typical" situations, that represent particular relative positions on the node/place diagram, are distinguished in the



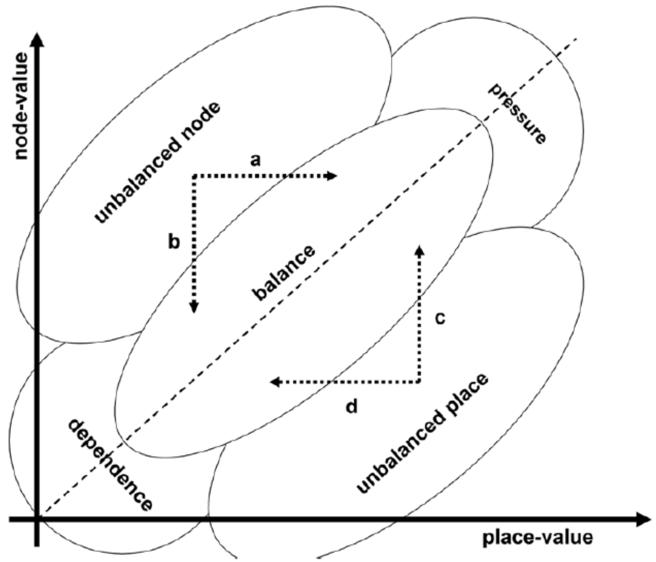


Figure 2.6 The node place model (left). (Bertolini, 1999)

Figure 2.7 Degree of balance between node-value and place-value (right). Van Nes and Stolk (2012) based on Bertolini (1999) model (fig. 2.6). They refer to the position of the station area in the node and place structure or organisation of an urban region (Bertolini, 1999; Chorus & Bertolini, 2011).

- Accessibility or balanced area: It includes the railway stations that are located along the middle diagonal line, where the node and the place values are equally strong.
- Stressed area: These locations include maximum or fullest node and place values. This means that the intensity and the diversity of both transportation flows and urban activities are elevated: high potential for physical human interaction (strong node) and high realisation of the interaction (strong place). Nevertheless, further development of flows can become conflictive in the land use development of the station area, and vice versa.
- Dependent area: These locations include low node and place values and are located at the bottom part of the middle line of the diagram. Demand for transportation services or activities are relatively weak, so the struggle for space is minimal.
- Unbalanced areas: It includes the station areas that have considerably stronger relative position in either the node or the place value, where two different situations exist. Unbalanced or unsustained nodes are located at the top left of the diagram, where transport facilities are relatively more developed than urban activities. Conversely, unbalanced or unsustained places are located at the bottom right of the diagram, where activities are more developed than accessibility. Hence, feasibility of urban development is not guaranteed.

According to the node/place model, unbalanced locations have the highest development potential, so they are the most interesting ones for that purpose (Chorus & Bertolini, 2011). Moreover, the balance between node and place provides one of the conditions to assess sustainability regarding land uses and transports (Reusser et al., 2008). Nevertheless, this balance can be obtained in[33] several ways (fig. 2.7): to diminish both node and place values; to increase both node and place values; to diminish or increase one of the values; or to diminish one value and increase the other (Bertolini, 1999; Reusser et al., 2008).

Other different models based on the Bertolini´s node/place model have been proposed for the analysis of railway stations or TODs. Each of the models creates a diagram, where the number of axis is related to the number of variables taken into account.

TRIAXIAL MODELS: NODUS/CIVITAS/URBS

Joan Moreno Sanz (2013) used, in addition to the node/place model, a three axes model to analyse important railway stations that were also related to main road infrastructures, which he called “urban corners in the territory”. According to him, they are the areas where the interrelationships between mobility and activity happen (Moreno, 2013).

Therefore, urban corners also have a double nature of node and place. In this case, the potential of these areas as territorial centres depends on the balance between the concentration of flows (nodus), human activities (civitas) and the urban morphology that promotes interaction (urbs) (Moreno, 2013). He called the NCU model. Quantitative (related to traffic and activity density or urban compactness) and qualitative measures (related to the diversity of means of transport, mixture of uses or quality of life) are taken into consideration in the model.

In the NCU model, “nodus” refers to the same as “node” in the Bertolini´s model, while “civitas” and “urbs” composed the

[33] According to the diagram, balance means to get close to the middle diagonal line.

"place" approach of the previous model:

- Nodus: the condition for node of a network is assessed by means of traffic intensity at regional level and the modal exchange of different transports at local level (Moreno, 2013).

- Civitas: According to the Romans, it refers to a social reality composed of the citizens that inhabit the city (Capel, 2003a). The condition of civitas in a city depends on the intensity and mixture of land uses in surrounding areas, while the mixture, in turn, depends on the balance between the different economic areas and their balance with residential areas (Moreno, 2013).

- Urbs: According to the Romans, it refers to the built area that has urban morphological characteristics (Capel, 2003a). Spatial features such as population density, compactness level, type of urban fabric, distance to the town centre or quality of life, are considered for its understanding (Moreno, 2013).

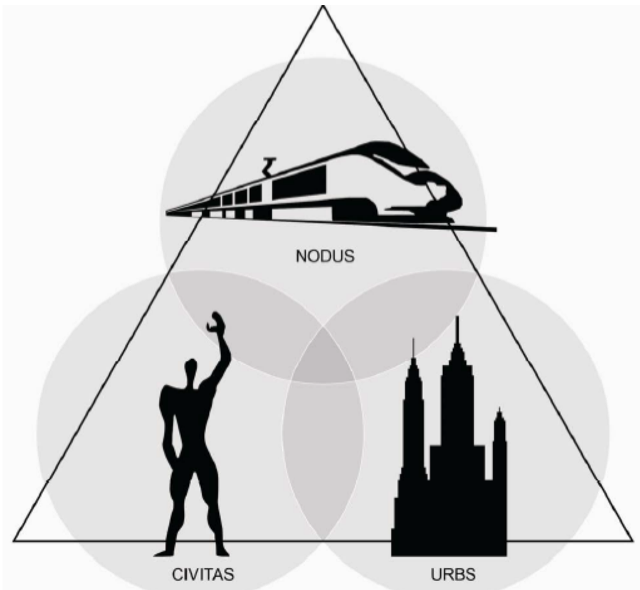


Figure 2.8 The NCU model (Moreno, 2013)
N axis (nodus): traffic intensity (50%) and modal exchange of transport (50%)
C axis (civitas): intensity of activities (50%) and balance between urban uses (50%)
U axis (urbs): urban compactness level (50%) and quality of life index (50%)

Taking into account these three variables, the NCU model is created, which is represented in a triaxial diagram, (fig. 2.8). Each variable (nodus, civitas and urbs) is located in one of the axes (N, C and U) and qualitative and quantitative measures are equally distributed in the axis. The resulting polygons are divided in two groups that represent a hierarchy of urban corners of the territory depending on the regularity of the polygon (50-75% and 75-100%).

MULTIAXIAL MODELS

Multiaxial models have been also created for the study of station or other areas with the aim of including several variables in a single diagram. In these cases, the number of axes of the diagrams can be related to the number of variables, or otherwise, the different indicators of the same variable can be distributed over the different axes.

In this framework, and derived from the node/place model, a circular model with four axes was proposed for the City Line of Stedenbaan, The Netherlands (Atelier Zuidvleugel, 2007; Balz & Schrijnen, 2009). First of all, they made an inventory of the areas within the influence of the railway stations and, accordingly, future development plans for these areas were analysed (fig. 2.9).

As a second step, the relations of the railway stations were analysed taking into account both spatial and network conditions, i.e. the position of the station within the network and the characteristics of the influenced area. For this purpose, four indicators that correspond to the four axes of the diagram were used (fig. 2.10): degree of access by public transport, degree of access by car, degree of mixed use, and local density of inhabitants and jobs. The first two refer to the node approach

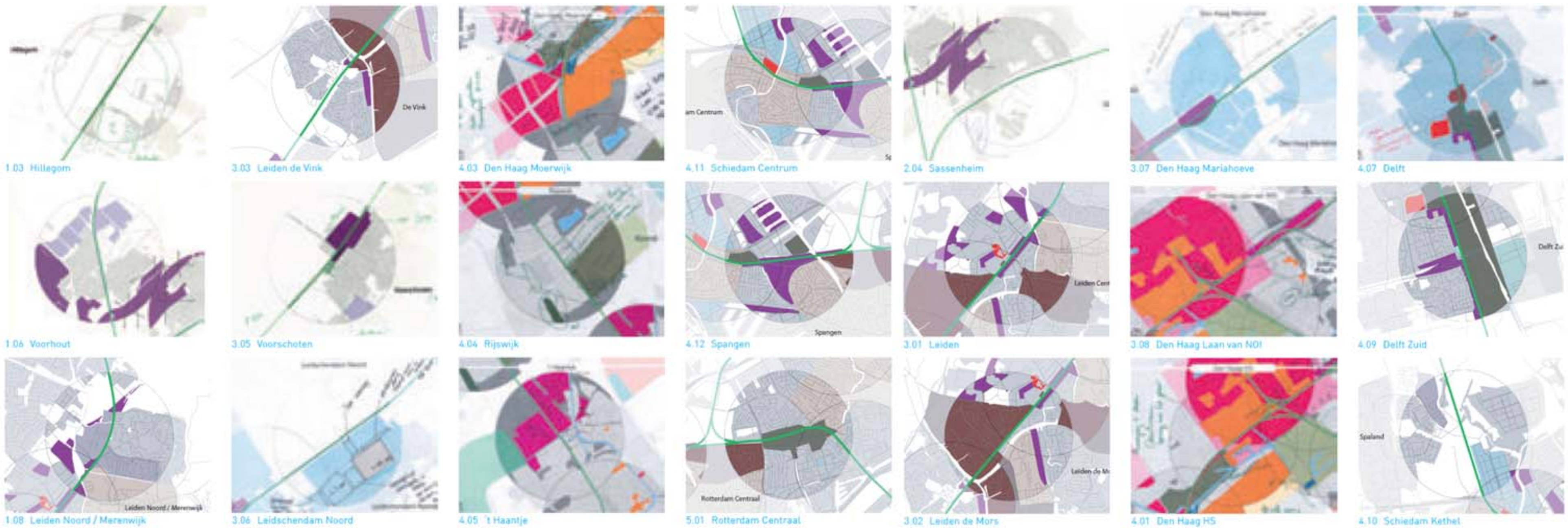


Figure 2.9 Plans for the 47 station areas involved in Stedenbaan (Atelier Zuidvleugel, 2007)

of the station, while the latter two are related to the place nature of the area. Hence, a four axes diagram based on two variables is created.

The resulting polygons of the diagram were classified in nine potential developments[34] that are typical for Stedenbaan (fig. 2.10). However, each of the station area was related to two or more different typologies according to their combination of indicators, (fig. 2.11). On the one hand, the results represented the potential of stations taking into consideration their node and place value. On the other hand, the features that must be changed to encourage a particular development were also illustrated (Balz & Schrijnen, 2009).

Finally, three future scenarios were proposed (the densification scenario, the South Wing Network scenario and the

[34] Stedenbaan typologies (Atelier Zuidvleugel, 2007):

Rural Areas: spaces in the middle of the landscape for low density housing development and recreational use.

Small Towns: new housing sites close to small towns that can expand into autonomous, compact, lively, multifaceted communities set in the countryside.

Outskirts of Cities: restructuring areas on the quiet, spacious and green edges of the cities; these qualities can be consolidated, enhanced and used.

Cities of the Future: easily accessible and dense housing areas; can gradually expand into mixed use developments with their own identity.

Business Sites: extensively used areas along the motorway to be turned into intensively used employment zones

Regional Crossroads: areas linked to one of the major motorway intersections in the South Wing; highly suitable for developing services with a supra-regional function.

Randstad Hubs: not intensively used areas, but highly accessible by road and local public transport; excellent places for experimental new employment and mixed use areas.

Creative Cities: urban centres accessible by every mode of transport well suited to new urban-type dwellings and creative workplaces.

City Centres: key sites, well served by every mode of public transport but less accessible by car; will have to be better designed for users of public transport.

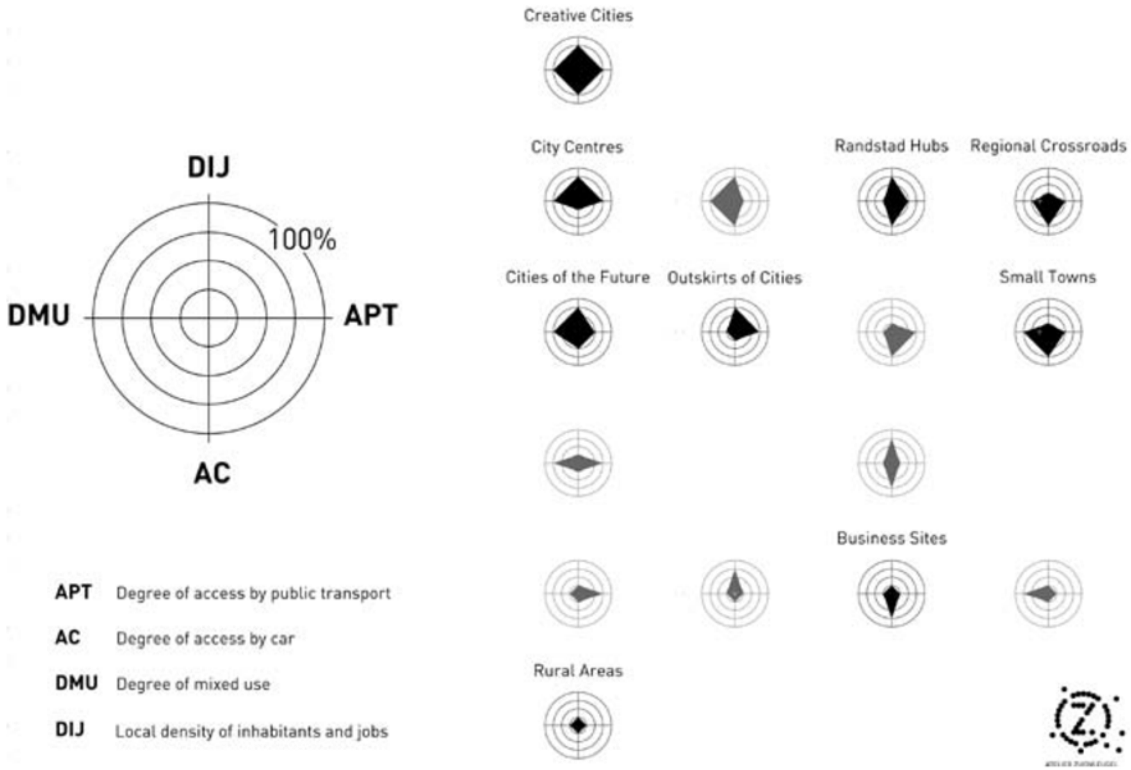


Figure 2.10 The node/place model with four axes and resulted nine developments (Atelier Zuidvleugel, 2007)

sustainability scenario) and the potentialities of the areas were assessed by means of a multi-criteria analysis (MCA).

The model used in the Stedenbaan project is based in the Bertolini´s node/place model but, in this case, each variable is located in two axes, which is the main difference from previous diagrams. This change could result interesting for the application of the model in disused railway lines of the Basque Country and Navarre, since the territory could present completely differing characteristics according to the analysed area (urban areas vs rural areas). This model has already showed a potential development typology related to rural areas. Nevertheless, spatial and network features related to the "urbanity" are only analysed. In this regard, other potentialities regarding rural or natural areas should be taken into consideration for the analysis of the disused railways.

Taking all the above into consideration, multiaxial diagrams are of interest because they are able to represent several variables in the same image. Accordingly, the representation of data related to urban and rural areas regarding the node and place approaches would be possible. In this regard, Poiraud et al., (2016) analysed geosites using a multiaxial diagram. Although this research is not related to railway stations as the others exposed above, the methodology used is similar and have some interesting variations.

The study was divided in two main phases. On the one hand, a preinventory based on a literature review and an inventory that takes into account all the criteria were developed. On the other hand, statistical and expert analyses were developed.

In this regard, the multiaxial diagram was used to assess all the criteria to create the inventory. For that purpose, nine different criteria were distinguished, which were grouped in three variables (scientific interest, development potential and need of protection) (fig. 2.13). Each of the criteria was scored and represented in one of the axis of the diagram, so a nine axes diagram was used (fig. 2.12).

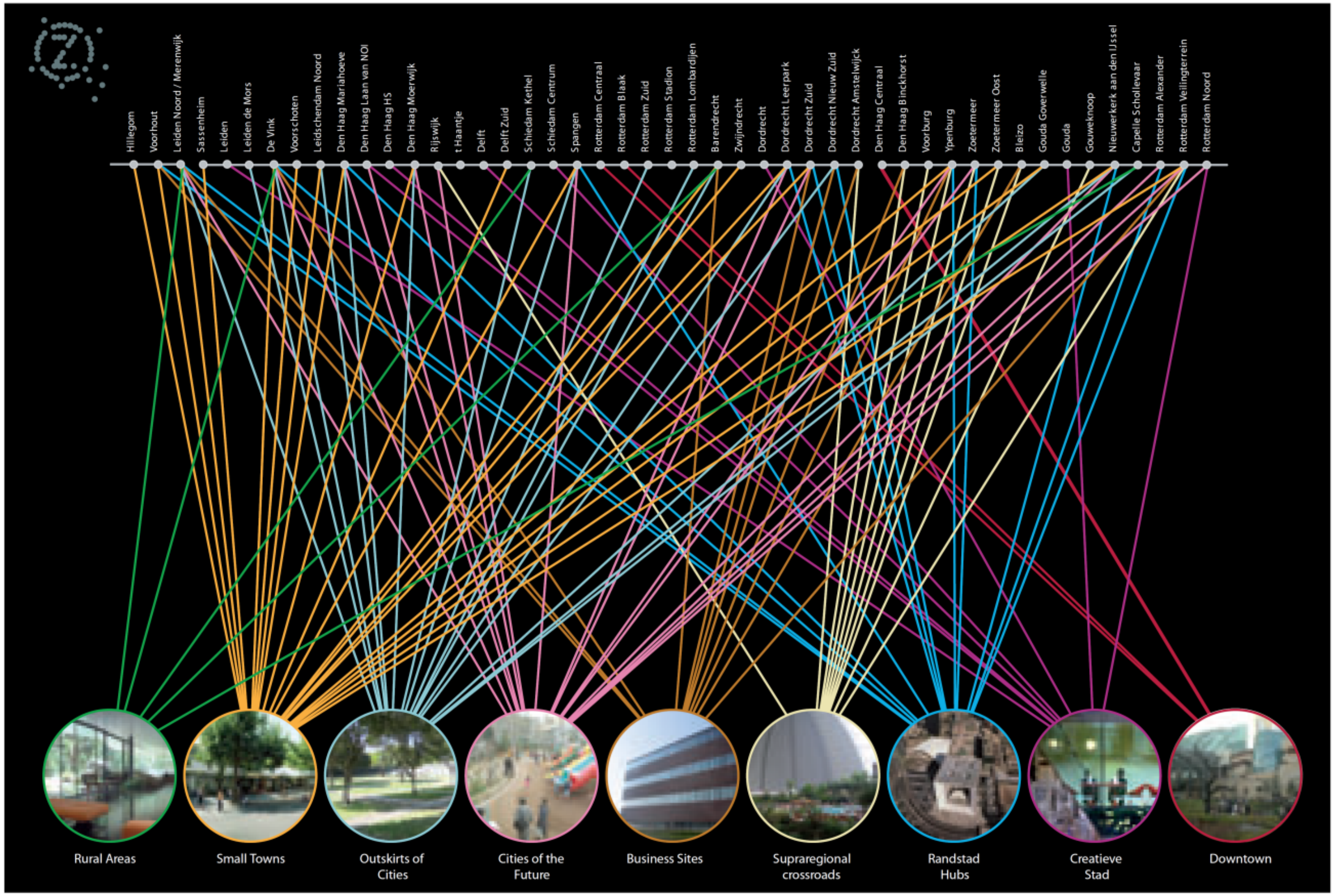


Figure 2.11 Relation between the railway stations and the nine potential developments (Atelier Zuidvleugel, 2007)

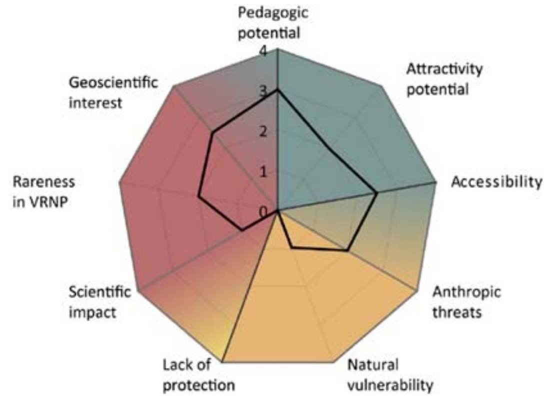


Figure 2.12 Multiaxial model representing the three variables: scientific interest (red), development potential (blue) and need of protection (yellow) (right) (Poiraud et al., 2016)

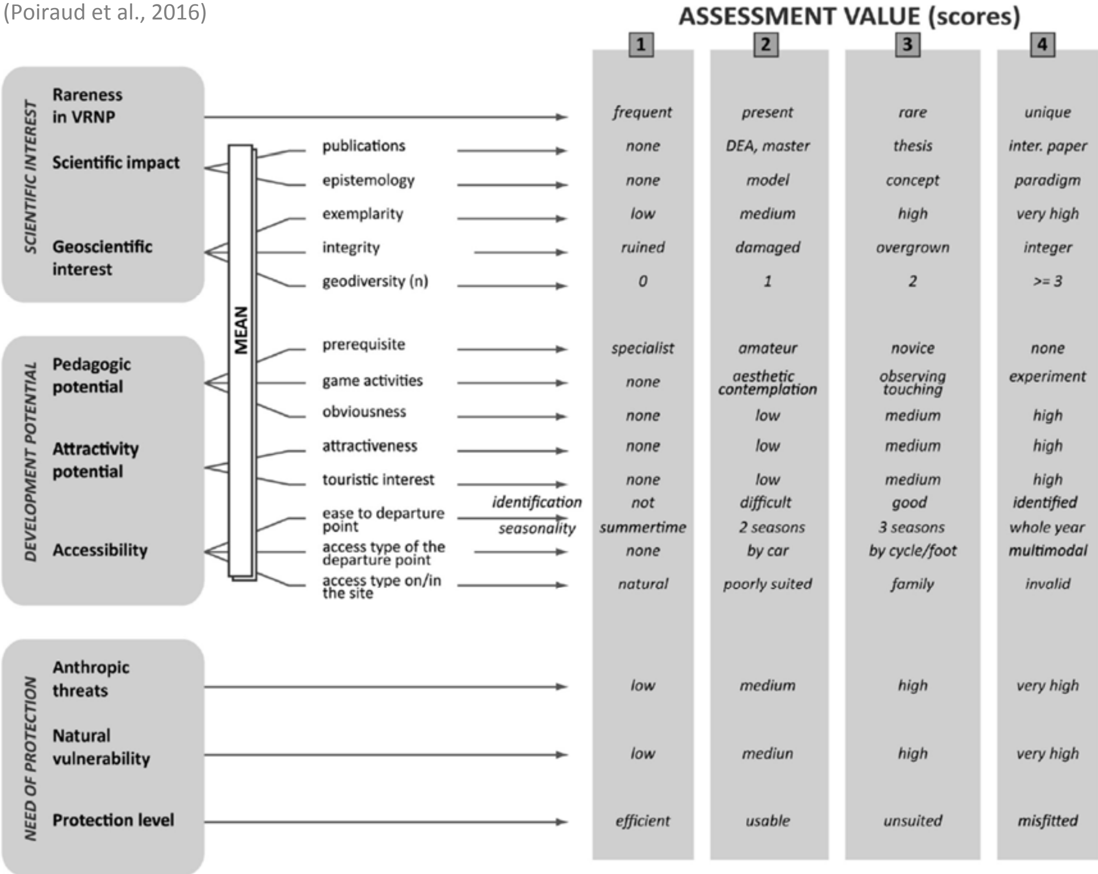


Figure 2.13 Assessment criteria and values used for the geoheritage inventory (below) (Poiraud et al., 2016)

A multiaxial model of this type is able to represent several different criteria that are related to few variables. In this regard, the analysis of disused railway lines taking into account urban and rural features is possible, within the framework of their node and place approach assessment.

2.3.3. Node/place indicators

In addition to the presented models and their representation, the variables and indicators that are selected for the analysis are also important. Those in turn, define the model itself. In this regard, the indicators that were used in the previous models will be studied down below.

Although the theoretical model of node/place was created by Bertolini, its operationalisation was developed by Zweedijk (1997) and Serlie (1998). For that purpose, they created a node-index and a place-index, where each of them combined several indicators using a multi-criteria analysis (MCA). As mentioned before, the node-index is related to the accessibility of the node, so it is represented by the intensity and diversity of transport supply. Hence, accessibility by train, bus, tram, underground, car and bicycle are considered (table 2.2). Meanwhile, the place-index measures the intensity and diversity of activities in the area. Population in the area, the number of workers per each economic area and the degree of functional mix are studied (Bertolini, 1999).

Based on the first node/place model, new proposals have been developed. However, there are small variances in the criteria analysed. On the one hand, while Bertolini (1999) defined 9 indicators to assess the node value, Reusser et al. (2008) used 10 and Chorus and Bertolini (2011) used 4 (table 2.2). Although, some of the criteria are different, the general variables are quite comparable. On the other hand, the indicators referred to the place value are similar in all studies. The only difference of the three studies is the indicator referred to the urban morphology (distance to the town centre) that was included by Reusser et al. (2008). Moreover, the degree of multifunctionality or functional mix is measured with the same formula in all of them (eq 2.1).

$x1$ = population **(2.1)**

$x2 \ldots x5$ = workers/economic clusters

$x6$ = degree of multifunctionality

$$x6 = 1- ((a-b)/d-(a-c)/d) / 2 \quad \text{with}$$

$$a=\max(x1, x2, x3, x4, x5)$$

$$b=\min(x1, x2, x3, x4, x5)$$

$$c= (x1+x2+x3+x4+x5) / 5$$

$$d= (x1+x2+x3+x4+x5)$$

Table 2.2 Comparison of node and place indicators of several studies

COMPARISON OF NODE AND PLACE INDICATORS						
		Luca Bertolini (1999)	**Reusser et al. (2008)**	**Paul Chorus_Luca Bertolinic (2011)**	**Joan Moreno Sanz (2013)**	
NODE	**Accessibility by train**	Number of directions served	Number of directions served	Number of train connections	-	**NODE**
		Daily frequency of services	Daily frequency of services	-	-	
		Amount of stations within 45 min.	Amount of stations within 20 min.	-	-	
		-	Passenger frequency (per day)	-	Passenger frequency (per section)	
		-	Type of train services	Type of train services	Type of train services	
		-	Staffing (present or not)	-	-	
	Accessibility by bus, tram and underground	Number of directions served	Number of directions served	Number of bus connections	Tram stop (yes/no)	
		Daily frefrequiency of services	Daily frefrequiency of services	-	Bus stop (yes/no)	
	Accessibility by car	Distance from the closest motorway access	Distance from the closest motorway access	-	Motorway access in 1800m (yes/no)	
		Parking capacity	-	-	Parking (yes/no)	
		-	-	-	Taxi stop (yes/no)	
		-	-	-	Traffic intensity (vehicles per day)	
	Accessibility by bicycle	Number of free.standing bicycle paths	path lenth in 2km	-	-	
		Parking capacity	-	-	Parking (yes/no)	
		-	-	Proximity to the central business district by ra	-	
	incluence area	700m	700m	700m	500m - 1200m - 1800m	
PLACE	**Urban morphology**	-	Distance to the town centre (1/distance)	-	Distance to the town centre	**URBS**
		-	-	-	Compacity	
		-	-	-	Type of fabric (urban-rural)	
		-	-	-	Quality of life	
	Population	Number of residents in the area	Number of residents in the area	Number of residents in the area	Population density (inhab/km2)	
	Number of workers	-	-	-	Number of wokers (workers/1000inhab)	**CIVITAS**
		-	-	-	Nº of wokers in distribution	
		Nº of wokers in industry and distribution	Nº of wokers in the secondary sector	Nº of wokers in industry and distribution	Nº of wokers in industry	
		Nº of wokers in services and administration	Nº of wokers in the tertiary sector	Nº of wokers in services and administration	Nº of wokers in services and administration	
		Nº of wokers in reatil, hotel and catering	Commercial services (presence)	Nº of wokers in reatil, hotel and catering	Nº of wokers in consumer services	
		Nº of wokers in education, health and culture	Nº of wokers in education	Nº of wokers in education, health and culture	Nº of wokers in social services	
	Multifunctionality	Degree of multifunctionality (eq. 2.2)	Degree of multifunctionality (eq. 2.2)	Degree of multifunctionality (eq. 2.2)	Degree of multifunctionality (diagram)	

Nevertheless, the limitation of this formula lies in the lack of variation in results when one of the indicators is null. Therefore, other measures can be used to define the level of land use mix, such as integral estimation measures. Although these measures do not take into consideration the location of the elements, the specific analysis area is previously defined in a node/place model.

Furthermore, the triaxial model of Joan Moreno (2013) divided the place value in two approaches as mentioned above: urbs and civitas. Hence, he included more indicators in the urbs value, while the criteria related to civitas is similar than the previous place values. Referring to the node approach, although indicators varied, the general variables are also the same.

Nevertheless, data related to each station area could be really different and not so comparable with each other. For that purpose, all criteria is usually rescaled, obtaining scores between 0 and 1: stations with the highest score in each of the criteria are assigned with a 1 score in that criteria, while the stations with the lowest score with a 0. Afterwards, the variables are z-transformed to obtain a comparable scaling and use standard deviation units as the distances for the diagram. Moreover, some of the criteria should be previously log-transformed in order to reduce the disparity in their original scores (Chorus & Bertolini, 2011; Reusser et al., 2008).

Finally, the discussion about the definition of the station catchment area should be mentioned. The previously presented

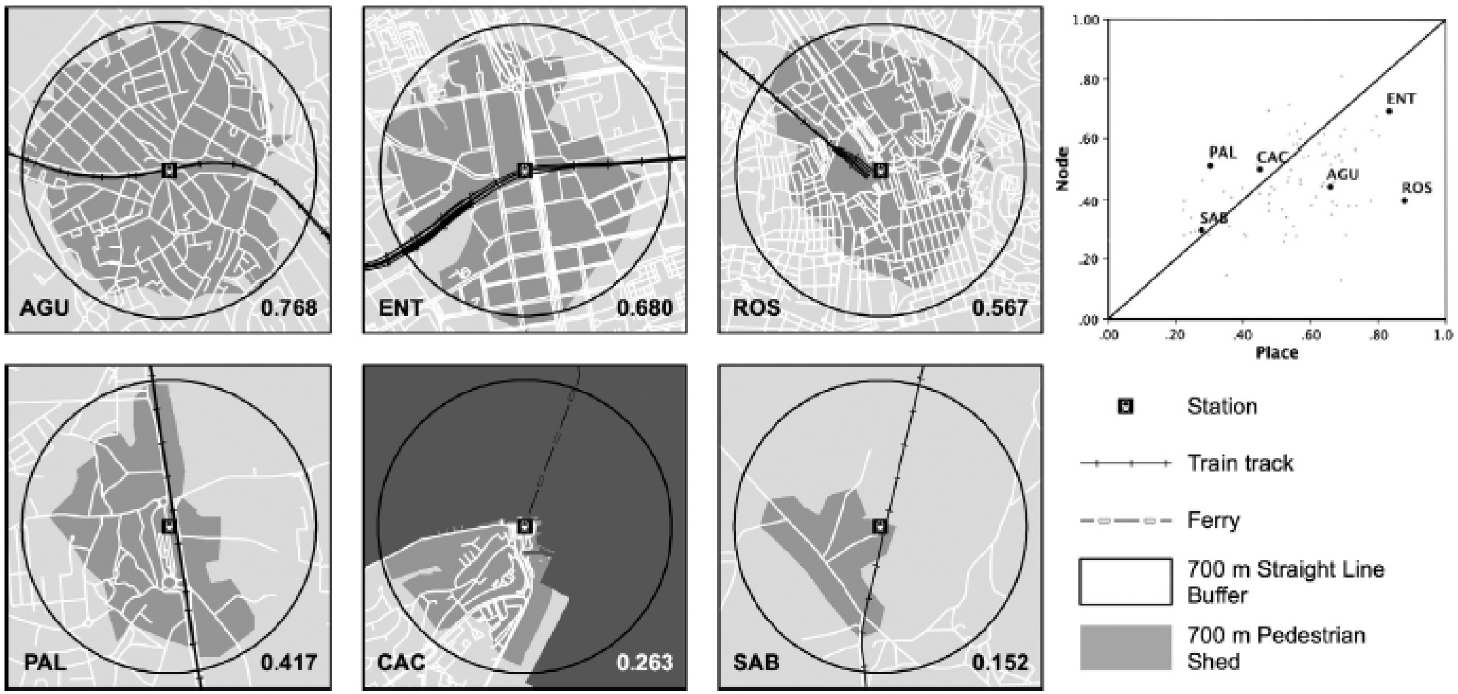


Figure 2.14 Examples of pedestrian shed ratios for station areas (Vale, 2015)

models usually defined a buffer that described the maximum theoretical accessible area around the station (700 m, based on the Calthorpe´s TOD definition or in the cases of the node/place models of table 2.2). Nevertheless, these models are not able to show the pedestrian friendliness of the area, which is essential for the creation of TOD proposals. In this regard, Vale (2015) proposed a pedestrian shed ratio (fig. 2.14) to assess the pedestrian connectivity and represent the size of the real accessible area, in order to complement the node/place model and classify station areas using cluster analyses. Going further, the application of the node/place to the pedestrian catchment areas themselves (network distance catchment areas) will provide a more detailed analysis.

Besides railway station areas, multicriteria analyses have also been used for the assessment of sustainability or vulnerability of different neighbourhoods in the Basque Country, developed by Gaindegia (2016) and Basque Government (2011), respectively, or the heritage value of industrial heritage elements in the Autonomous Community of Madrid (Claver, 2016). In the latter, five variables are defined for the assessment of the heritage value of the different elements and they are related to the singularity of the element in different aspects: technological, functional, constructive, historical and productive singularity. In this regard, three levels of criteria are used in order to structure the problem and Analytic Hierarchy Process (AHP) is used to weight the different variables and indicators. Accordingly, multiaxial diagrams of five axes, referred to each variable, are created. Furthermore, compatibility of uses according to the characteristics of elements or the uses located in their surrounding areas are also considered in a second phase.

It should be added that the variables and their indicators of each research are adapted to the available data of each area. In this regard, in the case of the DRLs of the Basque-Navarre territory, data should be adjusted to the available data of the two autonomous communities in addition to include data related to both urban and rural areas. Accordingly, the proposed analysis model will depend on these data.

2.4. Conclusions, definition of objectives and thesis structuration

2.4.1. Conclusions

Methodological proposals for the analysis of the different aspects that disused railway lines can include have been presented in this chapter, from which the main conclusions are obtained.

Referring to the subject of study, a disused railway line has been considered a territorial system, so as the first methodological conception, its analysis should focus on the study of its heritage elements and the relations with their surrounding territory. This will enable to define the different analysis areas that are necessary to consider in a comprehensive methodology. Moreover, the identification of different zones or subzones of similar features can result suitable for the future management of the entire system.

Furthermore, specific aspects that are related to the future approach of disused railway lines and can influence one of those analysis areas have been also defined. On the one hand, two items related to accessibility that are necessary to consider have been defined in the conception of disused railway lines as future transport axes: the transport mode and the analysis scale. As a combination of them, the analysis should focus on non-motorised accessibility taking into account the different levels in which a disused railway could operate. On the other hand, in the interaction between transport and land uses around the railway nodes, a model or different models that are able to include both urban and rural features should be defined for the analysis of disused railway lines.

2.4.2. Hypotheses and objectives

The future approach of disused railway lines have been proposed taking into consideration the territorial nature of disused railway lines and the interaction between the railway and its territory. In this regard, the initial main hypothesis is divided in two assumptions that are more precise.

- This research aims to prove that disused railway lines may have potential as non-motorised infrastructures that operate at urban or interurban scale for a more sustainable development, providing alternatives to private vehicles or motorised public transports in daily relatively short trips.

- This research aims to prove that disused railway nodes may have potential as future nodes of a non-motorised transport axis in developments based on active transports in order to support a more sustainable development.

Accordingly, primary and secondary objectives are defined:

1 Development of a comprehensive analysis method design based on a theoretical approach and practical case studies (general and specific).

1.1 Understanding of disused railway lines as territorial heritage systems.
1.2 Identification and validation of the different analysis areas of the proposed analysis method.
1.3 Creation of an inventory and a database of the different disused railway lines of the Basque-Navarre territory.

2 Development of a method for the accessibility analysis of

linear infrastructures in varied territories in order to show their potential as non-motorised infrastructures. Different scales can comprise the study of the whole system.

2.1 Study of the optimal accessibility measures.

3 Development of a method for the transport based development analysis of railway nodes in varied territories in order to show their potential as future nodes of a non-motorised transport axis. Balance between transport and land uses must be considered.

3.1 Study of the optimal transport and land-use model.
3.2 Study of existing criteria and adequacy to the research.
3.3 Identification method of possible new nodes along the disused railway line.
3.4 Evaluate the capability of MCDA methods for the analysis of disused railway node areas.

2.4.3. Research process

For the achievement of the main purpose (the creation of a methodological proposal for the analysis of DRLs as complex systems) and based on the three theoretical and methodological conceptions that define both the subject of study and the current state of the proposals, and the future opportunities, this research acquire the following structure (fig. 2.15):

- Initial approach of the method (Part II)

- Development of the method (Part III)

- Methodological proposal (Part IV)

Each phase is based on the conclusions of the previous phases and structured according to the three mentioned conceptions.

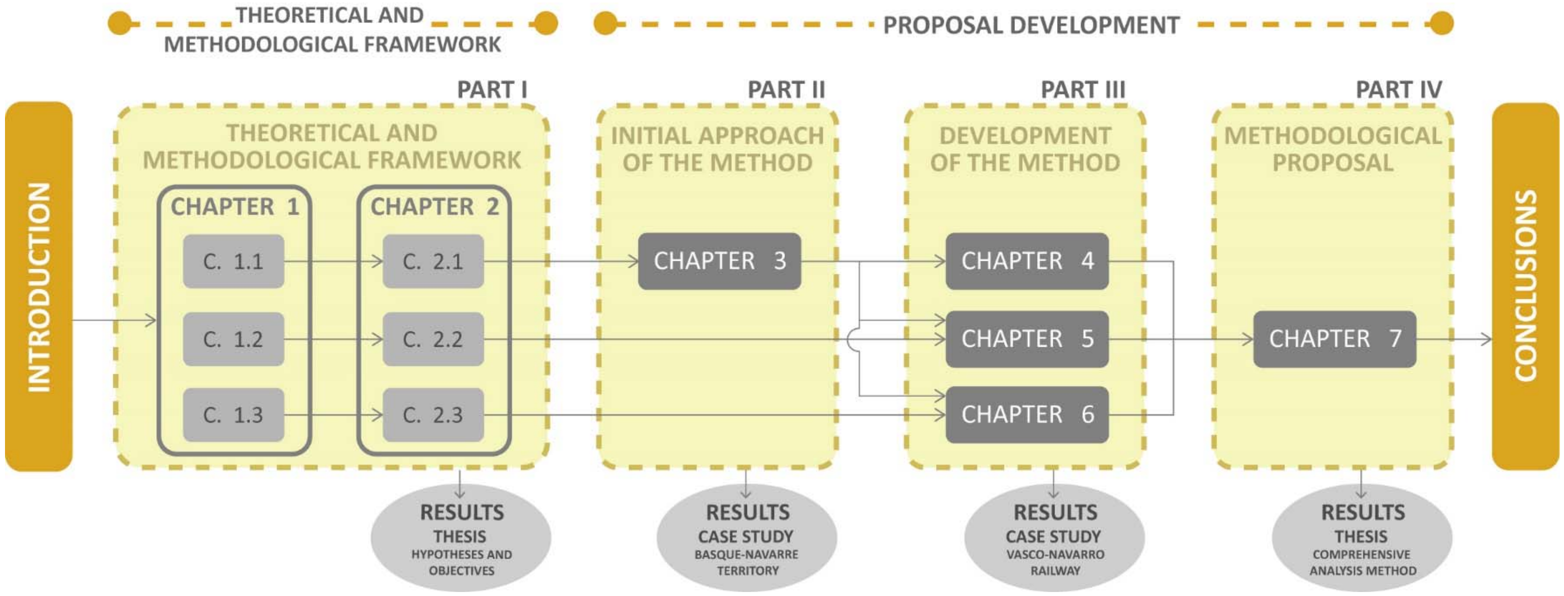


Figure 2.15 Flowchart of the research process

INITIAL APPROACH OF THE METHOD (PART II): ANALYSIS OF SEVERAL SYSTEMS

The objective is to define disused railway lines as territorial heritage systems according to the first theoretical approach and its methodological outcome (see chapters 1.1 and 2.1), and to identify the different analysis areas that are necessary to consider for their comprehension. In this regard, an initial approach of a comprehensive methodology will be proposed.

The method will be applied in the main disused railway systems of the Basque-Navarre territory and specific results will be related to them. The use of few criteria will make different disused railway lines comparable, but the need of deeper analyses for the comprehensive understanding of these systems is predicted.

DEVELOPMENT OF THE METHOD (PART III): ANALYSIS OF ONE SYSTEM

The objective is to deepen the study of the previously proposed analysis areas in order to define the potential of a disused railway line in its territory. For that purpose, in addition to the first theoretical and methodological conception referred to the composition of the subject of study, the other two conceptions that denote the future approach of disused railway lines are considered: disused railway lines as non-motorised transport axes (see chapters 1.2 and 2.2) with balanced node areas (see chapters 1.3 and 2.3). In this regard, a comprehensive analysis method will be defined. The different chapters of this part are linked to the analysis areas concluded in the initial approach so the first theoretical and methodological conception is present in all of them. Meanwhile, Chapter 5 and Chapter 6 are focused in the second and third theoretical and methodological conceptions, respectively.

The method will be much more specific and will focus on a single disused railway system, the Vasco-Navarro Railway. Accordingly, the potential of its linear infrastructure and the potential of its railway nodes will be assessed taking into consideration the different scales that each of them can include.

METHODOLOGICAL PROPOSAL (PART IV): COMPREHENSIVE ANALYSIS METHOD (CAM)

Finally, the Comprehensive Analysis Method (CAM) for the analysis of disused railway lines will be presented based on the three theoretical and methodological conceptions and the practical results obtained in the previous phases. The CAM will show the potential of a DRL as a territorial structuring system and it will be applicable to other disused railway lines of the Basque-Navarre territory or other varied territories composed of urban and rural areas.

PART II: INITIAL APPROACH OF THE METHOD

3. DISUSED RAILWAY LINES (DRL) AS TERRITORIAL SYSTEMS

THE BASQUE-NAVARRE TERRITORY

A general analysis that comprehend disused railway lines as territorial systems is proposed in this chapter. For that purpose, a new approach and its related methodological processes are developed. This general analysis will make possible the definition of suitable analysis areas for the later development of the comprehensive analysis method.

3.1. Proposed methodology

For the initial design of a comprehensive methodology, the understanding of Disused Railway Lines (DRL) as territorial heritage systems is necessary. The railway has already been presented as a territorial system in the theoretical approach. However, the concept of Disused Railway System (DRS) and its characteristics should be defined in order to create and support the methodology for its analysis.

Moreover, a previous identification and classification of the different disused railway lines of a territory is also required for their correct understanding. Accordingly, two steps are proposed in the comprehensive analysis process. First of all, the creation of a GIS-based inventory of different DRLs of a territory is proposed. Afterwards, an initial comprehensive analysis method is presented for the study of these lines as complex systems.

The combination of the inventory and the proposed analysis will be able to represent the general configuration of the DRLs of the territory. In this regard, an inventory and a comprehensive analysis of each system provide the characterisation of each disused line (fig. 3.1). On the one hand, the GIS-based inventory facilitates a correct data structuration and a continuously actualised data set, in order to know the current state of the heritage elements. On the other hand, the study of the different DRLs of a certain territory makes possible to create a classification of these systems (fig. 3.1).

3.1.1. The concept of Disused Railway System (DRS)

The system nature of railways has been showed in a previous section (see chapter 2.1). In this regard, it is important to define both the components and the relations that can be created in this type of systems —taking into consideration the definition of the concept of system— in order to develop a comprehensive analysis of disused railway lines.

Accordingly, a railway is a territorial system, formed not only by the nodes but also by the connecting thread (fig. 3.2). The connecting thread is the path or line, while the nodes are the areas of stations or halts. So, these two are the main components of the system. The path consists of a linear

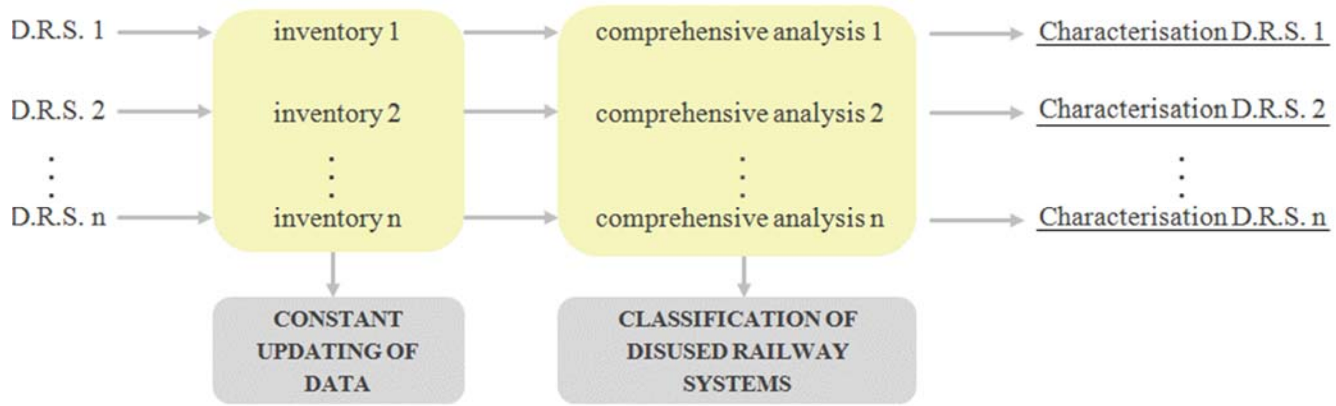


Figure 3.1 Methodological diagram for the analysis of Disused Railway Systems (DRS)

infrastructure and all specific elements that make it possible, such as bridges, tunnels, level crossings or gatekeeper houses. Meanwhile, the nodes can be formed either by a simple shelter or by a set of buildings (passenger building, warehouse, garage, offices, houses, toilets, etc.). Moreover, a third external component is closely related to the railway system: the surrounding territory.

The railway is a complex system, which acted as a structuring element of the territory when it arrived. It had a favourable influence area around, which was served by the train, excluding territories through which the train did not pass and thereby creating a territorial hierarchy. The nodes, in turn, created a second hierarchy within the system. Accordingly, railways and their stations became into the axis of the city and society, into the hubs of the economic, social and cultural activities (González et al., 2012). In this regard, the connecting thread creates longitudinal flows in the territory, while the nodes create the connections between the rail line and the territory at specific points. Therefore, two are the main relations to take into account: longitudinal relations at territorial scale and crosscutting relations at urban level.

Disused railway lines are also understood as territorial systems composed of their nodes and connecting thread (fig. 3.2). The main components and relations are the same as in the railway system. However, specific changes could appear in relation to the scheme presented. On the one hand, the nodes are formed by all railway buildings, including for example gatekeeper houses. Any railway building could act as a node, since they may accept a wide range of uses and create connections between the line and the territory. Meanwhile, as in the case of the railway, the connecting thread consists of the path and all construction elements that make it possible. On the other hand, the relations between the system and the territory are not only limited by the existing nodes. This is because any external element could work as a node due to the variety of future uses that the system could comprise. Hence, crosscutting relations are incremented in disused railway lines.

As in the case of the surrounding territory, these complex systems are constantly developing, from railway infrastructures to DRSs or to future possible territorial structuring elements. The components of the system however, could be in danger of

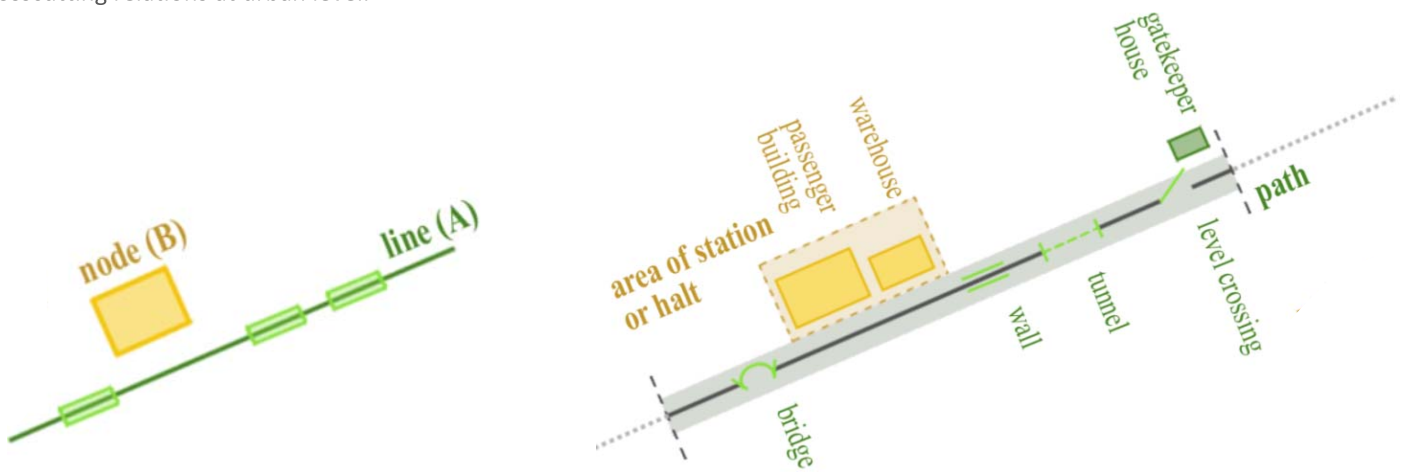


Figure 3.2 Components of Disused Railway Lines (DRL): the line (green) and a node (yellow)

disappearing in the current phase due to their lack of use, endangering the potential of the whole system. As mentioned before, the railway heritage should be considered as a whole in order to enable these areas and elements to be integrated effectively into their surrounding dynamics (Tarchini, 2010). This whole should be located in its current time but it should take into account previous periods. By means of this conception, on the one hand, the structuring nature they once had is restored and on the other hand, the conservation of endangered heritage is ensured.

3.1.2. GIS-based inventory

Due to the continuous damage and disappearance of the heritage elements of the DRLs, a Geographic Information System (GIS) software is selected for the creation of the inventory. It permits easy storage, management and updating of data. The GIS based inventory could provide large amount of high quality, georeferenced and constantly updating data, in order to obtain information of different periods, such as the railway period or the disused period. In this regard, historical data related to the period in which the railways were in use and their current status are required for the analysis of DRLs.

In the inventory, the information of each DRL is structured in two groups (data referred to the line and data referred to the nodes) and is managed by a GIS. Hence, two shapefiles are created in order to define each disused railway line: a linear shapelife (line) and a point shapefile (nodes). The linear shapefile comprises the general information of the infrastructure and has the following attributes: ID; Name; Opening year; Route; Route distance; Gauge; Type of transport; Year of electrification; Year of closure; Current route; Current route distance; Current use. Meanwhile, the point shapefile includes detailed information about each railway node, which is divided in: ID; Name; Location (x); Location (y); General Use; Buildings; Current buildings; Current use; Specific use; Current state; Floor area; Nº of floors;. Fig. 3.3 shows the selected information for each period and type of shapefile.

The inventory should be detailed according to the selected analysis scale. Accordingly, the analysis of different DRLs, requires data that must be comparable, so few specific data should be selected. Meanwhile, a more detailed and specific study, as in the case of a unique DRL, would require more information in each of the analysis areas.

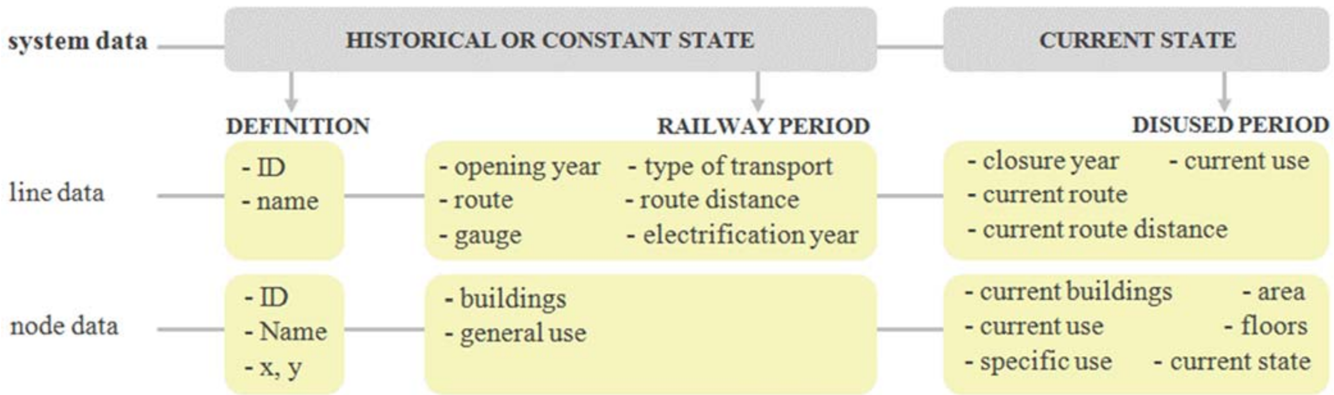


Figure 3.3 Information required for the GIS based inventory

3.1.3. Initial comprehensive analysis

For an initial approach to a methodology, an analysis of the defined elements and relations is developed in different DRSs. This first analysis would help to define the elements and relations that are necessary to consider in a comprehensive analysis. For that purpose, the analysis of disused railway lines as complex systems is proposed taking into consideration the previous definition and features of DRSs. The way to address the issue attempts to avoid the decomposition of the system and favour the maintenance of the structuring nature that railway lines originally had in each territory. This is one of the most important features for their possible reuse and the subsequent influence in the development of their environment in the new territorial view of the 21th century.

The characterisation of each selected disused railway line is obtained by means of the comprehensive analysis, with the aim of creating a classification of different systems that refers to their capability to work as a structuring element in the territory. The higher the capability, the wider the range of future strategies that the line can include for a new use. Accordingly, the analysis results in the potential of territorial structuring of the studied systems, thus making it feasible their proposition as territorial structuring systems again, if possible.

INITIAL COMPREHENSIVE ANALYSIS METHOD

Taking into consideration the previous definition given for the concept of a system, the comprehensive analysis covers both component elements and their relations, dividing the analysis in different areas. The number of areas depends on the number of elements and relations that the system includes.

Moreover, two variables are obtained in each analysis area. One of them refers to the historical or constant state of the system, whereas the other refers to the current state. The historical or constant state represents the characteristics that the railway had in its operational period or other features that have remained invariable over time. They are essential for the definition of the railway system and the understanding of its territorial influence. The current state corresponds to existing elements, comprising their preservations level and conditions, or their relations. It should be pointed out that the relations analysed in the two variables should be comparable.

The combination of the two variables shows the capability that each disused railway line has for future reconversion and territorial structuring in its territory. For that purpose, each variable is ranged in four levels in order to perform this combination. Range 1 refers to high scores results, while range 4 is related to low scores regarding each analysis area. Depending on the combination of the range of these variables, a system is classified into one of the five categories related to its territorial structuring capability and represented in fig. 3.4:

- C.1. Wide Range Capability: it is created from the combination of high ranges in both historical and current state.

Range 1 – Range 1
Range 1 – Range 2
Range 2 – Range 1

- C.4. Could have Wide Range Capability: it is created from the combination of a high range in one of the variables and a middle range in the other, or a high range in the historical state and a low range in the current.

Range 1 – Range 3
Range 3 – Range 1
Range 1 – Range 4

- C.2. Middle Range Capability: it is created from the combination of middle ranges in both historical and current state.

Range 2 – Range 2
Range 2 – Range 3
Range 3 – Range 2
Range 3 – Range 3

- C.5. Could have Middle Range Capability: it is created from the combination of a low range in one of the variables and a middle range in the other, or a low range in the historical state and a high range in the current.

Range 4 – Range 1
Range 2 – Range 4
Range 4 – Range 2

- C.3. Limited Range Capability: it is created from the combination of low ranges in both historical and current state.

Range 3 – Range 4
Range 4 – Range 3
Range 4 – Range 4

C.1, C.2 and C.3 represent a real capability, since they are created from the combination of the same ranges of each variable, whereas C.4 and C.5 represent a future possible capability. This is because it is considered that the historical analysis provides interesting data, especially in cases where the current analysis results are less favourable. That is to say, a system with a high territorial structuration or integration in its historical status enables the recovery of this system with the same characteristics.

In the proposed comprehensive analysis, the elements involved in the system are analysed on the one hand, without taking into account the relations they have with other elements or their environment. In a railway system, the main elements are two: the line and the nodes. On the other hand, the relations existing

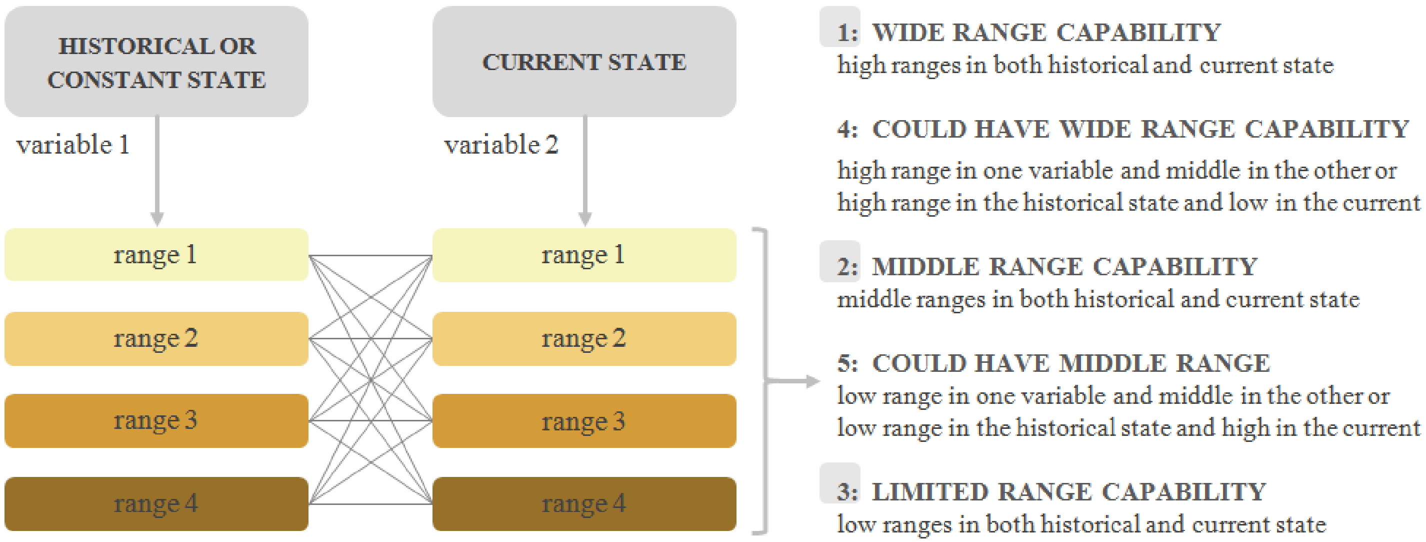


Figure 3.4 Different ranges of the two variables and the resulted categories

between the system elements and those created between the system and the surrounding territory are analysed, thus defining two types of relations. The relations created between the system elements are called internal relations, in this case, those created between the line and the nodes. The relations created between the system or its elements and the surrounding environment are called external relations. In this case, the line, the nodes and the whole system are related to the territory. Accordingly, the methodology is performed in six analysis areas (fig. 3.5): the line, the nodes, the internal relations between the system elements (line/nodes) and the three external relations between the system and the surrounding territory (line/territory, node/territory and system/territory).

In the **line analysis** (A in fig. 3.5), data such as track gauge or type of transport can be very characteristic to understand the evolution or the closure of a railroad. Nevertheless, the level of preservation of the line is considered as the main factor to define the system and its possible recovery of the structuring effect on the territory. Therefore, the percentage of preserved line is measured for the historical or constant state variable and the present features of the line are measured for the current state variable. These features consist of the state of preservation of the line (ruin, poor, regular or good), its general use (greenway, cycling line or path) and the percentage of reversibility of the disappeared sections (if reconversion is possible or not, because other infrastructures or buildings has been erected instead).

In reference to the **analysis of nodes** (B in fig. 3.5), the information collected allows an easy measurement of the preservation level of built heritage, as well as the characterisation of each system. The higher the level of preservation, the greater the possibilities for system recovery, assuming different types of uses. Accordingly, the percentage of preserved elements or items is the first variable, whereas their current state is the second. Three indicators are defined for this second variable: state of preservation (ruin, poor, regular or good), percentage of disused items and percentage of items with public use.

The **line/node relations** (C in fig. 3.5), which are internal relations, are associated to the distribution of the nodes along the infrastructure line. The first variable, concerning the historical state of the line, is deduced from the distances (network distance along the line) between the nodes, considering both all nodes and only those that are comprised of any building. The second variable is inferred by the distances between existing nodes and the length of the line in relation to the floor area of the existing buildings.

In the analysis of external relations and focusing on **line/territory relations** (D in fig. 3.5), territorial features are taken into account regarding the line. In this regard, population and municipal surface areas are considered the most suitable and comparable data to represent general territorial characteristics. Therefore, population and the municipal surface area concerning the line are analysed for the historical state, while current population, the municipal surface area and the number of towns and rural communities related to the line are studied for the current state.

As **node/territory relations** (E in fig. 3.5), the same territorial data (population and municipal area) are studied in relation to the railway nodes. In the historical state, population and the municipal surface area regarding the number of railway nodes and buildings are analysed. Meanwhile, in the current state, current population and the municipal surface area related to the number of existing nodes and their surfaces areas are studied for the current state.

Regarding the external **system/territory relations** (F in fig. 3.5), other systems that are located in the same territorial axis or around it are taken into consideration, since they are able to support or restrain the territorial influence of the infrastructure axis. On the one hand, the existence of rivers along the studied line or mountains crossing the line is observed for the historical or constant state. On the other hand, two indicators are analysed for the current state. One of them refers to the existence of protected natural areas and the other to the existence of current or future elements for the strengthening of the line axis.

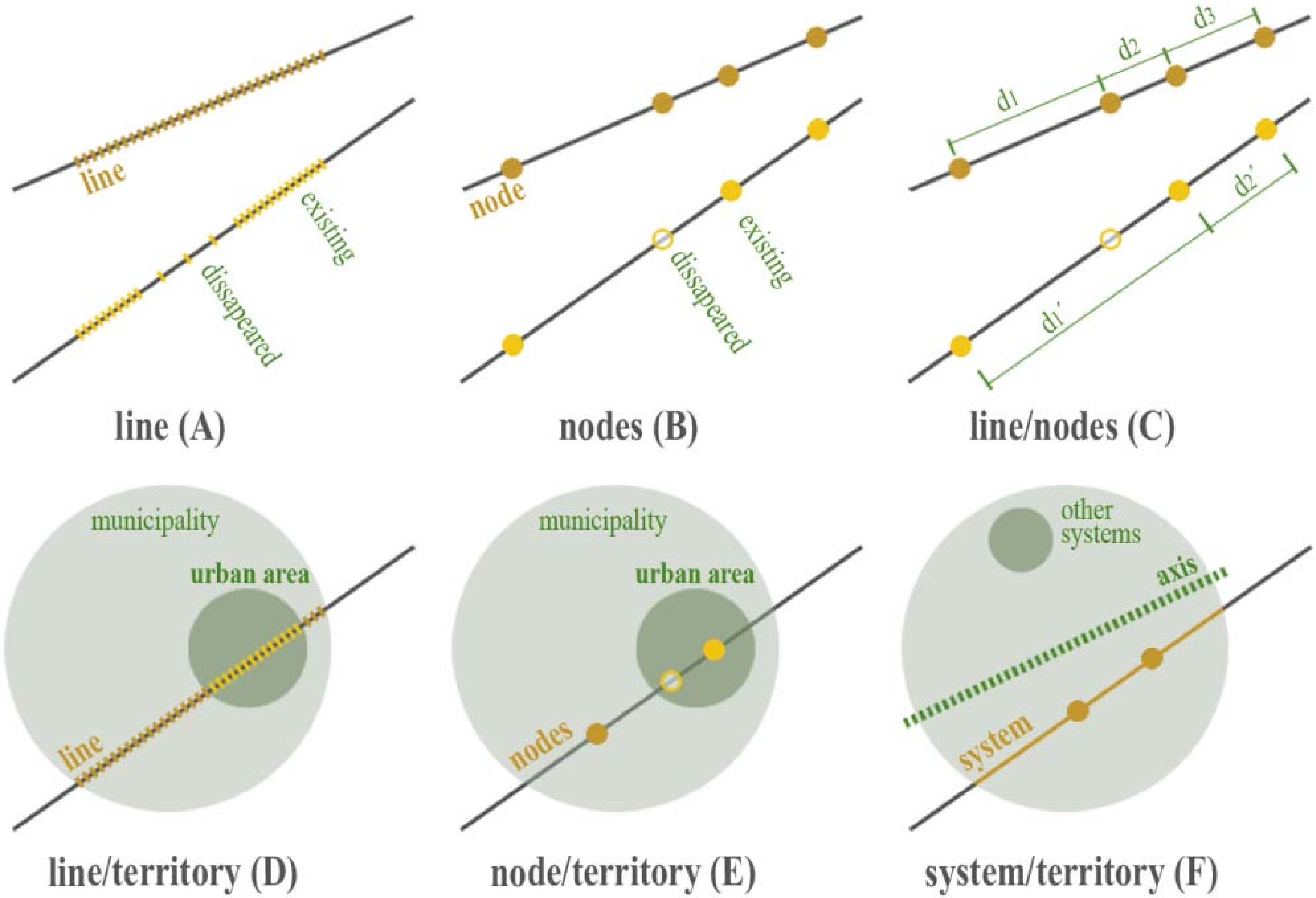


Figure 3.5 Components and relations in a DRS

Table 3.1 summarizes the indicators studied in each of the analysis areas. In the cases where there is an even number of indicators, underlined ones have more weight to create the ranges.

The results for each part of the analysis (A, B, C, D, E, F) are represented in the previously defined categories (1, 4, 2, 5, 3), obtaining the characterisation of each DRS regarding the capability of territorial structuring of the system. Thus, the

INDICATORS	HISTORICAL OR CONSTANT STATE	CURRENT STATE
LINE	Percentage of preserved line	State of preservation
		General use
		Reversibility of the disappeared sections
NODES	Percentage of preserved items	State of preservation
		Percentage of disused items
		Percentage of items with public use
LINE / NODE	Nº of nodes comprised of any building per km of line	Nº of existing railway buildings per km of line
	Nº of nodes per km of line	Floor area of existing buildings per km of line
LINE / TERRITORY	Line length (m) per inhabitant (1930)	Line length (m) per inhabitant (2013)
	Line length (m) per inhabitant (1981)	Line length (m) per municipal surface area
	Line length (m) per municipal surface area	Nº of towns and rural communities Nº of towns and rural communities centres
NODE / TERRITORY	Nº of nodes per 1000 inhabitants (1930) Nº of railway buildings per 1000 inhabitants (1930)	Nº of railway buildings per 1000 inhabitants (2013) Floor area of existing buildings per 1000 inhabitants (2013)
	Nº of nodes per 1000 inhabitants (1981) Nº of railway buildings per 1000 inhabitants (1981)	Nº of railway buildings per municipal surface area Floor area of existing buildings per municipal surface area
	Nº of nodes per municipal surface area Nº of railway buildings per municipal surface area	
SYSTEM / TERRITORY	Rivers in the axis	Strengthening of the line axis
	Mountains crossing the line	Protected natural areas

Table 3.1 Indicators of each analysis area and variable

result of a system has a six number format (x1, x2, x3, x4, x5, x6), where each number is related to each analysis area. The systems that have uniform outcomes in the different areas need to apply the same level of strategy for each area in future preservation and enhancement proposals. Otherwise, the systems with irregular results show an imbalance in the necessities that each area has for future strategies.

Finally, uniformity of the systems is checked because the analysis conducted focuses on the mean values for each data and further examination may allow a more accurate approximation. In this regard, the construction of box-plot type graphs, from data of relations between nodes and line, allows deciding whereas a division of the analysed systems into zones is necessary. The main reason for the division is the existence of line sections with very different characteristics within the same system. This could happen due to an unequal distribution of the nodes or significant differences in the surrounding territorial structure.

The box-plot graphs are created by the distances between nodes of each system, taking into account both the historical and current state. Three different factors are represented and considered in such graphs: the interquartile range (the less value, the more uniform system), the position of Q2 (second quartile or median) in the graphic (the more central position, the more uniform system); and the existence of outliers (the less number of outliers, the more uniform system). The location of the outliers facilitates the identification of the different sections and the choice of the most suitable division. If a division is necessary, the comprehensive analysis is carried out again for each divided section.

CLASSIFICATION OF DIFFERENT DRSs

As a final step, PCA (Principal Component Analysis) and k-means clustering are used to compare and classify the different systems in order to design future common strategies for their promotion. In the PCA, new components that combine the variables and represent as much information as possible are created. The comparison of different systems becomes easier by means of the projection of the data on the new components. Afterwards, the different systems are grouped using k-means clustering, where each system belongs to the group with the nearest mean. Each cluster or group has similar features regarding the elements and the relations that each disused railway comprises. This permits to identify the future approach that each line could have for its preservation and enhancement.

The PCA is parameterised using Pearson correlation with a significance level at 95% applied at the initial matrix. The principal components, their coordinates and the contribution of each variable to them are obtained for each DRS. The k-mean classification is employed with 500 iterations and a convergence value of 0.00001. The data is tested with the coordinates of the component axes obtained from the PCA.

3.2. Disused Railway Lines (DRL) of the Basque-Navarre territory

Different periods are distinguished in the railway development of the Basque-Navarre territory (González, 1999). The first railways, such as the Railroad of the North (1864) or the Bilbao-Tudela Railway (1863), were linked to commercial issues. They connected the Basque ports with hinterland markets fig. 3.6. Afterwards, mining railways, which went from the extraction areas to ports, rivers or factories, were built until 1880. During the final years of the century (1880-1900), the railway became in a territorial structuring element, which was closely linked to the industrialisation process and was even able to expand it.

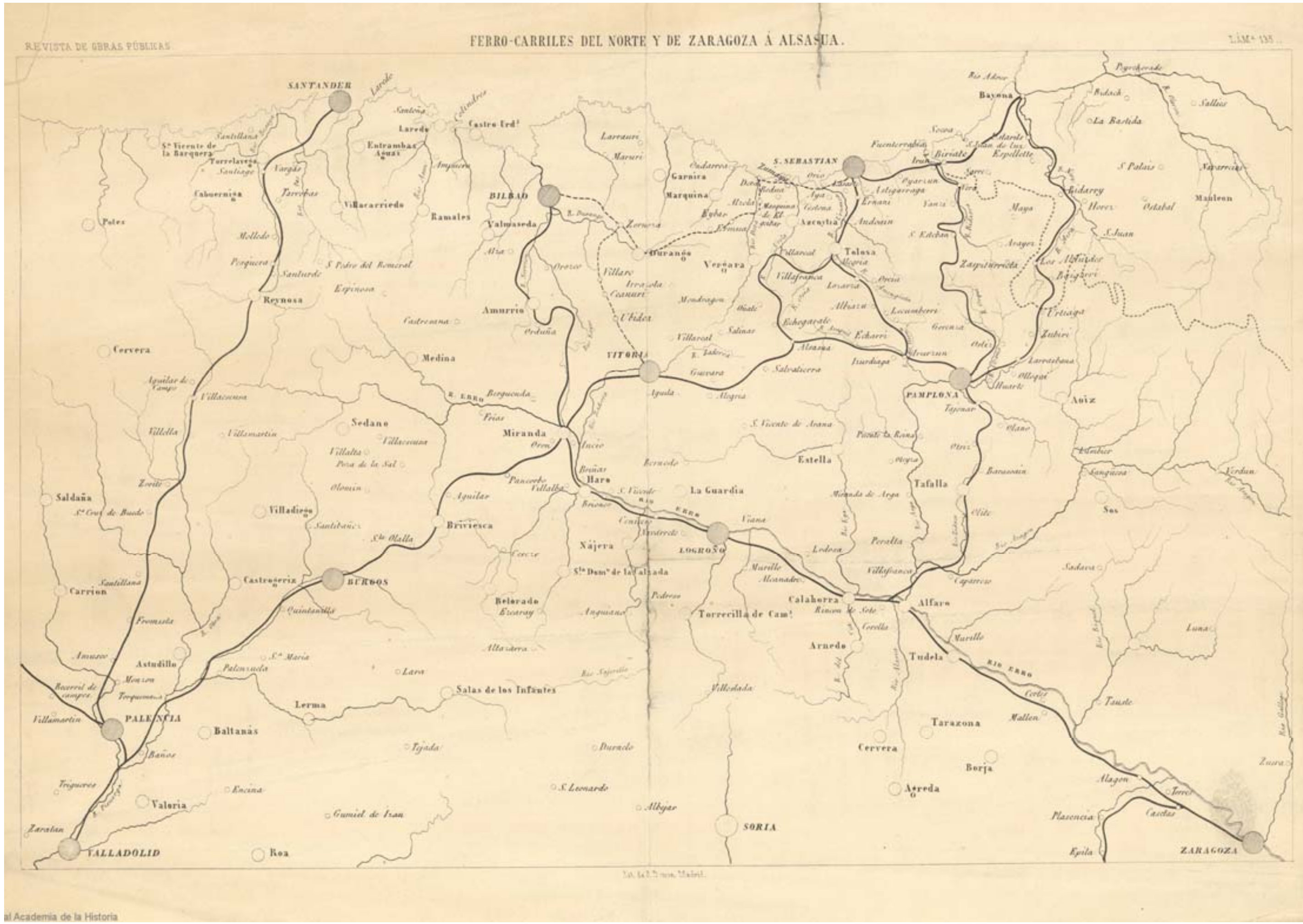


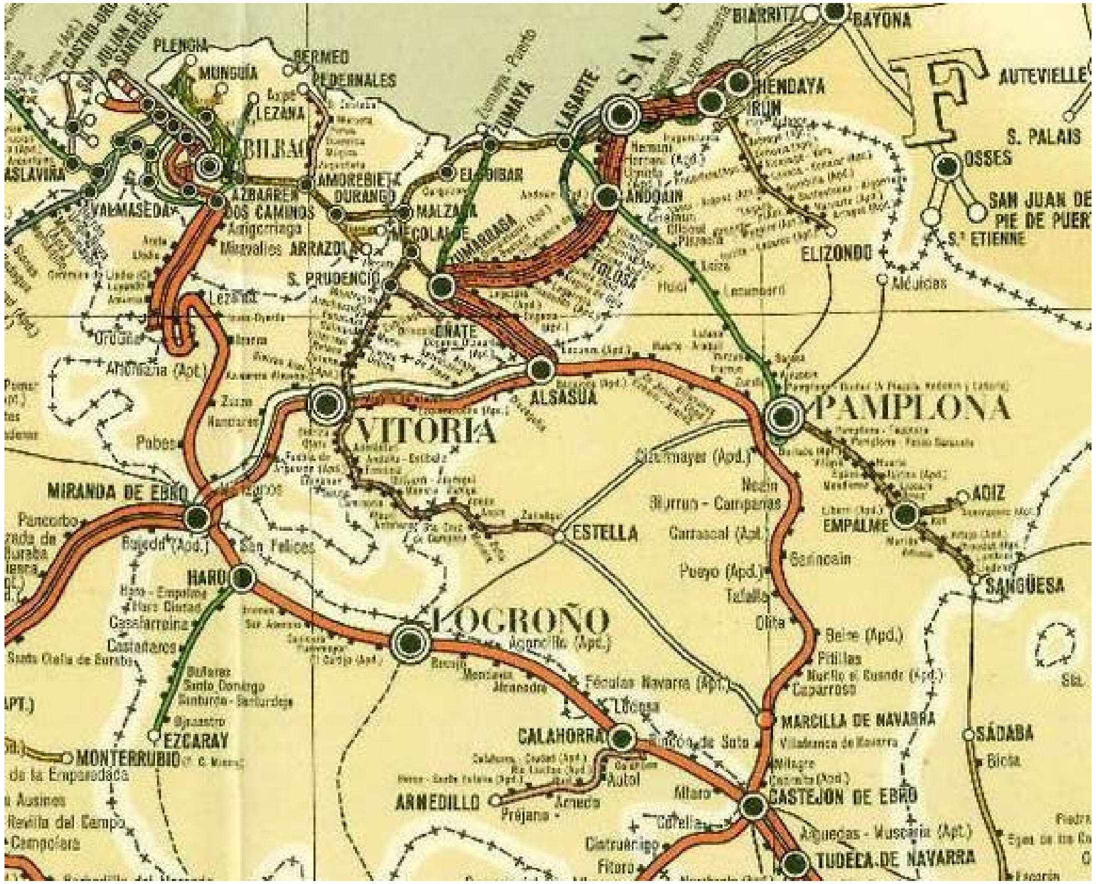
Figure 3.6 The Railroad of the North and the railway from Zaragoza to Altsasu in 1861, Julio Donon. Last seen January 2018, in: http://bibliotecadigital.rah.es/dgbrah/i18n/consulta/registro.cmd?id=28950

They were located along the main rivers or between the main cities and their surrounding areas. Eventually, from the beginning of the 20th century, the network was completed (Plazaola, Bidasoa, Urola and Vasco-Navarro railways), creating a vast railway network that covers almost all the territory (fig. 3.7). Even the layout of the Basque Y (the future high-speed railway) was used in narrow gauge until 1960 by means of the Bilbao-Donostia Railway and the Malzaga-Vitoria-Lizarra Railway (Unzurrunzaga, 1999). Nevertheless, all these lines were not initially built as a network; moreover, the two different gauges (broad gauge and narrow gauge) did not permit the connection between the different lines. As pointed out by Olga Macías (1994), broad gauge railways had general functions in the territory and connected the Basque-Navarre territory with other regions, while narrow gauge ones had county or local purposes. The latter linked the main lines and main economic centres with the rest of the territories they served. In this regard, although a hierarchy or even a marginalisation was created in the territory, the low economy of the narrow gauge permitted the construction of the final extensive network (Macías, 1994).

Although the Basque-Navarre territory had a high level of railway kilometres in relation to its territorial extent at the beginning of the 20th century, more than 500 kilometres have become disused for the end of the century. The causes of this decline have been defined as inappropriateness of the rail legislation, increase in raw materials, the social policy of the second Spanish Republic, fluctuations in international markets, and competition from road transport (Macías, 1994). Several of these former lines are located close to the area of Bilbao, where railway lines were built mainly due to the high mining activity of the area. Nevertheless, long disused railways that connect the different provinces can be found in the other three provinces (Gipuzkoa, Araba/Álava and Navarre).

All of them were used to transport different goods, but not all of them had passenger transport. In this regard, the main DRLs (the twelve lines that were used for both transport of goods and passengers, fig. 0.33) have been selected for the creation of the inventory and the application of the proposed methodology. They are the ones that may have some potential in the regional planning of their surrounding areas, since they structured the territory in its creation and connect different urban and rural towns at present. Hence, mountain mining railways have been excluded from the analysis.

Figure 3.7 Part of the map of the railways that were built, under construction or projected in Spain and Portugal in 1948, Alfredo Forcano. Published by the Spanish Geographic and Catastral Institute



Railways and disused railways of the Basque-Navarre territory have been widely studied in the last decades. Several authors have explored the historical aspects of the whole network (J. Olaizola & Vaillant, 2011; Ormaechea, 1999; Salmerón & Olaizola, 1990), but the historian Juanjo Olaizola has also carried out specific studies of most of the lines. Those historical aspects include general creation, development or closure history and specific issues, such as electrification, rolling stock or economic and social issues. Furthermore, some of the specific studies also include the current state of the disused railways. In this regard, the creation of reconversion proposals for the disused lines (such as Greenways) or the attempts to protect the railway heritage (such as the Inventory of Industrial Landscapes or the Inventory of Industrial and Public Works Heritage) have also contributed to the collection of their current state information.

Furthermore, some studies that analyse the influence of the creation of these railways in the territory have been developed, by focusing on the industrialisation process (González, 1999), economic development (Macías, 1994) or urban and population development (González et al., 2012). Conversely, the influence that the closure of these lines had in the territory or the relations that they can nowadays create have not been studied yet.

Taking into consideration all those previous studies, the need of historical and current data collection of the DRLs is clear. In the case of the current information, however, the updating of data is essential due to the passage of time and the effects that it could produce in the DRLs. In this regard, the creation of an inventory of the DRLs that is able to represent the railway heritage of the Basque-Navarre territory and can be easily updated is required. It should be mentioned that Spanish railways have already been located in Google Earth by Euroferroviarios[1], including the track and buildings or other facilities. Nevertheless, no information other than location about each element has been included and some of the locations or data are incorrect.

[1]Last seen January 2018, in: http://www.euroferroviarios.net/index.php?module=Foros&func=viewtopic&topic=1887&start=0

3.3. Development and results of the analysis of different DRLs

The initial analysis process has been applied to the main DRLs of the Basque-Navarre territory.

3.3.1. Inventory of the Basque-Navarre DRLs

The inventory of the Basque-Navarre DRSs has been developed by means of a data collection and fieldwork performed. On the one hand, the railway heritage of the Basque Country and Navarre has been identified and inventoried in a GIS software, providing us constantly updating data. On the other hand, the creation of different maps and analyses in GIS is possible, such as the analysis of the historical development of the system or the preservation state of the nodes, in order to understand these lines as complex systems.

The inventory comprises several DRLs of the selected territory and meanwhile, each system includes the line and multiple nodes. In this case, 12 lines and 217 nodes have been identified and analysed in total (annex 1.1). All these data have been structured depending on the periods mentioned before (definition, railway period, disused period) and have been included in the attribute table of each shapefile.

The information collected from the different lines shows that 50 years passed between the first and the last opening of the lines. Meanwhile, all the closures occurred in 30 years, table 3.2. The railways located in Navarra were the first to close, although they were not the first to open. They spent about 40 years in operation. Conversely, Sestao-Galdames Railway was in operation for the longest period, in addition to the fact that it was the first to open. Furthermore, Urola railway was the last to start its construction, as well as the last to close.

All the studied lines were built in narrow gauge (1 m), except Sestao-Galdames (1.15 m), probably due to it was the first one. They were not principal territorial lines for the connection of the Basque-Navarre territory with other regions, but they were essential in the organisation of the territory they served and

Table 3.2 Inventory of the DRLs of the Basque-Navarre territory with the information referring to the lines

DISUSED RAILWAY LINES OF THE BASQUE-NAVARRE TERRITORY

ID	NAME	OPENING YEAR	ROUTE	ROUTE DISTANCE (KM)	GAUGE	TYPE OF TRANSPORT	YEAR OF ELECTRIFICATION	YEAR OF CLOSURE	CURRENT ROUTE	CURRENT ROUTE DISTANCE (KM)	CURRENT USE
1	UROLA	1926	ZUMARRAGA-ZUMAIA	36.65	1	GOODS + PASSENGERS	1926	1988	ZUMARRAGA-ZUMAIA	36.65	GREENWAY (PARTLY)
2	MALTZAGA-ZUMARRAGA	1889	DURANGO- ZUMARRAGA/ELGOIBAR	58.04	1	GOODS + PASSENGERS	1929	1975	MALTZAGA-ZUMARRAGA	22.70	CYCLING LINE (PARTLY)
3	VASCO-NAVARRO	1927	MEKOALDE-GASTEIZ-LIZARRA	139.14	1	GOODS + PASSENGERS	1929-1938 -1948	1967	MEKOALDE-GASTEIZ-LIZARRA	139.14	GREENWAY (PARTLY)
4	DURANGO-ELORRIO	1905	DURANGO- ELORRIO/ARRAZOLA	15.18	1	GOODS + PASSENGERS	1946	1975	DURANGO- ELORRIO/ARRAZOLA	15.18	GREENWAY (PARTLY)
5	PLAZAOLA	1914	IRUÑA-LASARTE	84.15	1	GOODS + PASSENGERS	-	1958	IRUÑA-LASARTE	84.15	GREENWAY (PARTLY)
6	TUDELA-TARAZONA	1886	TUDELA-TARAZONA	21.39	1 - 1,67	GOODS + PASSENGERS	-	1972	TUDELA-TARAZONA	21.39	GREENWAY
7	TRASLAVIÑA-CASTRO	1898	TRASLAVIÑA-CASTRO / SOPUERTA-GALDAMES	32.70	1	GOODS + PASSENGERS	-	1966	TRASLAVIÑA-CASTRO / SOPUERTA-GALDAMES	32.70	GREENWAY (PARTLY)
8	SESTAO-GALDAMES	1876	SESTAO-GALDAMES	22.31	1.15	GOODS + PASSENGERS	-	1969	SESTAO-GALDAMES	22.31	GREENWAY (PARTLY)
9	SONDIKA-MUNGIA	1894	LUTXANA-MUNGIA	18.00	1	GOODS + PASSENGERS	1950	1977	SONDIKA-MUNGIA	13.00	GREENWAY (PARTLY)
10	BILBAO-LEZAMA	1895	BILBAO-LEZAMA	15.00	1	GOODS + PASSENGERS	1950	1908	BILBAO-DERIO	10.00	PATH
11	IRATI	1911	IRUÑA-ZANGOZA	59.00	1	GOODS + PASSENGERS	1911	1955	IRUÑA-ZANGOZA	59.00	GREENWAY (PARTLY)
12	BIDASOA	1916	IRUN-ELIZONDO	51.50	1	GOODS + PASSENGERS	-	1956	IRUN-ELIZONDO	51.50	GREENWAY

the connection to the main lines. Tudela-Tarazona Railway was the only one that changed its gauge in order to be adapted to the main line that linked Bilbao, Tudela and Zaragoza. It was transformed into a broad or normal gauge railway (1.67 m) in 1952 and that is why, it ran for a longer period of time than other lines of Navarre. Finally, and referring to the electrification of the lines, Irati Railway was the first in 1911, while some other lines have never been electrified.

To sum up, the main disused railway lines cumulate more than 500 kilometres of track in the Basque-Navarre territory. They comprise 217 railway nodes and innumerable heritage elements. More specifically, 44% of the railway nodes have already disappeared, but some elements have also disappeared in almost all the nodes. The different DRLs are studied in the following pages, while data related to their nodes have been included in annex 1.1.2.

MALTZAGA-ZUMARRA RAILWAY

Maltzaga-Zumarraga Railway (Durango-Zumarraga section and a branch to a factory located in Elgoibar) was opened in 1889 in order to connect the Bilbao-Durango Railway with the Railroad

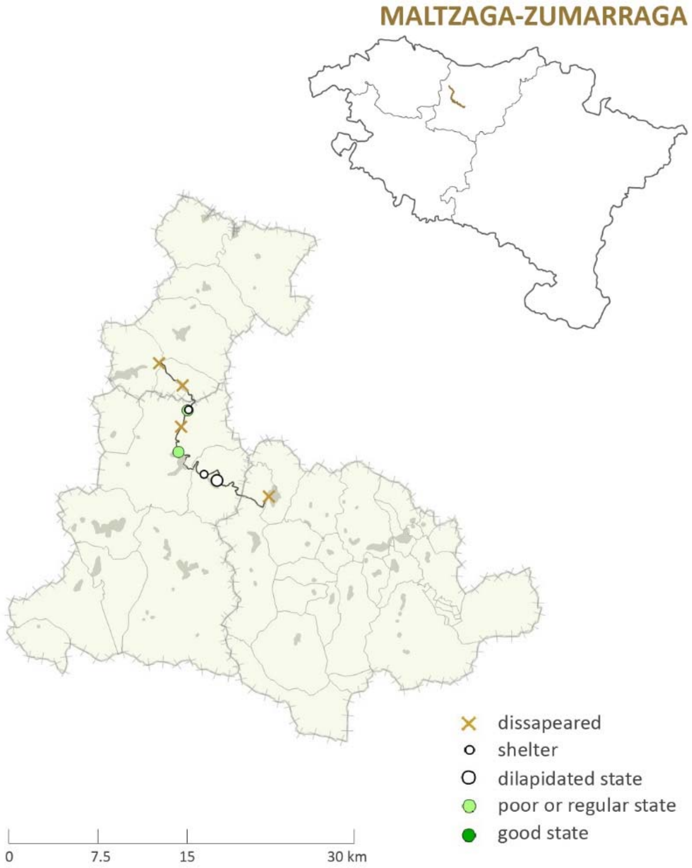


Figure 3.8 Maltzaga-Zumarraga Railway

Table 3.3 Inventory of the Maltzaga-Zumarraga Railway with the information referring to the nodes

MALTZAGA-ZUMARRAGA RAILWAY												
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	MALTZAGA	545719.00	4782341.00	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
2	SORALUZE	547774.00	4780407.00	STATION	STACION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	LOS MARTIRES	548366.10	4778317.10	HALT	-	-	-	-	-	0	0
3	LOS MARTIRES	548213.74	4778243.74	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	WAREHOUSE	BAD	134	1
4	MEKOALDE	547642.00	4776821.00	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
5	BERGARA	547415.00	4774621.00	STATION	STACION_WAREHOUSE_ ELECTRICAL SUBSTATION	WAREHOUSE_ ELECTRICAL SUBSTATION	PUBLIC USE	REHEARSAL STUDIOS	REGULAR	470	2
6	ANTZUOLA	549652.00	4772680.00	HALT	-	-	-	-	-	0	0
7	AMILLETA	550765.00	4772189.00	STATION	STATION	STATION	DISUSED	-	DISAPPEARED	0	0
8	ZUMARRAGA	555325.00	4770749.00	STATION	STACION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0

of the North in Zumarraga. Nevertheless, the different gauges of these lines encouraged the creation of the company called Ferrocarriles Vascongados and the extension of the line until Donostia in narrow gauge, connecting the two capitals. The line was electrified in 1929. Although the Bilbao-Donostia section is still in use, the brand between Maltzaga and Zumarraga fell into disuse in 1971 and it was definitively closed in 1975.

The disused section crosses from the Deba valley to the Urola valley, going through the mountain pass of Descarga and Antzuola. The lower part of the section is used as a cycling line, while the mountain pass has been somewhat adapted for pedestrian and cycling users. Furthermore, although the railway station of Bergara has disappeared, as the other main stations did, the electrical subcentral and the warehouse still exist.

UROLA RAILWAY

The Urola Railway was opened in 1926 and it was the last in starting its construction. That is why it was electrified from its beginning, although it was not the initial idea.

For the first time in Spain, substations with mercury vapour rectifiers were used instead of the previously used rotary converters. Furthermore, this railway was also a pioneer in the use of a 1,500 V DC voltage in its electrification, which has become the usual one in the lines narrower than the "normal" gauge over time (J. Olaizola, 2004). This railway went through the Urola valley and connected the Railroad of the North in Zumarraga to the Ferrocarriles Vascongados (Bilbao-Donostia) in Zumaia. The last train ran in 1987 and the line was closed in 1988. It was the last to close.

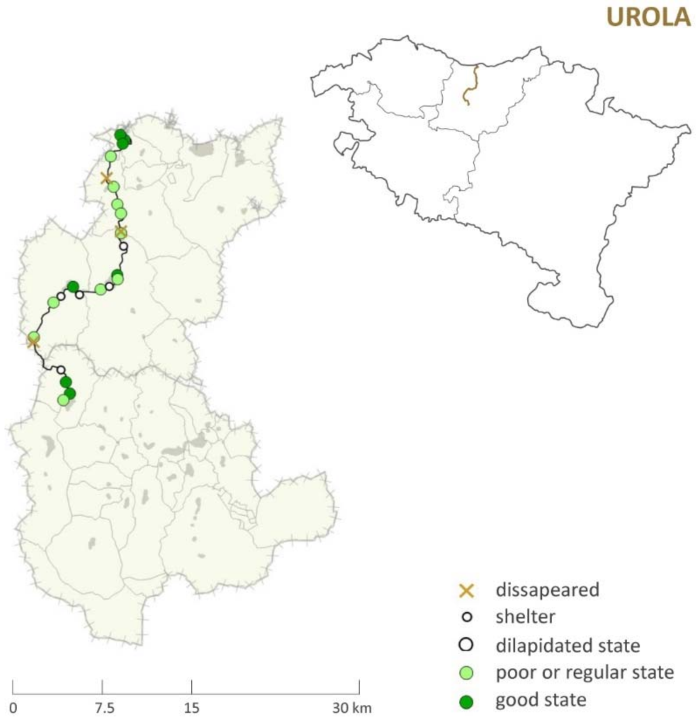


Figure 3.9 Urola Railway

Nowadays, it preserves most of the elements, such as all railway stations. Hence, it is one of the lines with more conserved elements due to the late closing and the interest of institutions for a future possible railway use. Moreover, the infrastructure is currently used as a greenway or a cycling line in most of its sections. However, there are sections that are still disused.

Referring to the railway buildings and their ownerships, two groups can be distinguished. On the one hand, city councils have owned the buildings located in the southern section. On the other hand, the Provincial Council has owned the buildings located in the north section[2]. While some of them are disused, others have public uses, such as a public library or a museum.

[2] The reactivation of the railway was proposed for this area in the Regional Sectorial Plan of the Basque Railway Network (Basque Government, 2001).

They cumulate 9000 built metres distributed in 17 different railway nodes. Most of them were composed by the passenger building and the warehouse, but there are others that have several elements, such as the railway station of Azpeitia (table 3.4), which has been restored into the Basque Railway Museum.

UROLA RAILWAY											
ID	**NAME**	**LOCATION (X)**	**LOCATION (Y)**	**GENERAL USE**	**BUILDINGDS**	**CURRENT BUILDINGS**	**CURRENT USE**	**SPECIFIC USE**	**CURRENT STATE**	**FLOOR AREA**	**Nº FLOORS**
1	ZUMARRAGA	555320.83	4770805.31	STATION	STACION_WAREHOUSE	STATION	DISUSED	-	BAD	434	3
2	URRETXU	555897.96	4771379.52	STATION	STACION_WAREHOUSE	STATION	PUBLIC USE	YOUTH CENTRE	GOOD	224	2
2	URRETXU	555546.49	4772379.9	GATEKEEPER´S HOUSE	HOUSE	HOUSE	DISUSED	-	GOOD	106	2
2	AGUIÑETA	555116.25	4773438.66	HALT	SMALL BUILDING	-	-	-	-	0	0
3	AIZPURUTXO	552732.4	4775884.06	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	AIZPURUTXO	552758.23	4776294.04	STATION	STATION	STATION	DISUSED	-	BAD	258	3
4	OLOTZAGA	554466.34	4779316.95	HALT	SMALL BUILDING	SMALL BUILDING	PRIVATE USE	WAREHOUSE	REGULAR	66.4	1
4	FORJAS JUBILAGA	555113.33	4779851.84	HALT	SMALL BUILDING	-	-	-	-	0	0
4	AZKOITIA	556171.59	4780686.02	STATION	STACION_WAREHOUSE	STATION	PUBLIC USE	LIBRARY	GOOD	498	3
4	SAN JUAN	556736.79	4779992.45	HALT	SMALL BUILDING	-	-	-	-	0	0
5	LOIOLA	558577.57	4780457.14	STATION	STACION_WAREHOUSE	STATION	DISUSED	-	REGULAR	219	2
6	BARRENETXEA	559329.93	4780716.87	HALT	?	-	-	-	-	0	0
6	AZPEITIA	560063.09	4781350.9	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PUBLIC USE	REHEARSAL STUDIOS	REGULAR	106	2
6	AZPEITIA	560022.25	4781708.54	STATION	STATION_WAREHOUSE_ OFFICES_DEPOT_POWER PLANT	STATION_OFFICESS_ DEPOT_POWER PLANT	PUBLIC USE	RAILWAY MUSEUM	GOOD	4602	3
7	DANONA-ANARDI	560572.71	4784222.97	HALT	SMALL BUILDING	-	-	-	-	0	0
7	LASAO	560349.73	4785359.04	STATION	STATION_ELECTRICAL SUBSTATION	STATION_ELECTRICAL SUBSTATION	PUBLIC USE	RAILWAY MUSEUM	REGULAR	356	2
7	LASAO	560338.8	4785506.58	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
8	ZESTOA-BALNEARIO	560348.41	4787077.06	STATION	STACION_WAREHOUSE	STACION_WAREHOUSE	DISUSED	-	REGULAR	340	2
9	ZESTOA-VILLA	560032.54	4787870.07	STATION	STACION_WAREHOUSE	STACION_WAREHOUSE	DISUSED	-	BAD	451	3
10	IRAETA	559702.42	4789400.36	STATION	STACION_WAREHOUSE	STACION_WAREHOUSE	DISUSED	-	BAD	312	2
11	ARROA	559099.25	4790156.99	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
11	ARROA	559462.74	4792052.44	STATION	STACION_WAREHOUSE	STACION_WAREHOUSE	DISUSED	-	BAD	316	2
12	ZUMAIA	560500.14	4793157.68	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	HOUSE	GOOD	106	2
12	ZUMAIA-EMPALME	560688.14	4793458.96	STATION	STACION_WAREHOUSE/ DEPOT	STATION	RAILWAY	STATION	GOOD	200	2
13	ZUMAIA PUERTO	560293.97	4793909.69	STATION	STACION_WAREHOUSE	STATION	DISUSED	-	GOOD	411	3

Table 3.4 Inventory of the Urola Railway with the information referring to the nodes

TRASLAVIÑA-CASTRO RAILWAY

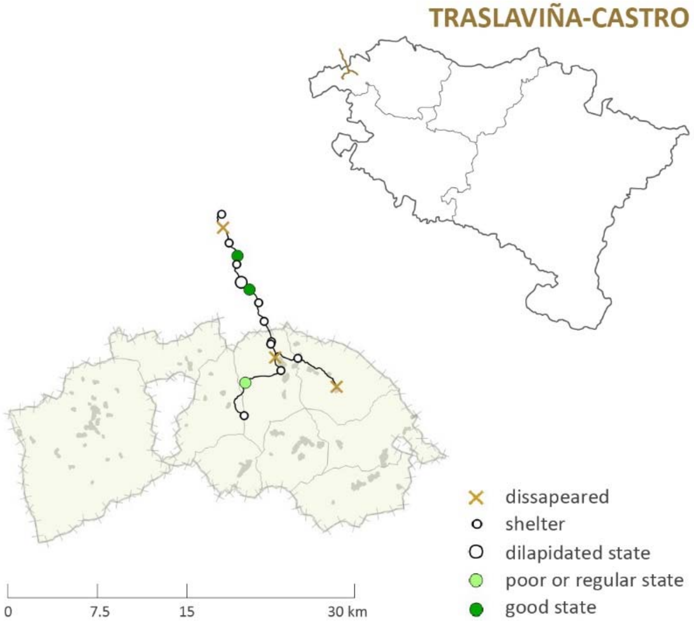
This railway interrelated Traslaviña with Castro Urdiales connecting the provinces of Bizkaia and Cantabria. It also included a branch that linked Sopuerta with Galdames. Furthermore, the combination with the Bilbao-Santander Railway (narrow gauge) happened in Traslaviña, making it easier to travel directly from Castro Urdiales to Bilbao.

The Traslaviña-Castro Railway was opened in 1898 and closed in 1966, without being electrified. Nowadays, the line is partly used as a greenway and some of the railway buildings are still preserved. Nonetheless, many of the railway nodes were rail sidings or loading docks, and did not have important buildings due to the main mining purpose of the railway.

SONDIKA-MUNGIA RAILWAY

The DRL between Sondika and Mungia was part of the Lutxana-Mungia Railway line, which was opened in 1894 and electrified in 1950. An extension to Bermeo was also projected, but it was never built. It was part of the Suburban Railways and Transports of Bilbao. In this context, the closure of 13 kilometres (Sondika-Mungia) of the total 18 kilometres happened in 1970.

The station located in Mungia and two houses were the main railway buildings in the operational period. The other railway nodes were comprised by small buildings or shelters that worked as halts. Nowadays, a gatekeeper house is only preserved and the disused infrastructure has been partially converted into a greenway.



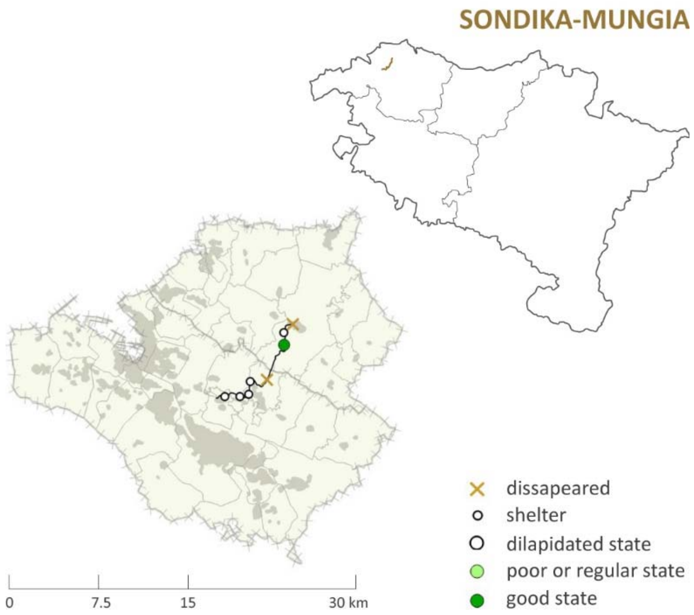


Figure 3.10 Traslaviña-Castro Railway

Figure 3.11 Sondika-Mungia Railway

TUDELA-TARAZONA RAILWAY

Tudela-Tarazona Railway was opened in 1886 and it connected the provinces of Navarre and Zaragoza. Although it was a narrow gauge railway in its beginnings, it was changed to the broad gauge (1.67 m) in 1952 as mentioned before. Even so, the line was closed in 1972.

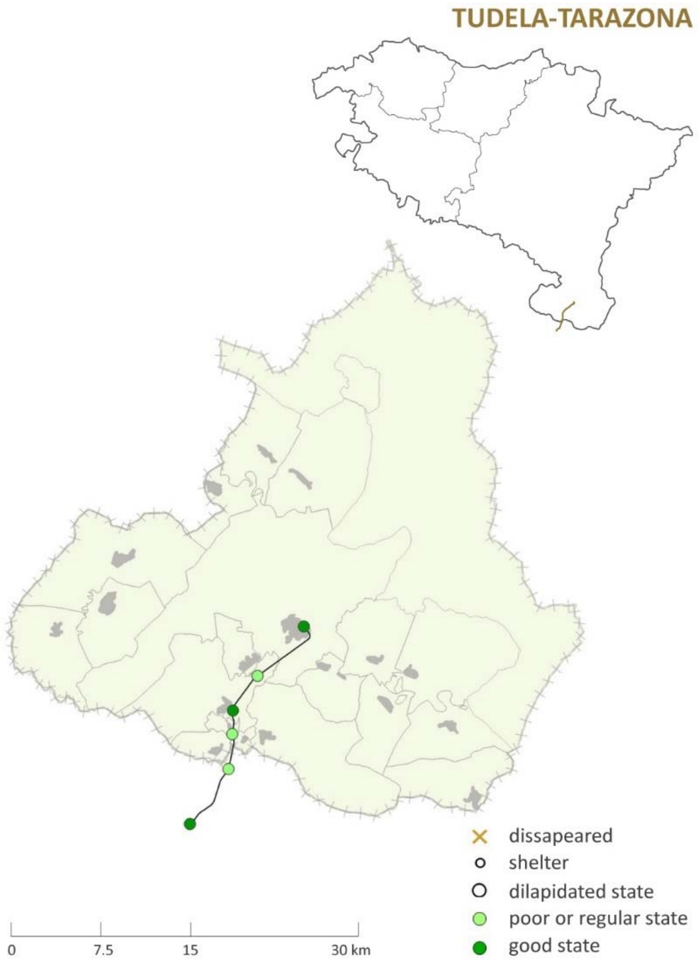


Figure 3.12 Tudela-Tarazona Railway

These days, the infrastructure has already been adapted as a greenway and all railway stations are still standing. The latter are located close to the urban areas but out of them.

IRATI RAILWAY

The Irati Railway linked Iruñea to Zangoza since 1911 and it included a small branch to Aoiz. Although the initial project developed a railway between Aoiz and Iruñea, which was used

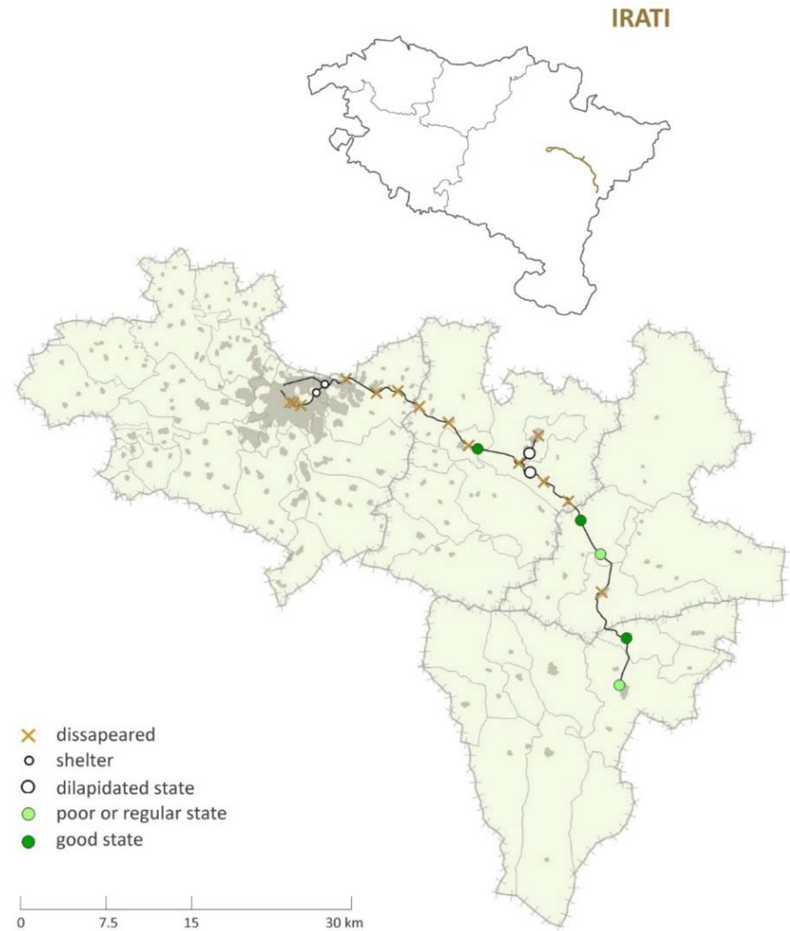


Figure 3.13 Irati Railway

to transport wood from the Irati Forest and produce electrical power, the extension of the line to Zangoza was decided soon. In this regard, both good and passenger transport were included from its beginning. Moreover, it was an electrified railway, being one of the earliest in Spain and the only Spanish railway that used the single-phase alternating current until its implementation in the Madrid-Seville Ave in 1992 (Martinena, 1998). Finally, the track along the urban area of Iruñea was removed in 1946 and all the line was closed in 1955.

As in the previous cases, the infrastructure is nowadays used as a greenway. In addition, all the nodes located in the northern half of the line, where the main city is located, have disappeared. Meanwhile, several buildings are preserved in the southern half part, although they all have private uses.

PLAZAOLA RAILWAY

A railway that linked the Plazaola mines to Andoain (the Railroad of the North) was built in 1905, which was extended between Iruñea and Lasarte by 1914. Thus, the Plazaola Railway connected the Navarre capital with Lasarte, where one the railway nodes of the narrow gauge Bilbao-Donostia line was located. The line was not electrified and was closed in 1959 due to the damages produced by the floods of 1953.

Nowadays, part of the infrastructure is used as a greenway and the former railway station of Lekunberri has been restored as the Tourism Consortium of Plazaola and the Tourist Office of Lekunberri, in addition to include a craft shop and a bar. Moreover, a project called Ederbidea[3] that will enhance the greenway and will include it in Eurovelo (the European cycle route network) is being developed.

Figure 3.14 Plazaola Railway

[3] Ederbidea is a cross-border mobility project that has been endorsed under the European Territorial Cooperation (ETC) Interreg-POCTEFA 2014-2020, through the European Regional Development Fund (Feder).

BIDASOA RAILWAY

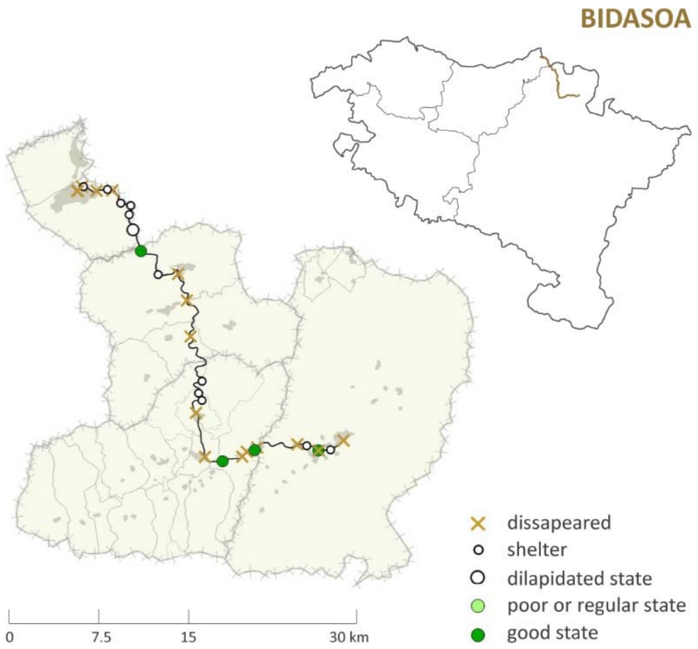
The mining railway from Irun to Endarlatsa (1890) was the predecessor of this line, which was widened and extended to Elizondo in 1916. Its track layout ran throughout the Bidasoa river, which is the border between Spain and France it is final section. Furthermore, it had a connection to the Donostia-Hendaia line in Irun. The Bidasoa Railway was never electrified and was closed in 1956.

The disused line has been reconverted into a greenway and is currently part of the Ederbidea project, as in the case of Plazaola. The disappearing of the railway nodes located in the main city (Iruñea) is another similarity to Plazaola. Nonetheless, they are not the only nodes that have disappeared, since few buildings have been maintained, as well as they have private uses.

BILBAO-LEZAMA RAILWAY

Bilbao-Lezama Railway was inaugurated in 1895, but 10 of the 15 kilometres of the infrastructure were already closed and substituted in 1905 (Bilbao-Derio). As in the previous case, it was part of the Suburban Railways and Transports of Bilbao and was electrified in 1950.

The only main railway station was in Bilbao (Calzadas), which is currently the Archaeological Museum of Bizkaia. Furthermore, the infrastructure is used as a rural path out of the urban area, while it is part of the existing street network in the urban setting.



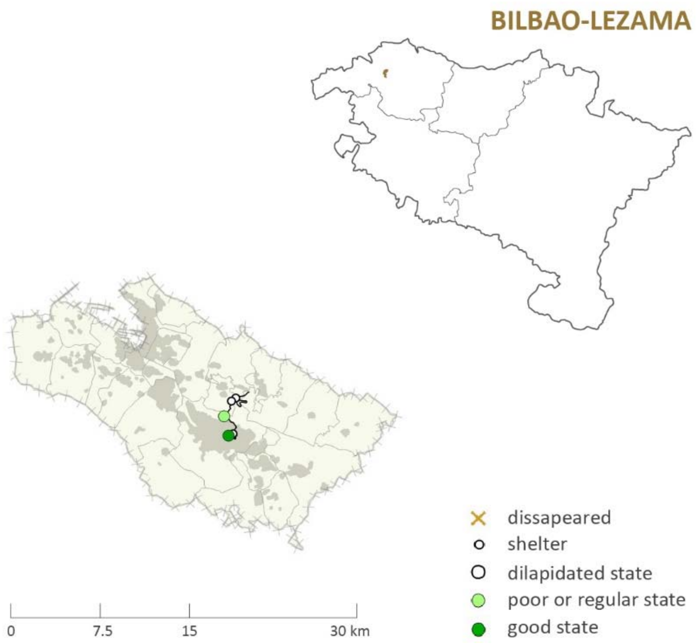


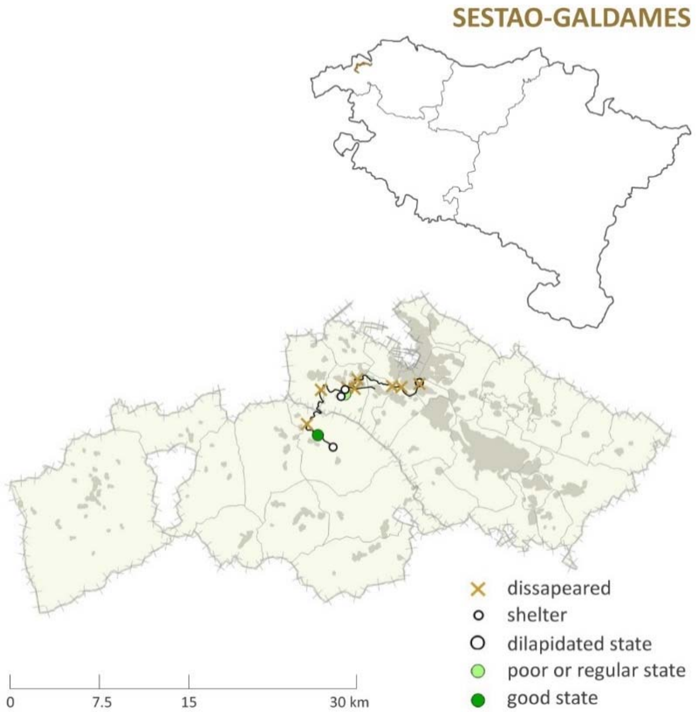
Figure 3.15 Bidasoa Railway

Figure 3.16 Bilbao-Lezama Railway

SESTAO-GASDAMES RAILWAY

The principal aim of the Sestao-Galdames Railway was to connect the mines located in the mountains of Galdames to the main river in Sestao. However, the railway was also operational for passenger transport.

This railway was the first of the studied lines to be constructed and the oldest to be in operation (1876-1969). Additionally, it employed the 1.15 metre gauge. In this regard, it was the only that was not of the common narrow gauge and the first mining railway to be operated by a private company in the Basque-Navarre territory[4]. Currently, although it is partly used as a greenway, most of the railway nodes have disappeared.



DURANGO-ELORRIO RAILWAY

Durango-Elorrio Railway was a branch of the Ferrocarriles Vascongados, as Maltzaga-Zumarraga. This branch went from Durango to Apatamonasterio, where was bifurcated to Elorrio and the mines of Arrazola. It was definitely closed in 1975.

Referring to the current state of this disused line, on the one hand, the infrastructure is used as a greenway. On the other hand, the passenger building and the warehouse of Apatamonasterio, which have public use, form the biggest element that is conserved in this line.

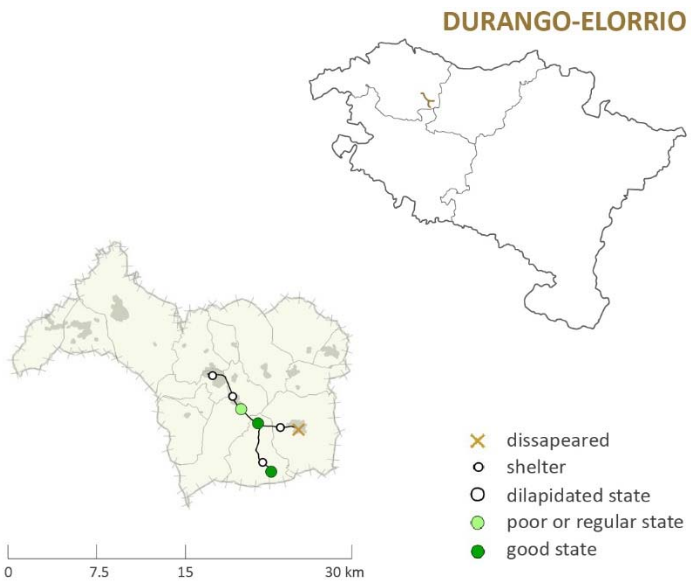


Figure 3.17 Sestao-Galdames Railway

Figure 3.18 Durango-Elorrio Railway

[4] Last seen January 2018, in: www.spanishrailway.com/2012/03/24/ferrocarril-de-galdames-a-sestao/

VASCO-NAVARRO RAILWAY

The Vasco-Navarro Railway is the longest disused railway (139 km) of the analysed territory and the only one that crosses three different provinces. The total line between Mekoalde and Lizarra was opened in 1927, but the section from Vitoria-Gasteiz to Arlaban was already operative since 1888, to Leintz Gatzaga since 1903 and to Mekoalde since 1919. Only two years after the opening of the line (1929), the southern sector of the line was electrified, while the northern section was not transformed until 1938. The total closure of the line happened in 1967.

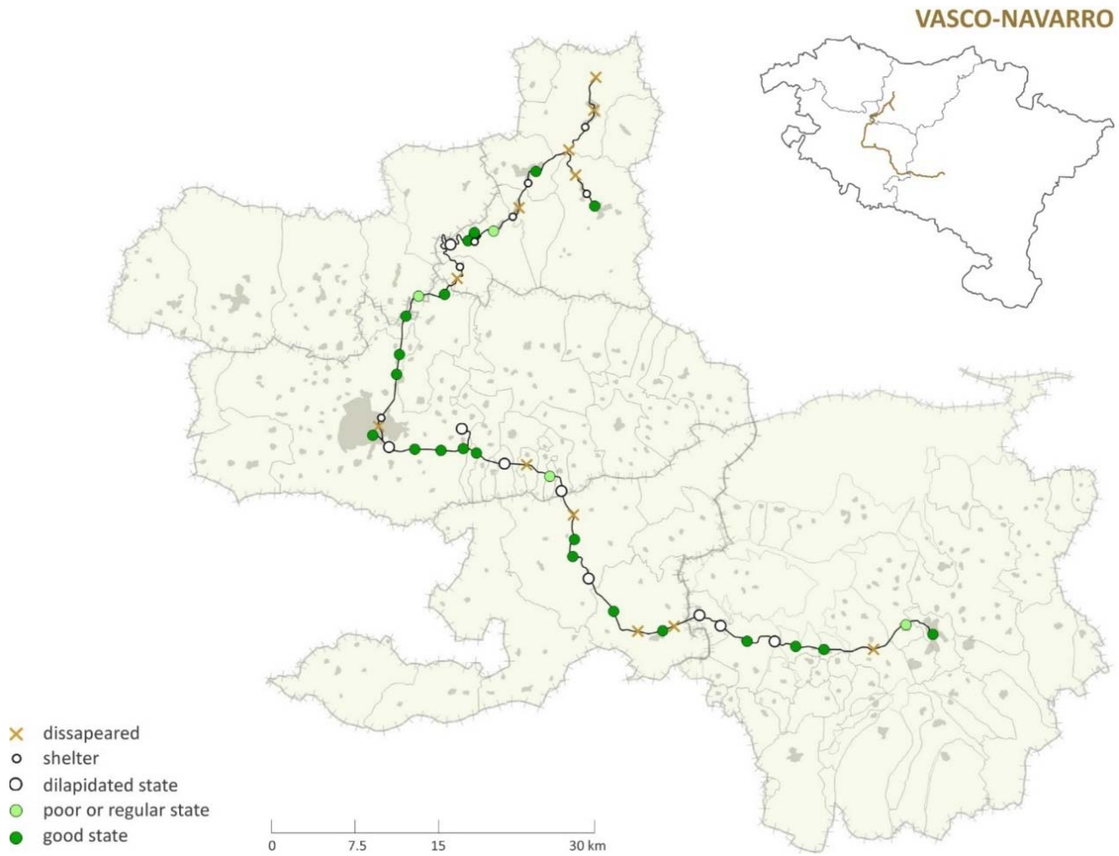


Figure 3.19 Vasco-Navarro Railway

The significant time gap between the aperture data of the mentioned sections produced the necessity to substitute the primitive railway stations by the end of the railway construction. In several cases, such as Landa or Villareal, both stations were conserved and the primitive station was used as a warehouse. The Vasco-Navarro Railway is the DRL with the highest number of railway nodes, from which almost 12000 m^2 are still preserved distributed in 33 existing nodes.

Taking all the above into consideration, it is possible to say that the current state of the railway elements would depend on the urban and economic development of their surroundings. Thus, all the railway nodes located in the main cities (except Bilbao-Calzadas) have disappeared, while the infrastructure layout has disappeared or has been adapted into the existing street network. Meanwhile, many of the railway nodes have been preserved in small population areas, especially in the rural areas of limited industrial and urban development. However, most of the nodes have private uses or a public use that is not related to the line itself. Finally, in middle-size towns, the preservation of the railway elements has been conditioned by the industrial development and the amount of available urban land.

However, it is also necessary to add that the railway closure data and in consequence, the development status at that time have also influenced the preservation of railway elements.

3.3.2. Initial comprehensive analysis of the Basque-Navarre DRSs

DATA

In addition to the first step for the identification and classification of the twelve main DLSs of the Basque-Navarre territory, the previous GIS based inventory is the main database of the following comprehensive analysis. Accordingly, data related to the systems have been organised according to the inventory, so the following indicators have been included in the shapefiles related to the lines and the nodes:

- Line: ID; Name; Opening year; Route; Route distance; Gauge; Type of transport; Year of electrification; Year of closure; Current route; Current route distance; Current use;

- Nodes: ID; Name; Location (x); Location (y); General Use; Buildings; Current buildings; Current use; Specific use; Current state; Floor area; Nº of floors;

Besides the inventory referred to all the systems, data related to the territory have been compiled for the initial approach of the comprehensive analysis. As mentioned before, railway heritage is directly related to its surrounding territory, generating relations between them. Thus, a polygon shapefile with municipal boundaries has been created to represent surrounding territorial data. The required attribute tables of these shapefiles have been defined with the following characteristics:

- Territory: ID; Name; Area; Population (beginning of the railway activity); Population (closure of the railway activity); Current population.

Finally, other shapefiles have been used to represent towns and rural communities, rivers, protected natural areas or main infrastructures.

A data collection and fieldwork were performed to create the system shapefiles. Otherwise, data concerning the territory were obtained from the spatial data infrastructures of each territory (Basque Country: geo.euskadi.net; Navarre: idena.navarra.es). Historical and current demographic data were also included from the Basque Statistics Institute (Eustat), the Statistical Institute of Navarre and the Spanish Statistical Office (INE). In this study, the demographic data of 1930 and 1981 were compiled regarding the historical state. In the first date, all selected lines had been already constructed, whereas in the second, all of them had been closed or were on the verge of it. Data related to 2013 was used as current population.

COMPREHENSIVE ANALYSIS OF THE DRSs

The analysis has been applied to the six mentioned parts (A, B, C, D, E, F) of each system, taking into account both component elements and their relations. According to the methodology, two variables have been obtained in each of them.

The part of the analysis referred to **the line** (A) has been neglected due to the similarities in the results. Nowadays, all selected lines have similar gauge (1 m, “narrow gauge”) or current use (greenway or cycle lane). That is why the paths remain at a high proportion although some kilometres have disappeared. Disappeared sections usually appear in areas where a rapid urban growth have happened or where new infrastructures have been built, such as highways or main roads.

In the analysis related to **the nodes** (B), the two variables have been obtained from collected data and divided into the four

Table 3.5 Node analysis of the initial comprehensive methodology

NODE ANALYSIS (B)

	VARIABLE 1: HISTORICAL OR CONSTANT STATE	VARIABLE 2: CURRENT STATE						V.1	V.2	CAT.
	existing nodes	state of preservation %				disused	public use			
	%	ruin	poor	regular	good	% of existing	% of in use	range	range	cat.
Urola	84.21	0	31.25	25	43.75	56.25	71.43	r. 1	r. 2	1
Maltzaga-Zumarraga	28.57	0	50	50	0	0	50	r. 3	r. 3	2
Vasco-Navarro	73.33	24.24	9.09	3.03	63.64	33.33	54.55	r. 2	r. 2	2
Durango-Elorrio	66.67	0	0	0	100	0	100	r. 2	r. 1	1
Plazaola	50	28.57	0	0	71.43	28.57	60	r. 3	r. 2	2
Tudela-Tarazona	100	0	16.67	33.33	50	50	66.67	r. 1	r. 2	1
Traslaviña-Castro	55.56	20	0	20	60	20	50	r. 2	r. 2	2
Sestao-Galdames	20	0	0	50	50	0	100	r. 4	r. 1	5
Sondika-Mungia	33.33	0	0	0	100	100	0	r. 3	r. 3	2
Bilbao-Lezama	100	0	0	0	100	0	100	r. 1	r. 1	1
Irati	31.58	16.67	0	33.33	50	16.67	0	r. 3	r. 2	2
Bidasoa	23.81	20	0	0	80	20	0	r. 4	r. 2	5
		x 1	x 2	x 3	x 4					
r. 1	76 - 100	326 - 400				0 - 25	76 - 100			
r. 2	51 - 75	251 - 325				26 - 50	51 - 75			
r. 3	26 - 50	176 - 250				51 - 75	26 - 50			
r. 4	0 - 25	100 - 175				76 - 100	0 - 25			

ranges (table 3.5). The first variable refers to the percentage of nodes preserved, whereas the second refers to their current state of preservation. Depending on the combination of these variables, the disused railway lines have been categorised in the previously presented five categories, which represent the capability range of territorial structuring of the system. V.1. in table 3.6 refers to the total range of the indicators analysed in the variable 1 (historical or constant state) while V.2. represents the total range of the second variable (current state). Categorisation (CAT. In table 3.5) has been obtained from the combination of these two.

In the historical or constant state, Urola, Tudela-Tarazona and Bilbao-Lezama Railways have the best results, although, the latter is related to a single node. In the current status, the state of preservation of the existing nodes is quite good in most of the systems, but the use of them varies depending on the system. In this regard, Durango-Elorrio, Sestao-Galdames and Bilbao-Lezama show the best results but all of them preserve only one or two nodes.

The data referred to the **line/node analysis** (C) have been similarly categorised in order to understand the internal relations of the system (table 3.6). Both variables are related to the distribution of the nodes along the line. The first one refers to the number of nodes and buildings per kilometre of railway line, while the second refers to the number of buildings and their floor areas in relation to the line. As two indicators have

Table 3.6 Line/node analysis of the initial comprehensive methodology

LINE/NODE ANALYSIS (C)	VARIABLE 1: HISTORICAL OR CONSTANT STATE		VARIABLE 2: CURRENT STATE		V.1	V.2	CAT.
	nodes per line km	buildings per line km	buildings per line km	floor surface per	range	range	cat.
Urola	0.68	0.52	0.44	244.12	r. 1	r. 1	1
Maltzaga-Zumarraga	0.34	0.27	0.08	22.77	r. 2	r. 4	5
Vasco-Navarro	0.39	0.33	0.24	87.67	r. 3	r. 2	2
Durango-Elorrio	0.46	0.2	0.13	37.22	r. 3	r. 3	2
Plazaola	0.21	0.17	0.08	34.52	r. 4	r. 3	3
Tudela-Tarazona	0.27	0.27	0.27	257.27	r. 4	r. 1	4
Traslaviña-Castro	0.58	0.29	0.16	34.63	r. 2	r. 3	2
Sestao-Galdames	0.62	0.44	0.09	24.00	r. 1	r. 4	5
Sondika-Mungia	0.82	0.25	0.08	9.71	r. 2	r. 4	5
Bilbao-Lezama	0.47	0.09	0.09	92.55	r. 3	r. 3	2
Irati	0.41	0.33	0.1	33.57	r. 3	r. 3	2
Bidasoa	0.62	0.41	0.1	19.81	r. 1	r. 4	5
r. 1	>0.6	>0.4	>0.3	>100			
r. 2	0.46 - 0.6	0.31 - 0.4	0.21 - 0.3	66 - 100			
r. 3	0.31 - 0.45	0.21 - 0.3	0.11 - 0.2	31 - 65			
r. 4	≤0.3	≤0.2	≤0.1	≤30			

Table 3.7 Line/territory analysis of the initial comprehensive methodology

LINE/TERRITORY ANALYSIS (D)	VARIABLE 1: HISTORICAL			VARIABLE 2:				V.1	V.2	CAT.
						nº of towns per line km				
	line m per inhabitant (1930)	line m per population (1981)	line m per municipal area	line m per population (2013)	line m per municipal area	towns	town centres	range	range	cat.
Urola	1.41	0.68	178.40	0.65	178.40	0.33	0.16	r. 2	r. 2	2
Maltzaga-Zumarraga	1.44	0.62	181.40	0.69	181.40	0.19	0.11	r. 2	r. 2	2
Vasco-Navarro	1.49	0.49	104.92	0.42	104.92	0.31	0.16	r. 3	r. 2	2
Durango-Elorrio	1.03	0.41	143.04	0.34	143.04	0.59	0.33	r. 2	r. 2	2
Plazaola	1.38	0.34	160.02	0.31	160.02	0.28	0.09	r. 2	r. 3	2
Tudela-Tarazona	0.80	0.53	40.08	0.42	40.08	0.54	0.14	r. 2	r. 3	2
Traslaviña-Castro	1.55	1.86	140.53	0.85	140.53	0.55	0.26	r. 3	r. 2	2
Sestao-Galdames	0.45	0.29	213.98	0.34	213.98	0.44	0.18	r. 1	r. 2	1
Sondika-Mungia	1.30	0.55	159.05	0.41	159.05	0.57	0.33	r. 2	r. 2	2
Bilbao-Lezama	0.06	0.01	130.84	0.01	130.84	0.38	0.09	r. 2	r. 3	2
Irati	0.98	0.26	123.70	0.21	123.70	0.43	0.14	r. 2	r. 2	2
Bidasoa	1.56	0.77	94.41	0.70	94.41	0.42	0.17	r. 4	r. 3	3
r. 1	≤1	≤0.4	>170	≤0.25	>170	>0.5	>0.2			
r. 2	1.01 - 1.4	0.41 - 0.6	136 - 170	0.26 - 0.5	136 - 170	0.41 - 0.5	0.16 - 0.2			
r. 3	1.41 - 1.5	0.61 - 0.9	101 - 135	0.51 - 0.75	101 - 135	0.26 - 0.4	0.11 - 0.15			
r. 4	>1.5	>0.9	≤100	>0.75	≤100	≤0.25	≤0.1			

Table 3.8 Node/territory analysis of the initial comprehensive methodology

NODE/TERRITORY ANALYSIS (E)	VARIABLE 1: HISTORICAL OR CONSTANT STATE						VARIABLE 2: CURRENT STATE				V.1	V.2	CAT.
	nodes per population (1930)	buildings per population (1930)	nodes per population (1981)	buildings per population (1981)	nodes per municipal area	buildings per municipal area	buildings per population (2013)	floor surface per population (2013)	buildings per municipal area	floor surface per municipal area	range	range	cat.
Urola	0.97	0.73	0.46	0.35	0.12	0.09	0.28	158.10	0.08	43.55	r. 1	r. 1	**1**
Maltzaga-Zumarraga	0.50	0.39	0.21	0.17	0.06	0.05	0.05	15.60	0.01	4.13	r. 3	r. 3	**2**
Vasco-Navarro	0.58	0.49	0.19	0.16	0.04	0.03	0.10	36.75	0.03	9.20	r. 3	r. 2	**2**
Durango-Elorrio	0.47	0.20	0.19	0.08	0.07	0.03	0.04	12.64	0.02	5.32	r. 3	r. 3	**2**
Plazaola	0.29	0.23	0.07	0.06	0.03	0.03	0.03	10.84	0.01	5.52	r. 4	r. 3	**3**
Tudela-Tarazona	0.22	0.22	0.14	0.14	0.01	0.01	0.12	109.13	0.01	10.31	r. 4	r. 2	**5**
Traslaviña-Castro	0.90	0.45	1.08	0.54	0.08	0.04	0.14	29.44	0.02	4.87	r. 1	r. 3	**4**
Sestao-Galdames	0.28	0.20	0.18	0.13	0.13	0.09	0.03	8.16	0.02	5.14	r. 3	r. 4	**3**
Sondika-Mungia	1.07	0.32	0.45	0.14	0.13	0.04	0.03	3.95	0.01	1.54	r. 2	r. 4	**5**
Bilbao-Lezama	0.03	0.01	0.01	0.00	0.06	0.01	0.00	1.11	0.01	12.11	r. 4	r. 3	**3**
Irati	0.40	0.32	0.10	0.08	0.05	0.04	0.02	7.20	0.01	4.15	r. 3	r. 4	**3**
Bidasoa	0.96	0.63	0.47	0.31	0.06	0.04	0.07	13.89	0.01	1.87	r. 2	r. 3	**2**
r. 1	>0.8	>0.5	>0.5	>0.4	>0.1	>0.06	≥0.2	>100	>0.04	>15			
r. 2	0.41 - 0.8	0.36 - 0.5	0.31 - 0.5	0.21 - 0.4	0.061 - 0.1	0.04 - 0.06	0.1 - 0.19	25.1 - 100	0.03 - 0.04	9.1 - 15			
r. 3	0.31 - 0.4	0.26 - 0.35	0.11 - 0.3	0.11 - 0.2	0.041 - 0.06	0.02 - 0.03	0.051 - 0.09	10 - 25	0.02	4 - 9			
r. 4	≤0.3	≤0.25	≤0.1	≤0.1	≤0.04	<0.02	≤0.05	<10	0.01	<4			

Table 3.9 System/territory analysis of the initial comprehensive methodology

SYSTEM/TERRITORY ANALYSIS (F)	VARIABLE 1: HISTORICAL OR		VARIABLE 2: CURRENT STATE		V.1	V.2	CAT.
	river	montain crossing	strengthen line axis	protected natural areas	range	range	cat.
Urola	yes	no	yes	yes	r. 1	r. 1	**1**
Maltzaga-Zumarraga	partly	yes	partly	no	r. 3	r. 3	**2**
Vasco-Navarro	partly	yes	partly	yes	r. 3	r. 2	**2**
Durango-Elorrio	yes	no	partly	yes	r. 1	r. 2	**1**
Plazaola	partly	no	yes	yes	r. 2	r. 1	**1**
Tudela-Tarazona	yes	no	no	no	r. 1	r. 4	**5**
Traslaviña-Castro	yes	no	no	no	r. 1	r. 4	**5**
Sestao-Galdames	partly	no	no	no	r. 2	r. 4	**5**
Sondika-Mungia	partly	no	partly	no	r. 2	r. 3	**2**
Bilbao-Lezama	no	yes	no	no	r. 4	r. 4	**3**
Irati	yes	no	no	yes	r. 1	r. 3	**4**
Bidasoa	yes	no	yes	yes	r. 1	r. 1	**1**
r. 1	yes	no	yes	yes			
r. 2	partly	no	partly	yes			
r. 3	partly	yes	partly	no			
r. 4	no	yes	no	no			

been used in both variables, the indicators have been weighted. For that purpose, the number of nodes in the historical state and the floor areas in the current state have been considered more influential.

Accordingly, Urola, Sestao-Galdames and Bidasoa are the systems that had more railway nodes and buildings in relation to the line length. Nowadays, the Urola Railway also has the highest rates. However, the other two present the worst results, together with Maltzaga-Zumarraga and Sondika-Mungia.

The same categorisation has been applied to the external relations (D, E and F) created along the studied lines. In the case of the **line/territory analysis** (D), territorial features in relation to the line length have been analysed (table 3.7). Three indicators have been measured in each variable, where the number of towns and town centres form the same indicator.

Therefore, Sestao-Galdames has the highest range in the historical state and the Bidasoa Railway has the lowest one. Meanwhile, other systems show similar medium results in both variables, concluding in a middle range capability.

In the **node/territory analysis** (E), territorial features in relation to the railway nodes have been studied using three indicators for the first variable and two indicators for the second (table 3.8). All indicators are composed of two different data in this area, where the number of nodes and the floor area of the nodes are more influential than the number of railway buildings.

In this analysis area, Urola and Traslaviña-Castro railways show the highest potential in the historical or constant state, but only Urola maintains the same level in the current state. Plazaola, Tudela-Tarazona and Bilbao-Lezama show the lower potentials in the first variable and Sestao-Galdames, Sondika-Mungia and Irati in the second. Moreover, taking into consideration both variables, Plazaola, Sestao-Galdames, Bilbao-Lezama and Irati present a limited range capability for territorial structuration in the node/territory area.

Lastly, and taking into consideration the whole system in relation to the territory —**the system/territory analysis** (F) —, the territorial axis where the system is located has been studied, showing the presence of other systems that can support or restrain its influence (table 3.9). For that purpose, the existence of other systems has been defined in the entire axis or in a section of it.

In this regard, most of the systems have high ranges in the first variable because railways were usually located in the lower areas of valleys, which means that they were located close to the rivers and they do not cross any mountain. Meanwhile, Urola, Plazaola and Bidasoa railways preserve this range in the second variable, since their territorial axes are strengthened by the spatial planning guidelines and protected natural areas are located around them. Nevertheless, several systems show low ranges in the second variables, such as Tudela-Tarazona, Traslaviña-Castro, Sestao-Galdames, Bilbao-Lezama or Bidasoa.

In summary, table 3.10 shows the results of all analysis areas of the initial comprehensive method, thus creating the characterisation of each system. Accordingly, the main conclusions of the study can be obtained. On the one hand, the Urola Railway delivers the best results because it was the last to close and it preserves almost all its nodes. This means

Table 3.10 Results of the different analysis areas of the initial comprehensive methodology

COMPREHENSIVE ANALYSIS	NODE (B)			NODE/LINE (C)			LINE/TERRITORY (D)			NODE/TERRITORY (E)			SYSTEM/TERRITORY (F)		
	V.1	V.2	CAT.	V.1	V.2	CAT.	V.1	V.2	CAT.	V.1	V.2	CAT.	V.1	V.2	CAT.
Urola	r. 1	r. 2	1	r. 1	r. 1	1	r. 2	r. 2	2	r. 1	r. 1	1	r. 1	r. 1	1
Maltzaga-Zumarraga	r. 3	r. 3	2	r. 2	r. 4	5	r. 2	r. 2	2	r. 3	r. 3	2	r. 3	r. 3	2
Vasco-Navarro	r. 2	r. 2	2	r. 3	r. 2	2	r. 3	r. 2	2	r. 3	r. 2	2	r. 3	r. 2	2
Durango-Elorrio	r. 2	r. 1	1	r. 3	r. 3	2	r. 2	r. 2	2	r. 3	r. 3	2	r. 1	r. 2	1
Plazaola	r. 3	r. 2	2	r. 4	r. 3	3	r. 2	r. 3	2	r. 4	r. 3	3	r. 2	r. 1	1
Tudela-Tarazona	r. 1	r. 2	1	r. 4	r. 1	4	r. 2	r. 3	2	r. 4	r. 2	5	r. 1	r. 4	5
Traslaviña-Castro	r. 2	r. 2	2	r. 2	r. 3	2	r. 3	r. 2	2	r. 1	r. 3	4	r. 1	r. 4	5
Sestao-Galdames	r. 4	r. 1	5	r. 1	r. 4	5	r. 1	r. 2	1	r. 3	r. 4	3	r. 2	r. 4	5
Sondika-Mungia	r. 3	r. 3	2	r. 2	r. 4	5	r. 2	r. 2	2	r. 2	r. 4	5	r. 2	r. 3	2
Bilbao-Lezama	r. 1	r. 1	1	r. 3	r. 3	2	r. 2	r. 3	2	r. 4	r. 3	3	r. 4	r. 4	3
Irati	r. 3	r. 2	2	r. 3	r. 3	2	r. 2	r. 2	2	r. 3	r. 4	3	r. 1	r. 3	4
Bidasoa	r. 4	r. 2	5	r. 1	r. 4	5	r. 4	r. 3	3	r. 2	r. 3	2	r. 1	r. 4	1

that it has a high territorial structuring potential, in order to cover new uses beyond the current greenways. On the other hand, the results of Plazaola, Sondika-Mungia and Bilbao-Lezama railways show that they have fewer possibilities to assume different uses for the territorial structuring, leaving their future direction towards the use of their paths as territorial infrastructures.

Nevertheless, the uniformity analysis of the node/line relations, developed by box-plot type graphs (see annex 1.2), reveals that some of the systems need a division into zones for the achievement of more accurate results. For that purpose, three factors (interquartile range, position of the Q2 and number of outliers) have been measured and represented in table 3.11. Taking into consideration the midspread or irterquartile range, most of the systems were quite regular in their creation (except Maltzaga-Zumarraga, Plazaola and Tudela-Tarazona), but some of the nodes have changed over the years and hence uniformity results have generally worsened. This depends on the territory and the urban areas that each line goes through. In the main cities, for example, almost all the nodes have disappeared, as in other cities where urbanisation processes have developed rapidly. Conversely, the railway nodes located in rural areas have not suffered any urban development pressure.

Although the lack of uniformity cannot be fixed with a division of the system in some cases (such as Plazaola, because any division would be irregular itself), some systems can be divided creating uniform sections that have different features. For instance, two adjacent outliers are obtained in the box-plot graphs created for the Urola Railway, which represent the division of the system into two zones. Meanwhile, some of the nodes have disappeared by zones in Irati and Bidasoa railways, so some outliers appear far from the remaining values, creating different zones (fig. 3.20). In the case of Bidasoa, three of the outliers of the historical state become a single outlier in the current state, which is one of the divided sections (B2) and creates in turn, the other two sections (B1 and B3). In the case of Irati, the railway nodes located close to the main city have disappeared, creating the I1 zone, while the other part of the

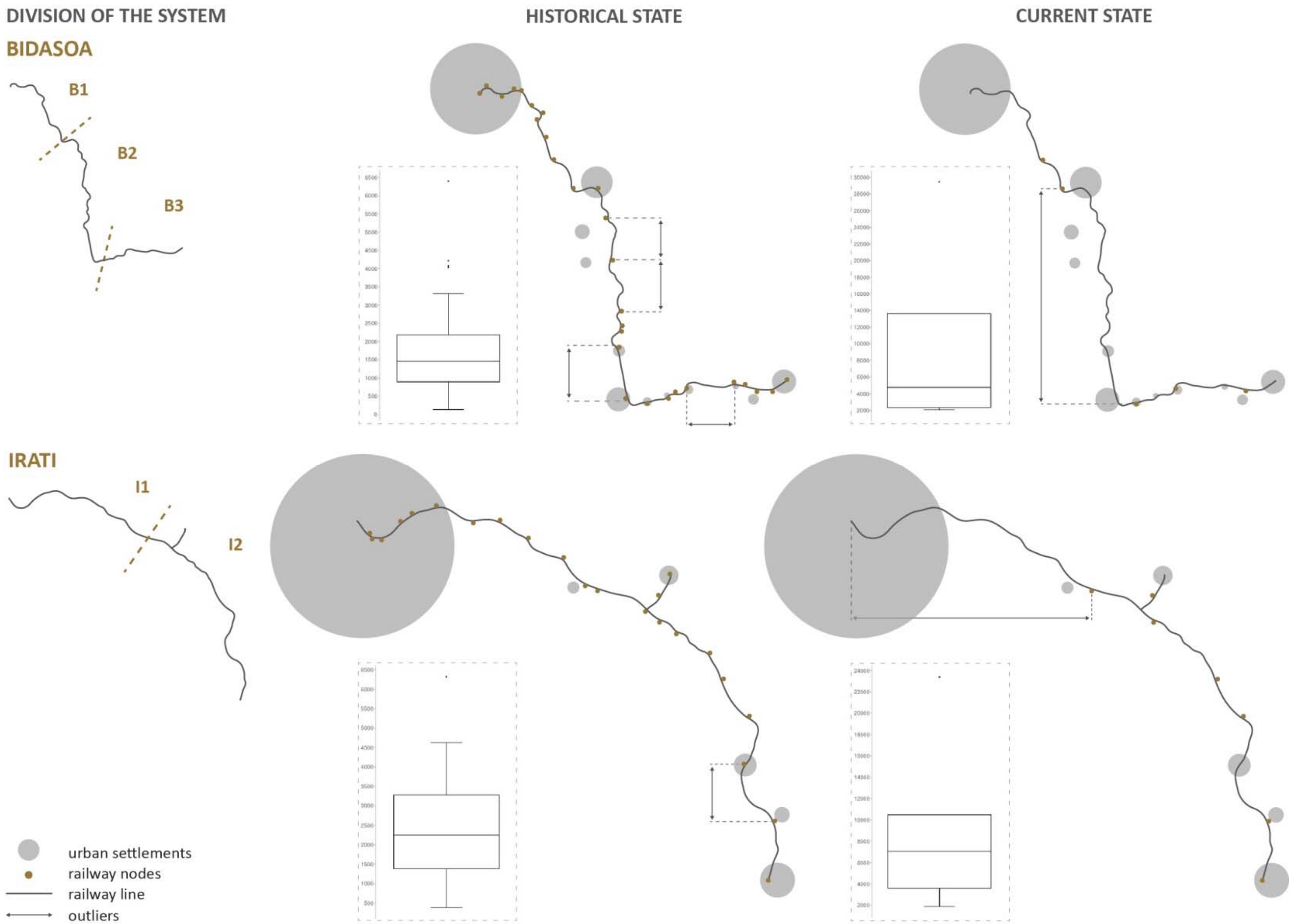


Figure 3.20 Uniformity analyses of Bidasoa and Irati DRSs

system (I2) preserves half of the railway nodes distributed quite uniformly. Finally, the division is not so clear in the case of the Vasco-Navarro Railway, since the obtained outliers are scattered along the line. That is why a partition that fits the territorial distribution has been proposed (five zones).

In this regard, the comprehensive analysis has been applied again to the new zones created after the divisions and their results are represented on the right part of table 3.12. The results of the division show that, Irati and Bidasoa railways present a zone where the results are worse than the ones

Table 3.11 Uniformity analysis. Some of the systems have not been analysed in the current state because they have few existing nodes (one or two).

UNIFORMITY ANALYSIS	HISTORICAL OR CONSTANT STATE			CURRENT STATE		
	IR level	Q2 position	Outliers	IR level	Q2 position	Outliers
Urola	1	middle	1	1	middle	2
Maltzaga-Zumarraga	2	middle	0	-	-	-
Vasco-Navarro	1	low	4	1	low	5
Durango-Elorrio	1	low	0	-	-	-
Plazaola	2	middle	0	4	middle	0
Tudela-Tarazona	2	low	0	2	low	0
Traslaviña-Castro	1	low	3	1	low	1
Sestao-Galdames	1	middle	0	-	-	-
Sondika-Mungia	1	low	1	-	-	-
Bilbao-Lezama	1	low	0	-	-	-
Irati	1	middle	1	2	middle	1
Bidasoa	1	low	4	3	low	1

Historical or constant state:
1 (≤2500)
2 (2501 - 5000)
3 (5001 - 7500)
4 (>7500)

Current state:
1 (≤2500)
2 2501 - 5000)
3 5001 - 7500)
4 (>7500)

obtained before the division (I1 and B2). It means that the divisions are adequate to understand the system in these two railways. In the case of Irati, the other zone has similar results while, in Bidasoa, the other two zones have better results than the whole system. However, the results after the division are similar in the case of Urola railway, so the division adds nothing new to the analysis. Finally, the results are worse than the ones obtained before the division in one of the zones of the Vasco-Navarro railway (VN2), while they are better in another (VN5). Although the other three have similar final results, the capability of each zone is different depending on the analysed area.

Accordingly, the comprehensive analysis has been able to show the elements and relations of each system, thus creating their general characterisation. Nevertheless, it is difficult to classify or compare these systems, especially when the results vary from one analysed area to another. In this regard, while Urola or Maltzaga-Zumarraga have the same results in four of the five areas, Bidasoa has different results in each area.

Table 3.12 Initial comprehensive analysis results. Entire systems are represented on the left side, while divided systems on the right

COMPREHENSIVE ANALYSIS	entire systems							divided systems						
	node	line/ node	line/ territory	node/ territory	system/ territory	total %		node	line/ node	line/ territory	node/ territory	system/ territory	total %	
Urola	1	1	2	1	1	**92**	**U1**	**1**	**1**	**2**	**1**	**1**	**92**	
Maltzaga-Zumarraga	2	5	2	2	2	**56**	**U2**	**4**	**1**	**1**	**2**	**1**	**88**	1: wide range
Vasco-Navarro	2	2	2	2	2	**60**	**VN1**	**4**	**2**	**2**	**3**	**1**	**64**	capability (c.)
Durango-Elorrio	1	2	2	2	1	**76**	**VN2**	**2**	**3**	**2**	**2**	**3**	**44**	4: can have a
Plazaola	2	3	2	3	1	**52**	**VN3**	**1**	**2**	**2**	**3**	**2**	**60**	wide range c.
Tudela-Tarazona	1	4	2	5	5	**56**	**VN4**	**2**	**4**	**3**	**2**	**4**	**60**	2: middle
Traslaviña-Castro	2	2	2	4	5	**60**	**VN5**	**1**	**4**	**3**	**1**	**4**	**76**	range c.
Sestao-Galdames	5	5	1	3	5	**56**	**I1**	**3**	**3**	**2**	**3**	**5**	**32**	5: can have a
Sondika-Mungia	2	5	2	5	2	**52**	**I2**	**2**	**2**	**3**	**2**	**4**	**56**	middle range
Bilbao-Lezama	1	2	2	3	3	**52**	**B1**	**3**	**4**	**1**	**2**	**1**	**72**	3: limited
Irati	2	2	2	3	4	**56**	**B2**	**3**	**3**	**2**	**5**	**1**	**48**	range c.
Bidasoa	5	5	3	2	1	**60**	**B3**	**2**	**4**	**2**	**2**	**1**	**72**	

PCA AND K-MEAN CLUSTERING OF THE DRSs

The results of the characterisation have already shown the high potential of the Urola line. However, results are more difficult to read in the cases where the partial outcomes of the different areas differ between them. In this regard, PCA has been used in order to compare the different systems, creating new components that combine the variables (B, C, D, E and F) and represent as much information as possible.

The PCA analysis has been applied to the 8 whole lines and the 12 zones of the four divided lines. The correlation matrix shown in table 3.13 reveals that the preservation of nodes (B) is intercorrelated with the relation between the line and the nodes (C), while the latter is also correlated with the relation between the nodes and the territory (E). Meanwhile, the relation between the line and the territory (D) and the relation between the whole system and the territory (F) are not correlated with any other variables.

In this regard, the first three components account for the 83.12% of the total variance, with a variance of up to 18%, while eigenvalues fall less than unity after the first two components (table 3.14). On the one hand, the first component or factor (F1) has a variance of 41.69% and is determined by the items related to the nodes (B, C and E), as expected in the correlation matrix. On the other hand, the factor F2 (23.14%) is characterised by the line/territory (D) and the system/territory (F) relations. Finally, the third factor F3 (18.29%) sets the line/territory (D) relations and the preservation of the nodes (B), although to a lesser extent. Accordingly, the two first components are easily able to represent all the variables. Fig. 3.21 represents the 20 DRSs depending on the new principal components.

CORRELATION MATRIX (Pearson (n))

Variables	B	C	D	E	F
B	**1**				
C	**0.519**	**1**			
D	-0.270	0.000	**1**		
E	0.223	**0.541**	-0.293	**1**	
F	-0.022	0.363	0.000	0.267	**1**

Table 3.13 Correlation matrix of the PCA. Values in bold represent significant correlation (95%)

EIGENVALUES

	F1	F2	F3	F4	F5
Eigenvalue	**2.084**	**1.157**	0.915	0.615	0.230
Variability (%)	**41.685**	**23.137**	**18.293**	12.292	4.594
Cumulative %	41.685	64.822	**83.115**	95.406	100.000

Table 3.14 Component characteristics of the PCA. Values in bold are meaningful

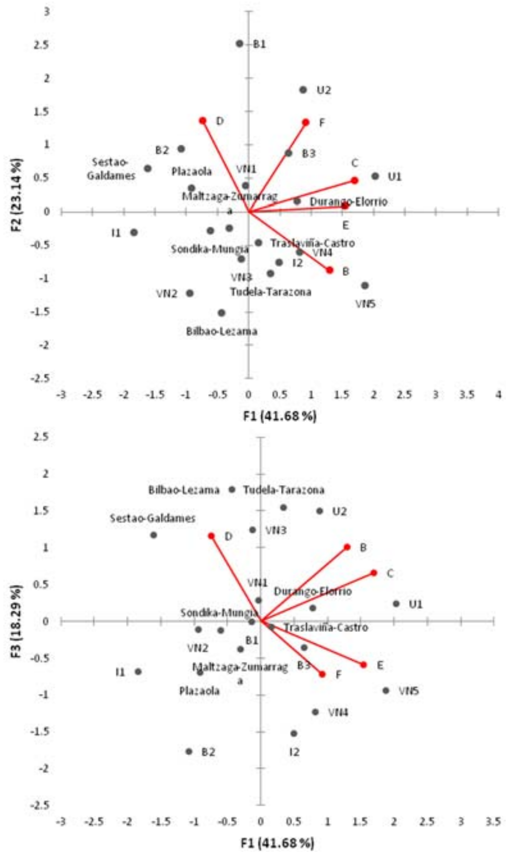


Figure 3.21 PCA components and the corresponding new values of the different DRSs

As a second step, k-means clustering has been used to group the different DRSs and identify the future approach of these lines, since each group has similar features in relation to their elements and relations.

The k-mean classification has implemented the coordinates of the first two principal components and as a result, the different DRSs have been distributed in three groups, table 3.15. Eight elements have been classified in groups 1 and 2. Four of the latter are part of the same disused line (the Vasco-Navarro Railway), which has its most unfavourable zone in Group 1. The most unfavourable zones of Irati and Bidasoa railways are also located in Group 1. On the contrary, the entire Urola Railway and the other two sections of the Bidasoa Railway comprise the third group.

Table 3.15 DRSs of each created group

GROUPING		
GROUP 1	GROUP 2	GROUP 3
Maltzaga-Zumarraga	Durango-Elorrio	Urola (1)
Plazaola	Tudela-Tarazona	Urola (2)
Sestao-Galdames	Traslaviña-Castro	Bidasoa (1)
Sondika-Mungia	Vasco-Navarro (1)	Bidasoa (3)
Bilbao-Lezama	Vasco-Navarro (3)	
Vasco-Navarro (2)	Vasco-Navarro (4)	
Irati (1)	Vasco-Navarro (5)	
Bidasoa (2)	Irati (2)	

Table 3.16 Characteristics and centroids (F1, F2) of created groups. N is the number of DRSs per group

CHARACTERISATION OF GROUPS				
GROUP	N	F1	F2	Observations
1	8	-1.3941	-0.2247	Low potential in relation to the nodes and medium territorial potential
2	8	0.7782	-0.5456	Medium/high potential of the nodes and medium/low territorial potential
3	4	1.2316	1.5407	High potential of the nodes and high territorial potential

In this regard, Group 1 is characterised by low node potential but presents better results in relation to the line characteristics and the territorial axis that are located around it (table 3.16). That is why the future of these DRSs should be related to the transportation connections that the line could create, where uses such as greenways could be appropriate. Meanwhile, although Group 2 does not show so much potential in relation to the territorial scale, the characteristic of the nodes and their relations make possible the use of these DRSs for the development of the surrounding urban and rural areas, including the use of the line for connections at local level. Finally, Group 3 delivers high potential in both areas. That is why these specific DRSs are the most suitable to take advantage of their territorial structuring capability. Accordingly, it is possible to create comprehensive proposals that are able to integrate the whole system in Group 3, including the enhancement of the nodes to the general proposal of the line.

3.4. Conclusions

This chapter presents an initial comprehensive analysis method (composed of a GIS based inventory and the comprehensive analysis itself) for the characterisation and classification of Disused Railway Lines (DRL) by understanding them as complex systems, i.e. Disused Railway Systems (DRS). For that purpose, a division of the study on elements as themselves and their relations is proposed, comprehending thus each railway element as part of the whole railway system. Consequently, the surrounding territory is also taken into consideration, which permits a more extensive study of the DRLs. In this regard, the territorial structuring potential of a DRS is shown in relation to the other DRSs located in the same territory, in order to cover new uses other than current greenways while promoting the preservation of this heritage.

In addition to the current data, the historical performance of the railway as a system and its integration into that period's territory are considered in the initial method. They are essential for the creation of future strategies to take advantage of the structuring character they had in the past, which is one of the most important features for their possible reuse in the new territorial view of the 21th century.

The use of a GIS based inventory is proposed for the understanding of the different systems, permitting an easy storage, management and updating of data referred to the different periods. In this way, a continuously updated current state of the elements is provided, which is necessary due to the continuous damage and disappearance of the heritage elements of DRSs. In this regard, although the inventory provides a lot of information referred to the system elements, it is not able to provide information about the created relations. However, some differences can be appreciated between the different lines and their zones in the created maps, and hence, some causes can be concluded, such as the long period between their closure years or the existence of big or dense cities that could have urban development pressures.

The methodology has been applied to a real case, where the disused railways from the Basque Country and Navarre have been deeply studied. However, any other territory with several disused lines could be also analysed by means of the initial comprehensive method. The application is based on the analysis of a system composed of a linear component (the line) and some point components (the nodes). That is why the presented method could be widespread to other territorial linear systems, such as rivers and their hydroelectric plants or cattle routes.

In this case, the results of the characterisation have already shown the high potential of the Urola line or the low potential of other lines, such as Plazaola, Bilbao-Lezama or Sondika-Mungia, which are confirmed in the PCA and k-mean analyses. Nevertheless, results are more difficult to read in the cases where the partial outcomes of the different areas differ between them. In this regard, the PCA has shown the relations between the different analysis areas creating new components, while the k-mean classification has provided a suitable grouping of the lines. The creation of the different groups characterised by only two main factors have permitted to identify the future preservation and enhancement approach that each line could include. Accordingly, the creation of new uses beyond the greenways will be difficult in the DRS included in Group 1, since it is the most unfavourable group. Meanwhile, new uses that combine the different elements of the system should be proposed in the DRS located in Group 2 and especially in Group 3, where the preservation of the heritage elements should be ensured. K-mean classification has also confirmed the necessary division into zones of some of the lines. In this regard, previously identified unfavourable sections of Irati and Bidasoa railways are included in Group 1, while other sections are located in Group 2 (Irati) or Group 3 (Bidasoa). In the case of Urola, both sections are located in the same group, claiming that there is no necessity for that division.

To conclude, the initial comprehensive analysis has been limited to less quantity and more selected information, since the analysis of different systems requires data that must be comparable in order to create a classification between them. That is why the inventory and the comprehensive analysis should be detailed according to the selected analysis scale. Meanwhile, the characterisation obtained from the analysis of each DRS results inaccurate, requiring a more detailed and specific study, such as a multilevel analysis with more information in each of the areas.

Contribution 1:

The concept of Disused Railway System (DRS) has been defined in order to study the disused railway lines as territorial systems. The definition of the concept has permitted the development of the comprehensive analysis method.

Contribution 2:

The different analysis areas for the understanding of Disused Railway Lines (DRL) as systems have been defined in the initial comprehensive analysis method. On the one hand, the two areas related to the elements (line and nodes) have been proposed to consider for the comprehension of the railway itself. On the other hand, the areas referred to the relations should be studied. Although internal and external relations were initially defined, the analysis area related to the internal relations (line/node) is dismissed for the posterior development of the comprehensive analysis. This is because the distribution of nodes in a line depends on the location of the urban or rural settlements, so territorial characteristics are already included. Accordingly, the two analysis areas referred to the external relations are only justified for the development of the methodology: line/territory and node/territory areas. Both areas should be studied in a multilevel approach to comprise all necessary data.

Contribution 3:

Historical data have been taken into consideration in addition to the current data to comprehend the territorial structuring nature of these systems. For that purpose, specific data have been selected in order to create a comparison between the different periods and systems. Nevertheless, this few selected data result imprecise for the development of the methodology.

Related Publications:

Eizaguirre-Iribar, A., Etxepare, L., Hernández-Minguillón, R.J., 2015. An approach to a methodology for the analysis and characterization of disused railway lines as complex systems. *WIT Transactions on The Built Environment* 153, 811–823.

Eizaguirre-Iribar, A., Etxepare, L., Hernández-Minguillón, R.J., 2017. The analysis of disused railway lines as complex systems: GIS based inventory and Comprehensive Analysis Method. *International Journal of Sustainable Development and Planning* 12 (6), 1018–1031.

PART III: DEVELOPMENT OF THE METHOD

4. CHARACTERISATION OF DISUSED RAILWAY ELEMENTS

VASCO-NAVARRO RAILWAY

As the first part of the comprehensive study of a DRS, the analysis of the different railway components or elements is developed in this chapter. Accordingly, the two main railway elements (the line and the nodes) and the third external component (the territory) are studied. For that purpose, the different periods of the DRS are taken into consideration.

4.1. Proposed methodology

The proposed methodology for the analysis of the railway elements is divided in two main variables as presented in chapter 3. One of them refers to the historical or constant state of the system, whereas the other refers to the current state. The historical or constant state represents the characteristics that the railway has in its operational period or other features that remain invariable over time. Meanwhile, the current state corresponds to existing elements and their main features. The consideration of both the historical and the current state will enable to consider both the structuring character the railway system had in the past and the existing heritage elements that can be preserved or reused. Before starting the analysis of the different railway elements, however, the history and context of the railway system must be known, including its conception, construction or closure.

4.1.1. Historical state

The linear infrastructure, the station areas and the surrounding territory are studied from the beginning of the railway to it closure.

RAILWAY LINEAR INFRASTRUCTURE AND ITS ELEMENTS

First of all, as the main element, the linear component of the railway is studied. Its historical analysis enables the perception of the longitudinal flows that it creates in the territory, in addition to the definition of the technical features that each section includes.

Accordingly, on the one hand, a general description of the linear infrastructure or route is presented, where specific data related to technical features are included (type or measure of gauge, profile and slopes or turns) or intermodality points are identified. On the other hand, the auxiliary elements that enable the conception of the linear infrastructure are studied. In the case of civil constructions, such as tunnels or bridges, construction techniques, materials and dimensions are analysed. Meanwhile, auxiliary systems, such as electrification or worker-housing, are shown in the case of buildings.

RAILWAY NODES OR STATION AREAS

The nodes are composed of former railway station areas, which create the connections between the rail line and the territory, defining the crosscutting relations at urban level.

As part of the analysis, first of all, different groups of station areas are identified depending on the construction process and especially if different construction or operationalisation periods exist. Afterwards, station areas and their buildings are analysed and described.

For that purpose, the general description of uses and services is included and the distribution of the different buildings in the station areas is represented. In this regard, it is interesting to define the location of the main station areas that included the complete service in order to define the general structuration of the railway system. On the other hand, the architectural styles of the different buildings are defined and their corresponding elements and compositional features are described. In this approach, the construction systems and the materials used are also taken into consideration.

SURROUNDING TERRITORY

As the third element, the territory around the disused system is studied, which is essential to understand the relations that are created in the system and will enable to develop the analyses included in following chapters.

First of all, a general description of the territory is included, where orographic and natural features are presented on the one hand, and location and characteristics of built elements are described on the other, such as urban settlements, communication infrastructures, connections with other counties and the location of the railway itself.

Afterwards, the evolution of population over the railway period and in its closure is studied as one of the main representative data related to the territorial development. Different situations in the evolution of the railway surrounding areas are also identified in this regard: expansion of urban or rural areas, creation of new industrial areas or infrastructures and standstill of urban or rural areas.

Finally, the location of the railway infrastructure and the station in the city, and its influence in the urban expansion are analysed in the main urban areas describing the first expansions out of the old city, the arrival and location of the railway elements, the development of the city in the railway period and the city tendencies after the closure of the railway. The use of graphical information is considered essential for this purpose.

Descriptions are mainly used for the representation of the historical state of the railway system, but graphical information is also considered essential for the correct understanding of the system. In this regard, the availability of historical documents becomes crucial in this phase. Accordingly, the engineering projects and reports usually include detailed descriptions of the construction elements, historical photographs or plans of the station areas and buildings. Historical aerial views or ortophotos can also provide interesting data.

4.1.2. Current state

Characterisations of the same three elements (linear infrastructure, station areas and surrounding territory) are developed in this section taking into consideration their existing current features.

RAILWAY LINEAR INFRASTRUCTURE AND ITS ELEMENTS

Regarding the disused linear infrastructure, first initiatives after the closure of the railway and the materialisation of these purposes are presented in order to show how the current situation has been reached. In turn, current uses and tendencies are presented, including principally regional development approaches or proposals that can comprise the whole system.

Once a general condition has been studied, specific analysis of the different stretches is made defining the disappeared and existing sections first and describing the conservation level and current use of existing ones then. Data related to the interaction with the surrounding areas and the type of pavement are also included for the understanding of the future development possibilities of the different sections.

On the other hand, as in the historical state, auxiliary elements that enable the conception of the linear infrastructure (mainly tunnels and bridges) are analysed. Their preservation level and the changes that have been made until the current state have been studied according to their location or current use.

RAILWAY NODES OR STATION AREAS

Disused railway nodes, composed of any railway building, are studied in their current state. For that purpose, protection or recovery initiatives as part of the whole railway system are firstly analysed, but individual public or private initiatives at local level are also taken into consideration in a second glance.

Furthermore, disappeared and maintained elements on the one hand, and the preservation level and current uses of existing buildings on the other hand, are studied as essential data for the promotion of these nodes in the future. Accordingly, definition of the different conservation levels is necessary for the correct development of the analysis. In addition, percentages of nodes according to the different conservation levels and uses are included.

Moreover, the regulatory aspects of buildings or environments that can limit new uses or approaches in the railway nodes are studied, or on the contrary, the aspects can offer them new opportunities. Accordingly, heritage protection features or natural protections that limit their surrounding territories are presented, since they can promote the preservation of the nodes or even their reconversion into new uses. For that purpose, the elements that are influenced by these regulations are identified, defining for example the existing or proposed heritage protection level of each element.

SURROUNDING TERRITORY

The current state of the territory around the railway system is presented describing the main territorial organisation of the different provinces and the population distribution among them.

The rest of the necessary data for the understanding of the territory and the consequent relations that exist nowadays between the DRS and the territory will be studied in each defined relation and its corresponding following chapter.

In general, the previous analyses made by other authors are of great help in the definition of the current state of the railway components, but the fieldwork is also essential, since the passage of time can provoke changes and can highly influence the state of conservation of the elements, especially when they are disused.

4.2. Vasco-Navarro Railway: construction, development and closure

The construction of the Vasco-Navarro Railway was related to the aim of linking the capitals Vitoria-Gasteiz and Bilbao by train. Vitoria-Gasteiz was traditionally an important commercial area between the hinterlands and the port of Bilbao or the province of Gipuzkoa by means of the Deba Valley and the area of Durango (Macías, 2001). Moreover, it was the first Basque capital that has a railway (the Railroad of the North, Madrid-Irun). Nevertheless, the creation of the Bilbao-Tudela Railway avoided Vitoria-Gasteiz being a railway junction, including a new difficulty in its development. It changed from being 60 km away from Bilbao by road to 139 km by rail (Rivera, 2008).

In this regard, in 1878 Juan José Herrán published several newspaper articles supporting the creation of a railway between Vitoria-Gasteiz and Durango, where a connection with the Ferrocarriles Vascongados (Bilbao-Durango railway) would be possible. This idea corresponds to the current High Speed Railway proposal (Suso, 2009a). Furthermore, the proposal was later extended to Navarre, creating the Railway of Lizarra-Gasteiz-Durango. The latter was related to a second objective of linking Vitoria-Gasteiz with Navarre, with Lizarra as the first main urban area (Macías, 2001).

Figure 4.1 The ascent to Leintz Gatzaga. Juan Mª Zubia´s Collection

The study and project were developed by Juan José and Joaquín Herrán in 1881, in which a narrow gauge railway was considered more economical (Olaizola, 2002). Accordingly, a concession was granted to Joaquín Herrán and Wenceslao Martínez[1] in 1882 for the creation of a narrow gauge railway between Durango and Lizarra, locating the main station in Vitoria-Gasteiz and including a branch to Arroniz and Lerin.

Due to the lack of local funding, foreign investors were sought. English funds were finally used and The Anglo Vasco-Navarro Railway Company Limited was created in 1886, which was granted for the construction and operationalisation of the railway in 1887. A four-year limit was established for the construction, although two extensions were after conceded in 1891 and 1894. The construction works of the line that were entrusted to the engineer Ignacio Carbó started on 20 January 1887 and were awarded to the Artola Bank[2].

Two years later, the first section of the railway (From Vitoria-Gasteiz to Leintz-Gatzaga) was opened (fig. 4.1). However, the works went on slowly and at an uneven pace along the mountain port between Gipuzkoa and Araba/Álava until Eskoriatza, and the bankruptcy of the main shareholder entailed

[1] He handed all his rights over to Joaquín Herrán in 1885 (Olaizola, 2002).
[2] It was one of the main shareholders of The Anglo Vasco-Navarro Railway Company Limited. Although it has most of its businesses in London, its origins are Basque (Olaizola, 2002).

the interruption of the construction and the seizure of it by the state in 1897[3] (Olaizola, 2002).

Once the railway was in the state´s hands, several changes were made. On the one hand, the north end of the line was modified. Ferrocarriles Vascongados had already built a railway between Durango and Zumarraga, so they decided to relocate the connection point in Mekoalde, going through Arrasate and Bergara. On the other hand, the high cost of the initial route through Los Arcos and the new proposed railway between Iruñea-Lizarra-Logroño[4] that would supply Los Arcos, induced the redesigning of the route along the Ega River and the suppression of the Arroniz and Lerin branch (Mendizábal, 1926) (fig. 4.2).

In the light of the cessation of works, several options were taken into consideration, such as the division of the railway in two parts. The section from Vitoria-Gasteiz to the north had potential investors (Sociedad Unión Cerrajera de Mondragon and the Ferrocarriles Vascongados), but the Council of Navarre knew that this would induce the renunciation of the south part construction (Sanz, 1992). In this regard, and to maintain the entire railway route, the integration of the railway in the Secondary Railway Network was requested and completed[5].

In fifteen years, several actions were held without positive results, so the state decided to support directly the constructions works in collaboration with the three provincial councils. Accordingly, advance payments made by the provincial councils were used as funding method (Olaizola, 2002).

The project[6] that took into account the changes that were previously mentioned was developed by the civil engineer Ramón de Aguinaga Arrechea in 1910 and presented by the province council in 1913. Having done this, the construction of the railway was redirected: in 1915, the branch between the

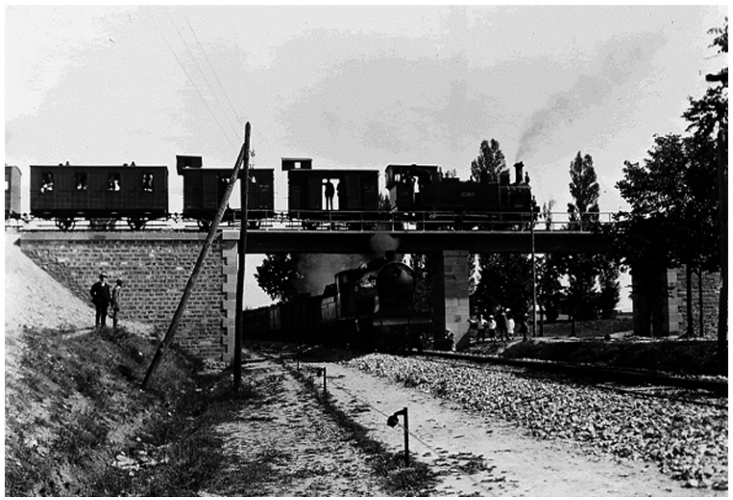


Figure 4.2 Final route of the Vasco-Navarro Railway (above).
Mendizábal, A. (1931) Ferrocarril eléctrico de Estella a Vitoria. Memoria sobre su total actuación 1920-1931. Municipal Archive of Vitoria-Gasteiz (MAV)

Figure 4.3 Crossing between the Vasco-Navarro Railway and the Railroad of the North in Vitoria-Gasteiz in 1915 (left). Archive of the Basque Railway Museum (ABRM)

Figure 4.4 Tracks of the Vasco-Navarro Railway and the Maltzaga-Zumarraga railway in Mekoalde (right). ABRM

[3] The definitive seizure was in 1903.
[4] The Iruñea-Lizarra-Logroño Railway was never built.

[5] Published in La Gaceta de Madrid, 23.06.1912.
[6] Aguinaga, R. (1910). F.C. de Estella-Vitoria-Los Mártires. Antecedentes, datos, planos. Araba/Álava Provincial Press, Vitoria-Gasteiz.

Figure 4.5 Route of the southern section of the Vasco-Navarro Railway (Mendizábal, 1926)

station of Vitoria-Gasteiz and the Railroad of the North was opened (fig. 4.3), and the two corresponding railway stations were erected; in 1916 and 1918, the railway ran until Eskoriatza and Arrasate respectively; and in 1919, all the northern section between Vitoria-Gasteiz and Mekoalde was inaugurated (fig. 4.4). The branch between San Prudencio and Oñati would be opened few years after, in 1923.

In the section between Vitoria-Gasteiz and Eskoriatza, which was already in use, it was necessary to renew rails and sleepers, to include ballast and to finish the construction of the railway stations[7]. Meanwhile, in the Eskoriatza-Mekoalde section, the original route was excluded because several buildings and constructions have been built since the first study[8], so a new route that includes the construction of new tunnels was developed[9].

In 1919, the civil engineer Alejandro Mendizábal Peña[10] was designated as a person in charge of the construction of the south section of the railway (from Vitoria-Gasteiz to Lizarra). He improved considerably the project[11] and the construction cost was even reduced (Suso, 2009b). Although the new route along the Ega River avoided the construction of some bridges and tunnels, significant changes were proposed in it (fig 4.5). From the 75 km of the section, only some parts of the 30 km of the Navarre route were used[12].

Under this final project, the section between Vitoria-Gasteiz and Lizarra was inaugurated in 1927 (fig. 4.6). Nevertheless, Mendizábal had already studied and asked for the electrification of the entire railway, which was developed by the year 1929 in the southern section and by the year 1938 in the north (due to the outbreak of the Civil War) (fig. 4.7). Meanwhile, the main repair workshops of the railway were located in Vitoria-Gasteiz, which were reconstructed after a fire in 1942[13]. Furthermore, a small branch from Andollu to the sanctuary of Estibaliz was created in 1948.

The construction of the Vasco-Navarro Railway was not able to achieve the initial objective of linking Vitoria-Gasteiz and Bilbao in a feasible way, since the change of the end of the route from Durango to Mekoalde reduced only in 10 km the alternative route through Miranda de Ebro (broad gauge, Bilbao-Tudela Railway) (Olaizola, 2002). Nevertheless, even after the opening of the railway, the transformation of the Vasco-Navarro Railway in a broad gauge was suggested to enhance the connection between Bilbao and Navarre. In this case, Bilbao was the main interested in this connection due to the depletion of the mineral deposits of Bizkaia, the supply needs of the growing population of Bilbao, the expectation of an increase in Navarre production because of the irrigation plans or the desire to avoid the competence of the port of Pasaia (Gipuzkoa). Nevertheless, the city council and the Camber of Agriculture of Lizarra were not willing to stop the electrification of the railway (that was being realised in this period) or to accept a provisional stop on the railway operation for the new constructions works, since this

[7] Last seen in April 2017 in: http://www.spanishrailway.com/2012/05/07/ferrocarril-vasco-navarro-ferrocarril-de-vitoria-a-mecolalde-y-estella/

[8] Provincial Archive of Araba/Álava (PAA), 1917-1920 DH. 6236-1. Seen in Sanz (1992)

[9] Last seen in April 2017 in: http://www.spanishrailway.com/2012/05/07/ferrocarril-vasco-navarro-ferrocarril-de-vitoria-a-mecolalde-y-estella/

[10] He was later the manager of the Operation of State Railroads until 1961 (Olaizola 2002)

[11] Construction details were included in the annual report of the Board of Works of the Railway from Lizarra to Vitoria-Gasteiz and from Oñati to San Prudencio

[12] PAA, 1917-1920 DH. 6236-1. Seen in Sanz (1992)

[13] Last seen in April 2017 in: http://www.spanishrailway.com/2012/05/07/ferrocarril-vasco-navarro-ferrocarril-de-vitoria-a-mecolalde-y-estella/

would induce not to fulfil the specific needs of that moment (Macías, 2001). While Bizkaia was interested in a broad network between its port and Navarre, looking at a territorial level, Navarre was focused on the creation of rail links that were able to fulfil the local requirements at a regional level.

In addition to the change of gauge in the Vasco-Navarro Railway, a railway between Logroño and Iruñea and a branch from Lizarra to Marcilla were also suggested for the same purpose, but they have never been built mostly due to the failure of the first proposal. The construction works of the Logroño-Iruñea Railway were about to start during the final stage of the dictatorship of Primo de Rivera (Olaizola, 2002). Meanwhile, the construction of the branch was agreed in 1934, but they did not agree in the decision of the gauge, nor were they able to obtain the grant for its creation (Macías,2001).

In this regard, the construction of the Vasco-Navarro Railway was going to be the initial step to become Lizarra in a railway junction. Nevertheless, due to the gauge selected (narrow), the lack of continuity to Iruñea and the agricultural nature of the area that produced few passenger traffic, the railway was mainly used for the good transport between Lizarra and Vitoria-Gasteiz (Macías, 2001). This made the initial objective unfeasible, as in the case of Vitoria-Gasteiz.

Just as there were important distinctions in the construction of the Vasco-Navarro Railway between the different sections, diverse services were also established according to the period and the section of the railway. In the north part, three trains were used for passenger and freight transports, which were increased (other two trains) between Mekoalde and Arrasate. In addition, other extra circulations were included for freight transport. In the branch to Oñati, six trains were running.

Moreover, the speed reached depended on the type of train (23-32 km/h) and the most transported goods were steel industry materials (coal, mineral, scraps or final products) transported to the main industries, such as the Blast Furnaces of Bergara and Unión Cerrajera of Arrasate; and construction

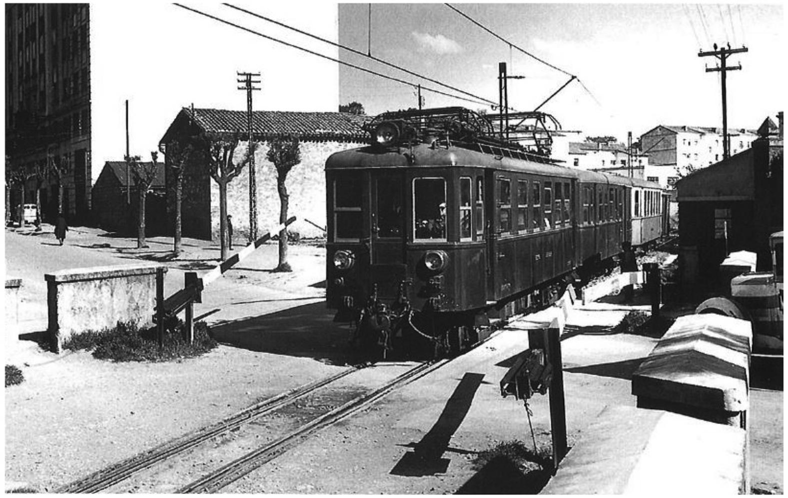


Figure 4.6 The Vasco-Navarro Railway in Zuñiga in 1927 (left). ABRM

Figure 4.7 The electrified Vasco-Navarro Railway in Vitoria-Gasteiz (right). Felix Zurita materials, such as wood or ashlar masonry for construction focused in Vitoria-Gasteiz coming from quarries of Urbina and Landa. Accordingly, the most transited section was the one between Mekoalde and the blast furnaces, while the branch had little good traffic (Olaizola, 2002).

When the line was opened until Lizarra, one passenger service that covered the whole route was installed and an average speed 28 km/h was reached. With the electrification, the number of trains and the speed increased considerably (five trains per day at 35-50 km/h) in the south section. On the other hand, the freight transport was lower than in the northern section and was mainly related to agricultural products, such as beet, or construction materials (natural asphalts of Atauri or sand of Laminoria (Olaizola, 2002; Suso, 2012). Finally, the electrification of the northern route also increased the average speed (40 km/h) of the section, where five passenger trains (eight in the branch) substituted the mixed trains.

Hence, the section between Mekoalde and Vitoria-Gasteiz had an active economic life due to the important level of industrial manufacturing, while the section between Vitoria-Gasteiz and Lizarra, although it was also quite used, was related to the agricultural production and construction materials of Araba/Álava and Navarre (Suso, 2012).

In the route between Vitoria-Gasteiz and Leintz-Gatzaga, an average of 50.000 passengers and 10.000 tonnes were transported per year (table 4.1), while with the opening of the entire north section more than 250.000 passengers and 100.000 tonnes were transported in 1922, with a positive coefficient of exploitation (85%). Nevertheless, there were economic losses in most years, except in the first years of the seizure by the state, due to a minimum expenditure.

The construction of the southern section and especially its electrification increased considerably the number of users and the freight transport, which translates into positive coefficients of exploitation. Accordingly, in 1933 more than 400.000 passengers and 200.000 tonnes (one of its highest level of freight transport) were transported (table 4.1). This positive balance continued until 1945, but losses appeared again in the way due to the economic crisis and the war (Olaizola, 2002).

In 1948 and 1949, the electric constraints of the states encouraged the suppression of several services in the southern section. Furthermore, the competition of the growing road transport affected the freight transport of the Vasco-Navarro Railway (Olaizola, 2002). The initiated negative economic balance continued until the closure of the line.

In the fifties, another service from Kanpezu was included (six in total) in the section between Vitoria-Gasteiz and Lizarra, and the branch to Estibaliz was opened with four trains per day. In the sixties, suburban rail services were included between Vitoria-Gasteiz and Leintz-Gatzaga, creating new stops for supplying the different industrial areas. Moreover, special services to the swimming pools of Gamarra, the reservoir of Ullibarri or the natural swimming pool by the river in Fresnedo were added during summer time (Olaizola, 2002).

Those were the best years referring to the passenger traffic (the maximum in 1966). Nevertheless, the improvements in services did not enhance the situation of the railway. Renovations were not made in the infrastructure since years, which was translated into a reduction in speed. In this regard, trucks easily became in competitive transports. Accordingly, the freight transport by rail was significantly reduced, especially in the southern section, since 1962 (table 4.1).

At the time of the closure, the usual five services and a worker train between Marin and Arrasate were operative in the northern section, while other five plus two services in the branch were used in the south (Olaizola, 2002).

In 1965, the state company of Narrow Gauge Railways (FEVE) was created, which has comprised the railways operated by the state since then, including the Vasco-Navarro Railway. It made a feasibility study of all its railways in 1966 in order to decide whether to close them or not. The Vasco-Navarro was the railway of FEVE with the highest freight transport in that period and it was at a second place in passenger traffic. Nevertheless, the Spanish Ministry of Public Works announced the closure of the Vasco-Navarro Railway in 1967, after the recommendation of the feasibility study, even though other two preserved railways had shown worse results (Olaizola, 2002).

Several members of the different city councils met in Lizarra in 1966 against the possible closure of the railway that was presented in the FEVE´s study. They all were all in favour of maintaining the railway[14], since it had a social mission, such as the transport of workers and students of small Navarre towns, or the attraction of tourists[15]. The Provincial Council of Navarre and the City Council of Vitoria-Gasteiz supported the decision of the meeting (Suso, 1999). Furthermore, the three provincial councils met in Iruñea in 1967 and published a report about the railway, mentioning the reasons of the bad economic state of the railway (defective or null maintenance, low fees, lack of generational replacement, lack of management in trains, competence of road transports, lack of connections in the south section, etc.) and proposing a separate study for each of the two

[14] Municipal Archive of Vitoria-Gasteiz (MAV), 02/16/26. Seen in I. Suso (1999)
[15] Municipal Archive of Kanpezu (MAK). Minute book of the City Council of Kanpezu, 1966. Seen in I. Suso (1999)

OPERATING RESULTS OF THE V-N RAILWAY FROM ITS OPENING TO ITS CLOSURE

YEAR	PASSENGERS	GOODS (t)	REVENUES (pts)	EXPENSES (pts)	RESULTS (pts)	OPERATING RATIO
1890	30.600	1.100	36.100	85.500	-49.400	236%
1891	30.500	2.400	31.100	60.100	-29.000	207%
1892			29.800	71.900	-42.100	241%
1893			30.200	67.100	-36.900	222%
1894			35.600	68.100	-32.500	191%
1895						
1896						
1897			28.900	22.900	6.000	79%
1898			37.900	41.000	-3.100	108%
1899	40.600	3.300	43.500	36.700	6.800	84%
1900	42.300	8.600	54.500	50.400	4.100	92%
1901	42.100	14.900	62.000	57.100	4.900	92%
1902	45.400	10.700	54.800	53.700	1.100	97%
1903	43.600	5.600	47.300	46.800	500	98%
1904	52.200	14.800	59.000	56.100	2.900	95%
1905	45.400	14.300	55.800	53.600	2.200	96%
1906	47.400	7.100	48.500	72.800	-24.300	150%
1907	46.300	6.300	46.900	70.900	-24.000	151%
1908	46.200	7.900	42.000	61.000	-13.000	145%
1909	48.900	4.600	42.700	66.200	-23.500	155%
1910	56.800	5.400	46.100	77.000	-30.900	167%
1911	52.200	5.900	44.600	65.400	-20.800	146%
1912	58.400	5.700	47.700	58.200	-10.500	122%
1913	55.300	6.800	48.000	73.500	-25.500	145%
1914	58.500	7.000	50.600	76.900	-26.300	151%
1915	64.100	8.300	55.900	81.200	-25.300	145%
1916	76.100	9.200	79.700	104.700	-25.000	131%
1917	77.200	13.100	132.400	153.900	-21.500	116%
1918	110.000	15.900	183.300	242.800	-59.500	132%
1919	118.000	35.800	236.000	307.400	-71.400	130%
1920	204.800	82.200	506.900	752.100	-245.200	148%
1921	233.400	90.800	579.000	1.115.200	-536.200	192%
1922	258.300	108.600	926.300	795.700	130.600	85%
1923	258.300	102.600	659.900			
1924	231.300	105.200	769.700	983.800	-214.100	127%
1925	220.500	102.000	710.000	963.200	-253.000	135%
1926	222.700	118.300	711.000	966.400	-255.400	135%
1927	237.600	117.200	953.700	711.300	242.400	74%

Table 4.1 Operating results of the Vasco-Navarro Railway from its opening to its closure (Olaizola, 2002)

OPERATING RESULTS OF THE V-N RAILWAY FROM ITS OPENING TO ITS CLOSURE						
YEAR	PASSENGERS	GOODS (t)	REVENUES (pts)	EXPENSES (pts)	RESULTS (pts)	OPERATING RATIO
1928	549.800	142.200	1.454.200	1.339.900	114.300	92%
1929	338.200	178.100	1.495.500	1.244.100	251.400	83%
1930	341.600	170.900	1.618.100	1.252.400	365.700	77%
1931	389.600	183.100	1.551.800	1.451.300	100.500	93%
1932	325.600	179.000	1.478.700	1.451.300	27.400	98%
1933	464.800	211.900	1.411.200	1.640.700	-229.500	116%
1934	457.500	202.900	1.369.100	1.565.800	-196.700	114%
1935			1.224.000			
1936			813.900	1.371.200	-557.300	168%
1937			1.171.800	1.436.700	-264.800	122%
1938			1.771.300	1.706.000	65.300	96%
1939			2.055.600	2.000.100	55.500	97%
1940			2.444.600	2.329.700	114.900	95%
1941			3.194.400	3.340.100	-145.700	104%
1942	1.492.000	158.800	4.753.500	4.148.600	604.800	87%
1943	1.533.200	163.200	4.472.300	4.406.600	65.700	98%
1944	1.541.500	184.600	4.849.700	4.365.100	484.600	90%
1945	1.489.200	182.700	5.491.900	5.373.300	118.600	97%
1946	1.631.500	197.600	6.394.500	6.557.400	-162.900	102%
1947	1.726.100	184.400	6.434.300	7.259.900	-825.500	112%
1948	1.717.800	199.700	6.689.900	7.794.200	-1.104.300	116%
1949	1.585.900	190.600	7.274.700	8.911.600	-1.636.800	122%
1950	1.539.000	197.700	8.964.300	10.412.100	-1.447.800	116%
1951	1.365.600	177.000	9.708.800	11.065.200	-1.356.400	113%
1952	1.345.100	201.500	9.244.500	11.798.800	-2.554.300	127%
1953	1.298.500	206.900	9.097.300	13.132.400	-4.035.100	127%
1954	1.209.700	181.000	10.332.600	14.459.200	-4.126.600	139%
1955	1.259.600	192.500	10.691.800	14.723.200	-4.031.400	137%
1956	1.298.700	193.100				
1957	1.221.300	192.300	13.863.800	20.447.200	-6.583.400	147%
1958	1.243.500	194.500	14.606.300	21.247.100	-6.640.800	145%
1959	1.320.200	186.900	15.025.200	22.240.600	-7.215.300	148%
1960	1.361.700	194.200	13.746.300	22.054.900	-8.308.500	160%
1961	1.351.300	232.700	14.358.000	22.413.700	-8.055.700	156%
1962	1.406.100	232.800	15.325.300	26.608.600	-11.283.300	173%
1963	1.488.600	209.600	14.152.100	30.574.900	-16.422.800	216%
1964	1.723.900	172.200	16.027.100	34.360.600	-18.333.500	214%
1965	1.819.900	165.000	16.903.700	40.411.400	-23.507.700	239%
1966	1.883.800	162.900	17.399.000	34.540.600	-17.141.500	198%
1967	1.809.700	122.800	17.718.700	33.266.100	-15.547.400	187%

sections[16]. All these attempts or posterior ones were unsuccessful and the Vasco-Navarro was definitively closed at the end of 1967.

Consequently, the urban and rural areas located along the line suffered several difficulties in their daily lives. In general, communications were weakened, since some areas had narrow, curved and congested roads (upper basin of the Deba River), unpaved roads (small towns in Navarre) or others were even isolated, such as Marin or Mazmela in Gipuzkoa (Olaizola, 2002). In this regard, the construction of new road infrastructures became necessary. On the other hand, the closure of the railway also led to problems referred to the electricity supply, since several towns in Navarre (Antzin, Mendilibarri, Murieta, Abaigar, Legaria, Oco, Olejua, Etayo and Zuñiga) took their electric power from the railway[17].

[16] Report on the Vasco-Navarro Railway developed by the presidents of the Provincial Councils of Navarre, Gipuzkoa and Araba/Álava, 1967. Archive of the Basque Railway Museum (ABRM). Seen in I. Suso (1999)

[17] Vasco-Navarro Railway. Report developed by the Provincial Council of Navarre. Archive of the Regional Government of Navarre (ARGN), 3.2/003. Seen in I. Suso (2012)

4.3. Development and results of the historical state

The Vasco-Navarro Railway has been studied in its historical state taking into consideration the two main elements that compound the railway (the linear infrastructure and its elements; and the railway nodes) and its surrounding territory. Main features of each element have been identified and described for that purpose.

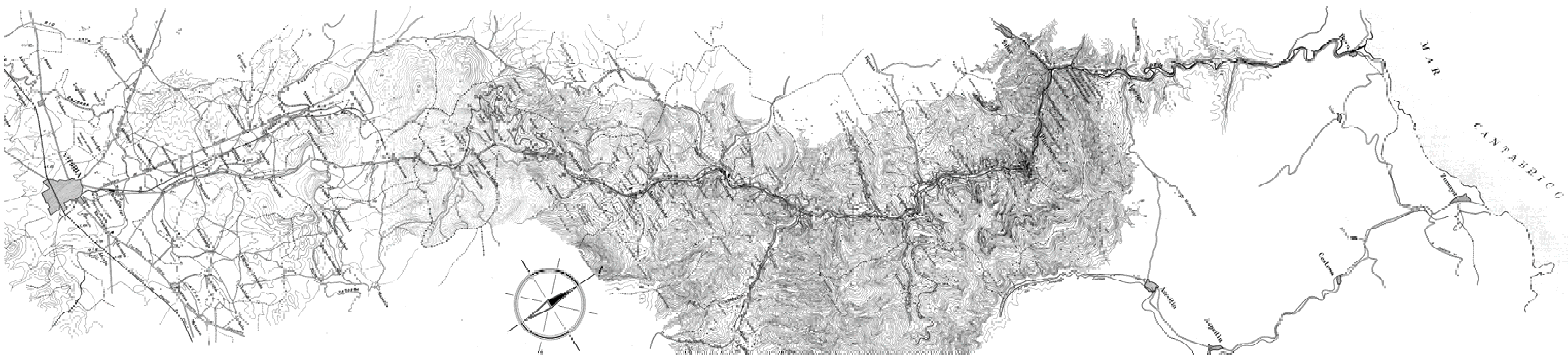
4.3.1. Railway linear infrastructure and its elements

The railway track of the Vasco-Navarro was divided in two main sections. The northern section, between Vitoria-Gasteiz and Mekoalde (fig. 4.8 and annex 2.1.1.), was constructed by parts and was 58883 metres long[18] (Aguinaga, 1910) without taking into account the branch to Oñati, which measured 6723 metres (Maluquer y Salvador, 1923). Meanwhile, the southern section from Vitoria-Gasteiz to Lizarra (fig. 4.9 and annex 2.1.1.), was 69670 metres long[19] according the construction report of Alejandro Mendizábal, where detailed information is included[20]. The construction of all these kilometres of railway track was only possible by means of numerous additional elements that ensure the route itself and the operability of the trains.

THE RAILWAY TRACK

The initial point of the northern section (fig. 4.10 and annex 2.1.1.) of the railway was located in the station of Vitoria-Norte, where the connection with the Railroad of the North was made. Leaving this area behind, the railway head north along the plain terrains of Araba/Álava following the Zadorra River until it reached the railway station of Landa. From there, the train started the ascent to the port of Arlaban, which is the watershed between the Mediterranean and Cantabrian seas

Figure 4.8 General plan of the northern section of the Vasco-Navarro Railway from Gasteiz to Mekoalde. Collection of the Narrow Gauge Railways (FEVE) in the Railway Museum of Asturias (RMA).



[18] According to Aguinaga, in 1910 the railway was operating along 18400 metres, while there were 211600 metres of works at a standstill and 18883 metres without being built (Aguinaga, 1910).

[19] The initial design of Ramón Aguinaga was 72342 metres long (Aguinaga, 1910)

[20] Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. (Ferrocarril eléctrico de Estella a Vitoria. Memoria sobre su total actuación 1920-1931). MAV

and the limit between the provinces of Araba/Álava and Gipuzkoa. The transport was performed through wide straights and smooth ramps. Meanwhile, the descent towards Eskoriatza was dizzying, including gradients up to 22 thousandths and quick succession of curves that include minimum radiuses of 85 m, which became this stretch in the most difficult one of the entire route. Although, the track was adapted to the rough terrain, the construction of several structures, such as tunnels, were necessary (Olaizola, 2002).

From Eskoriatza, the railway came down smoothly through the narrow valley of Deba (see the level curves of the map in fig. 4.8) following the river until Mekoalde, where the connection with the branch of the Maltzaga-Zumarraga Railway (Ferrocarriles Vascongados) was done. The connection with the railway between Donostia and Bilbao of the same company was in turn located in Maltzaga, creating a continued railway network of narrow gauge.

Finally, the route of the branch between San Prudencio and Oñati, which was built years after, ascended smoothly following the Oñati River until that town.

On the other hand, the route of the southern section (fig. 4.9) was extensively described in the general report on the constructions works of the Vasco-Navarro Railway[21]. According to the report, from the initial point of the railway in Lizarra, the train went towards the limit between the provinces of Navarre and Araba/Álava following the Ega River and crossing a narrow gorge in the area of Arquijas, where important construction works were necessary, such as a long tunnel (more than one kilometre long) or a large viaduct. Crossing the provincial boundary, the railway reached Kanpezu by means a counter slope. From there, and going across the area of Maeztu, the railway track started the ascent to the watershed between the Ega and Zadorra rivers, where the longest tunnel of this railway is located. After the tunnel, the train started to descend to

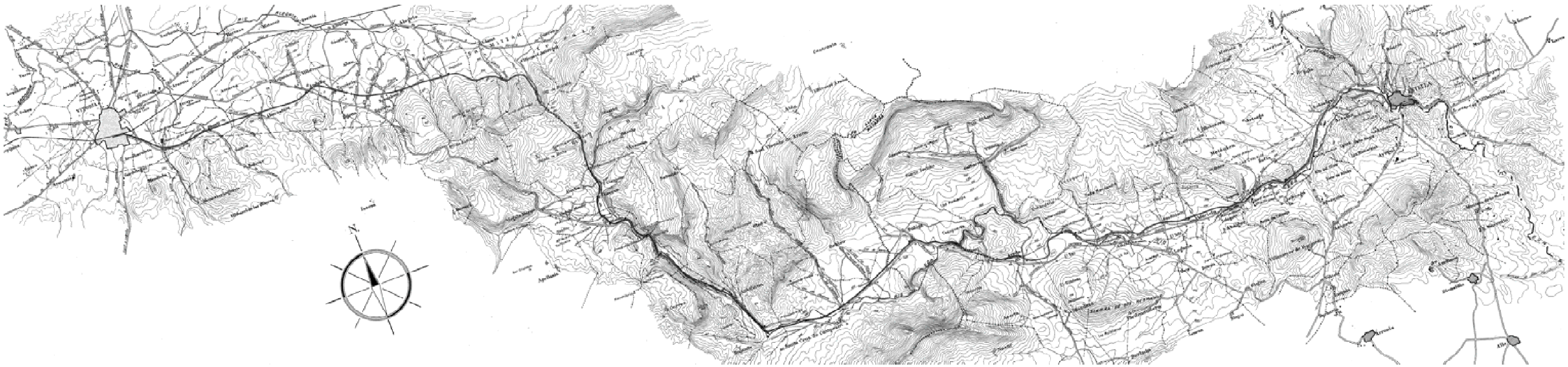
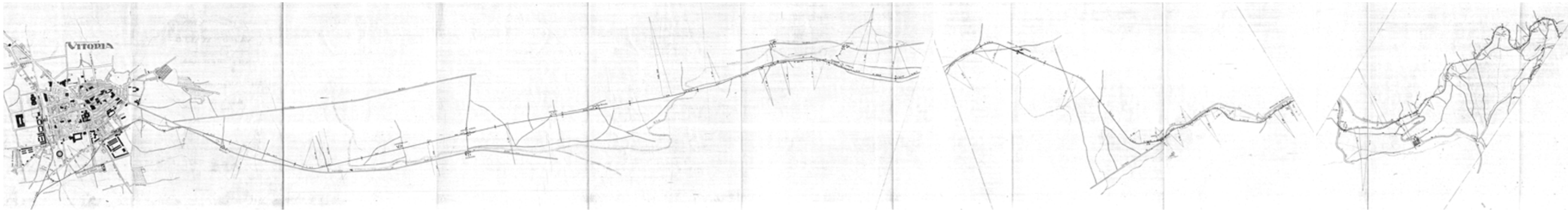


Figure 4.9 General plan of the southern section of the Vasco-Navarro Railway from Gasteiz to Lizarra. FEVE´s Collection in RMA.

[21] Idem



Uribarri-Jauregi and continued along the plain terrains of Araba/Álava until its capital, Vitoria-Gasteiz. This route was formed by long straights, although there were trenches as it passes through the area of Erentxun. Hence, comparing to the previous parts of the route, the construction of few minor structures was only necessary in this area. Conversely, the intermodal station of Olarizu is located at the entrance of Vitoria-Gasteiz, where a combined service of freight transports was installed with the company of the Railroad of the North.

Finally, with the construction of the branch of the sanctuary of Estibaliz, the train left the town of Andollu and ascended smoothly without structures of important size (fig. 4.13).

The southern section was characterised by its high technical quality (comparing to the primitive study of the northern section) and according to Olaizola, it is one of the best sections of narrow gauge built in the state, even more, taking into consideration the rugged territory that the train went through in some of the areas. This section was mainly composed of long straights, which accounted for 78% of the route (Olaizola, 2002).

In this regard, the profile of the route (fig. 4.14) had a special relevance in the construction project of Alejandro Mendizábal. The aim was not to use counter slopes, but finally two of them were used, which, according to him, were justified. One of them was located in the tunnel of Arquijas to both improve its conditions and diminish the height of the viaduct of Arquijas, while the other comprised the descent from Zuñiga to Kanpezu (Mendizábal, 1926). He established, moreover, 20 thousandths as the gradient limit, which was only used in the accesses of the Laminoria tunnel, while in the other stretches, very smooth ramps were used. Meanwhile, gradients up to 22 thousandths were reached in the northern section (in the mountain pass).

In accordance with the above, a minimum curve radius of 200 m was established (113 m in the railroad switches of station areas), which was only exceeded in the area of Arquijas (170 m) due to its geographical complexity. Furthermore, straight stretches of at least 100 metres long were inserted between curves of opposite direction (Mendizábal, 1926). On the contrary, railway curve radiuses of 85 m were used in the descent from the mountain port of the northern section. All this allowed trains to reach higher speeds in the southern section.

The Vasco-Navarro Railway included a single track in its entire route, with the exception of the section between Olarizu and the Vitoria-Norte station, where the transfer of goods between the two railways (the Vasco-Navarro Railway and the Railroad of the North) was carried out. Accordingly, tracks of two gauges

Figure 4.10 General plan of the northern section of the Vasco-Navarro Railway from Gasteiz to Mekoalde (left and right). FEVE´s Collection in RMA.

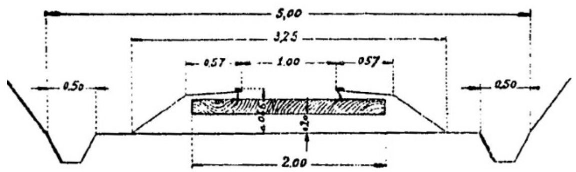
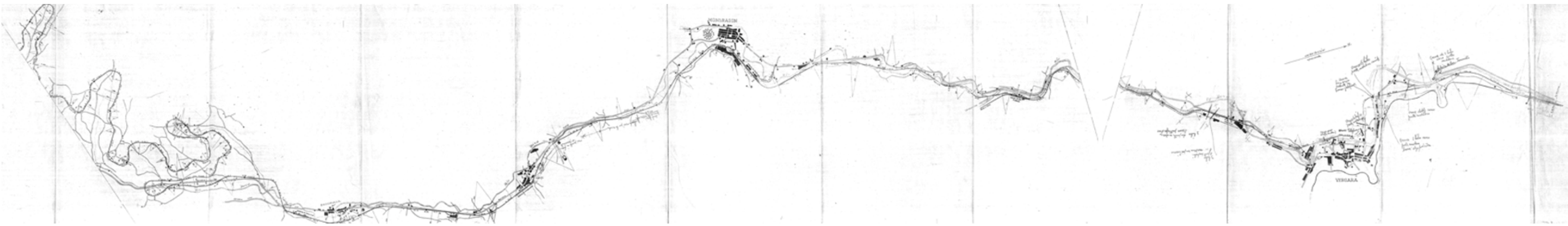


Figure 4.11 Section of the railway track in excavated areas (Mendizábal, 1926)



(narrow gauge and normal or broad gauge) were used in this section.

As mentioned, the Vasco-Navarro Railway was a narrow gauge railway, which included a track of one metre wide measuring from the interior sides of the rails. The rails sat on a ballast bedding of 3.25 metres wide, which in turn sat on a 4 metres wide platform[22] (fig. 4.11 and fig. 4.12). In this regard, the rails used in the northern section of the route were Belgian and weighted 22 kg/m. Nevertheless, in the branch to Oñati and the entire southern section, Mendizábal used rails from the Altos Hornos de Vizcaya (Blast Furnaces of Bizkaia), which have also substituted the ones of the northern section in its electrification (Olaizola, 2002). They weighted 32.2 kg/m and were 12 metres long, joined by six-bolt flanges and soleplates to the sleepers. The latter were made of oak (2 x 0.22 x 0.14 m) and were not disposed equidistantly (18 sleepers in each rail). Eventually, for the creation of the bedding, one cubic metre of ballast was used for each metre of railway line, made of crushed limestone from the nearby quarries (Mendizábal, 1926).

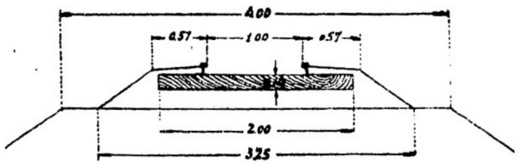


Figure 4.12 Section of the railway track in embankments (Mendizábal, 1926)

AUXILIARY ELEMENTS

In addition to the longitudinal track, the line had other specific elements that enable the conception of the track itself and the operation of the trains along it. The masonry, concrete, or steel structures built along the line are one of the most important elements of this group, since they facilitate the passage of the train across abrupt terrains, where tunnels and bridges become the main items. Nevertheless, other elements, such as level crossings, worker housing or electrification elements made also possible the maintenance of the railway route.

In the northern section of the Vasco-Navarro Railway, there were 2041 m of tunnels, divided in 12 tunnels located in the mountain pass that comprised 1370 m (fig. 4.16 and fig. 4.19) and 5 tunnels in the narrow valley of Gipuzkoa (671 m) (Suso, 2009c; Maluquer y Salvador, 1919). There were no tunnels in the stretch between Vitoria-Gasteiz and Landa, or the branch to Oñati.

Conversely, there were more bridges located in the plain terrains, since the railway followed the rivers, crossing it when necessary. In the initial route from Vitoria-Gasteiz to Eskoriatza, five bridges were built. There were two metal bridges (that were substituted by concrete structures in 1942) located between the capital and Landa (Suso, 2009c). One of them, constructed by a company from Barcelona in 1888, had a span of 30 metres (fig. 4.18). Nevertheless, three stretches of

[22] Idem

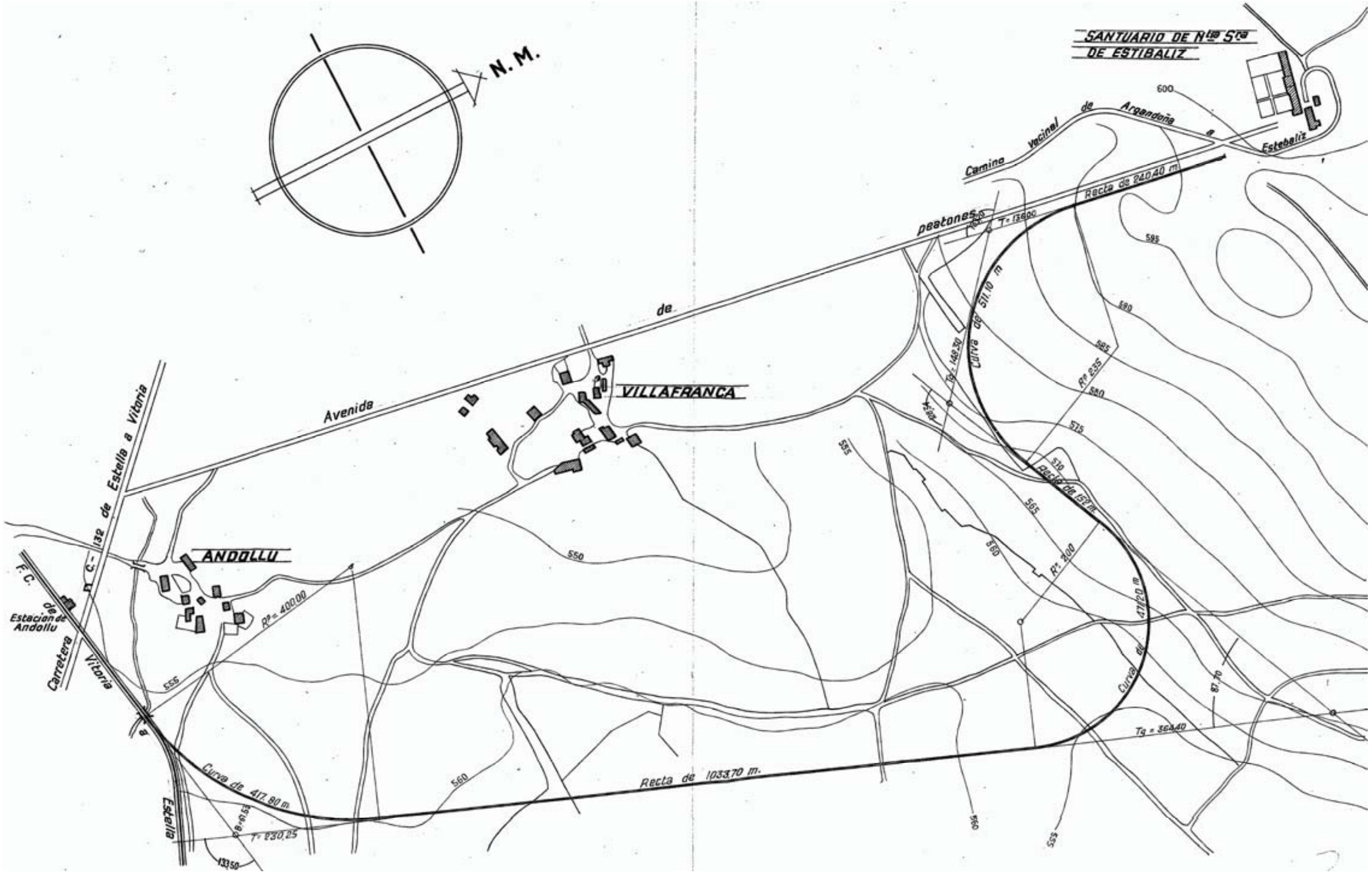
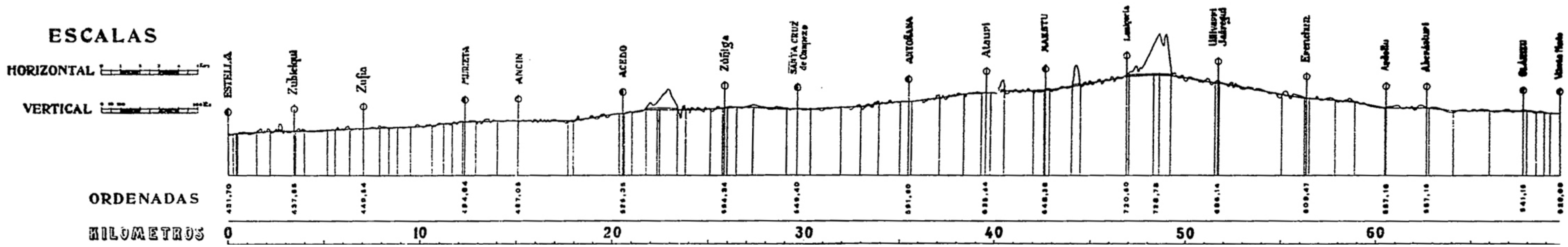


Figure 4.13 General plan of the branch to Estibaliz (left). Construction project, FEVE´s Collection in RMA

Figure 4.14 Longitudinal section of the southern section of the Vasco-Navarro Railway (bellow) (Mendizábal, 1926)



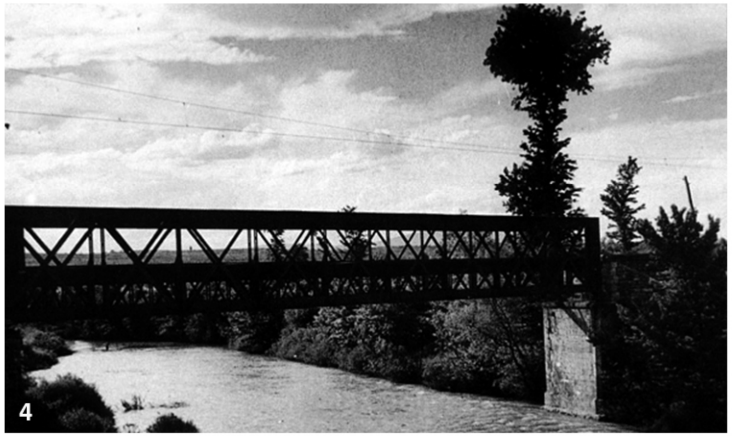


Figure 4.15 Viaduct of Castañares (1). Sancho el Sabio Foundation

Figure 4.16 The tunnel between Zarimuz and Mazmela (2). Last seen April 2016, in: http://iruditan.eskoriatza.net/

Figure 4.17 A bridge close to the blast furnaces of Bergara, 1917 (3). ABRM

Figure 4.18 Initial metal bridge of Eskalmendi (4). ABRM

Figure 4.19 A tunnel of the northern section (5). B. Sobrado, MAV

Figure 4.20 New concrete bridge of Eskalmendi (6). Schommer Koch, PAA concrete were used in its replacement (fig. 4.20) (Olaizola, 2002). The other three bridges were located in the mountain pass between Araba/Álava and Gipuzkoa. The most significant one, sited in the area of Castañares (fig. 4.15), was made of two ashlar arches and had a curved path (Olaizola, 2002).

Furthermore, thirteen bridges or viaducts were built in the construction of the second part of the railway between Eskoriatza and Mekoalde and other five in the branch to Oñati (fig. 4.17). All of them were made of concrete. The first ones were reinforced concrete girder bridges resting on ashlar piers designed by José Eugenio Ribera[23]. The latter were also concrete viaducts that used the Ribera System (Olaizola, 2002).

On the other hand, there were two tunnels and other two bridges in the section of the Maltzaga-Zumarraga Railway that joined the Vasco-Navarro Railway in Mekoalde (Maltzaga-Mekoalde). As mentioned before, this section has been included in the study to consider the entire territorial corridor in the northern section.

Referring to the southern section, Mendizábal included detailed descriptions of the main structures in his report. It should be noted that most of the descriptions of the text below are based on his annotations[24]. Accordingly, tunnels were made of mass concrete vaults (section depending on the type of the terrain that was necessary to support) and masonry abutments (fig. 4.21). In the cases where walls were quite resistant, abutments were lightened using masonry pillars (fig. 4.22) (Mendizábal, 1926).

Although fewer tunnels were perforated in the southern section (10 in the south vs 17 in the north), the underground route distance was significantly higher (4877.1 m in the south vs 2041 m in the north).

In this regard, in the province of Navarre four tunnels were created. One of them was more than a kilometre long, while other one was an artificial tunnel. The first tunnel of the southern section was Zubielqui (fig. 4.23), a curved tunnel of 161 metres long that had been built without lateral abutments but with concrete vaults in its entire length. Afterwards, between Acedo and Antzin, an artificial tunnel of 46.2 m was constructed using minimum dimensions and light materials to avoid collapses in the slopes of a trench (fig. 4.24). The tunnel of the area of Arquijas was the second longest of the Vasco-Navarro Railway (1415 m) (fig. 4.25). A well was drilled first, and hence, four fronts were used for the construction of the tunnel. Moreover, thick mass concrete vaults (80 cm) were necessary in some of its sections. Another small tunnel called El Peñon (20.2 m) was also built in Navarre (fig. 4.26).

In Araba/Álava, two tunnels were built in the area of Maeztu. The first one (called Fuenfría) was an artificial tunnel of 109.5 metres that was able to absorb the horizontal thrusts of the surrounding terrains. Its cross-section was oval and the entrances were oblique and with no finish for cost reduction (fig. 4.27). The second tunnel crossed Atauri by underground and was 363.2 metres long. Mass concrete vaults and masonry abutments were used in its entire route (fig. 4.28). Furthermore, other three tunnels were perforated in order to cross the watershed between the Ega and Zadorra rivers in Araba/Álava. The Leorza tunnel was 336 metres long and mass concrete vaults were used for its construction in all its length, covered with rough ashlar in some parts for the protection of

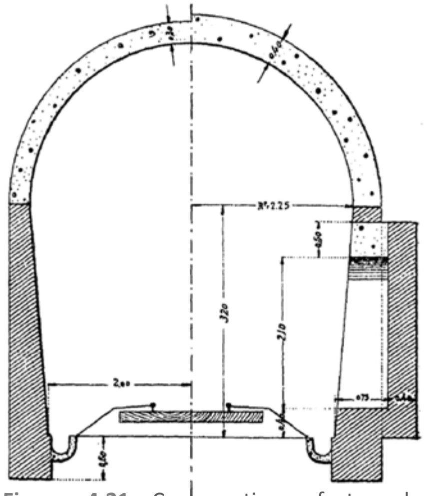


Figure 4.21 Cross-section of tunnels (Mendizábal, 1926)

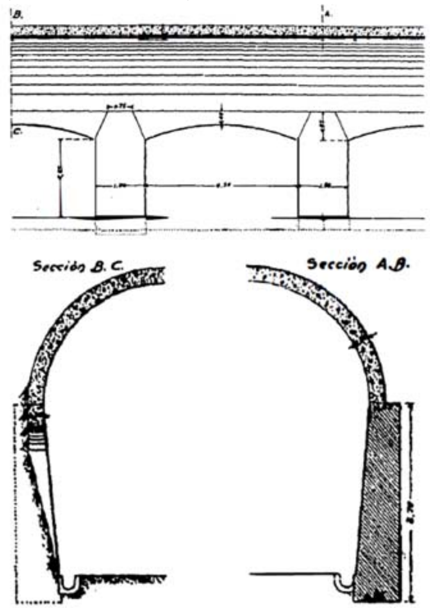


Figure 4.22 Abutment lightening in tunnels. Longitudinal section (above) and cross-sections (below) (Mendizábal, 1926)

[23] He was one of the first researchers on reinforced concrete in Spain and he is credited with introducing concrete girder bridges into the county.
[24] Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

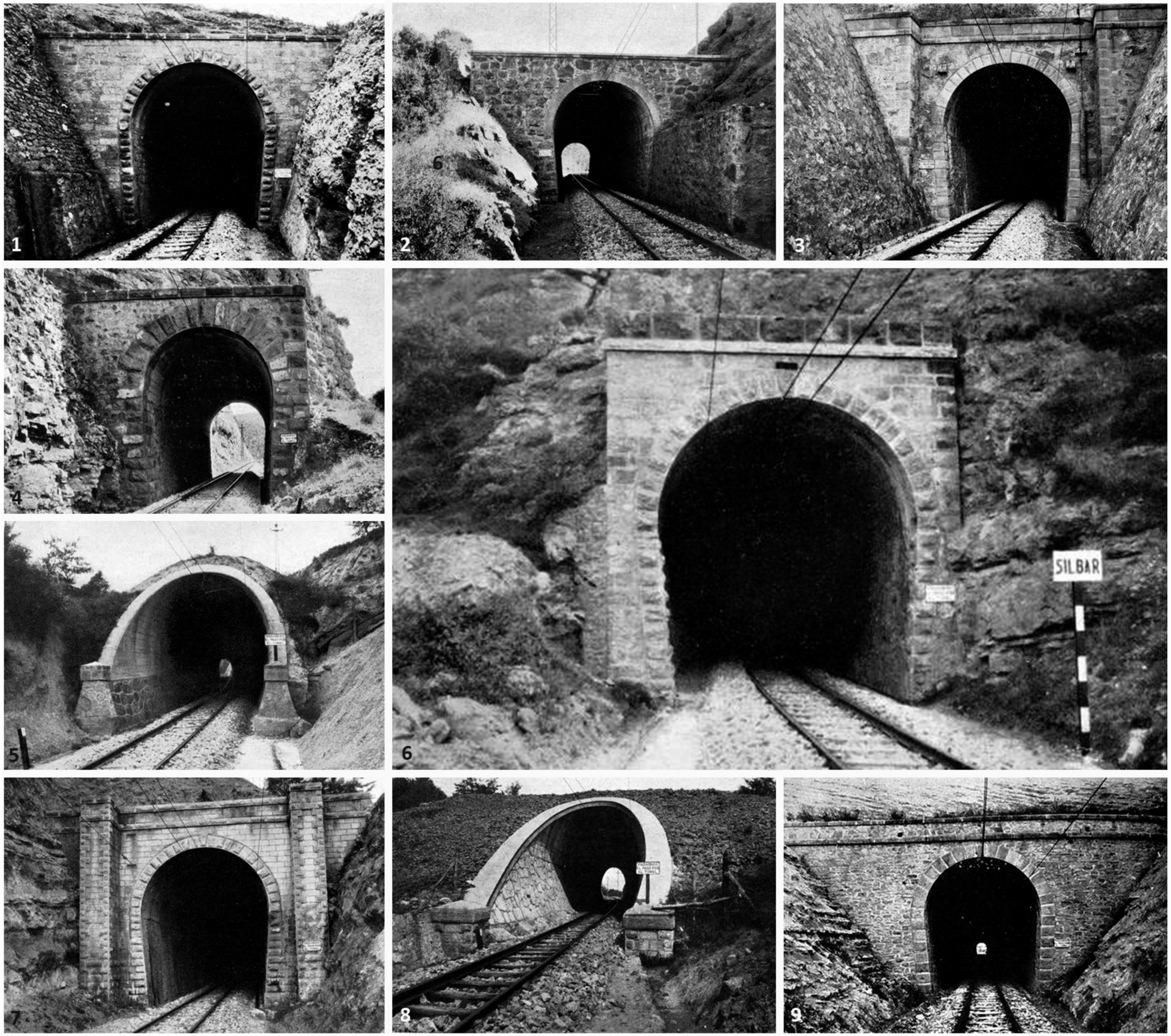


Figure 4.23 Zubielqui tunnel (1). Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.24 Artificial tunnel of Granada (2). Idem

Figure 4.25 Arquijas tunnel (3). Idem

Figure 4.26 Peñón tunnel (4). Idem

Figure 4.27 Artificial tunnel of Fuenfría (5). Idem

Figure 4.28 Atauri tunnel (6). Idem

Figure 4.29 Laminoria tunnel (7). Idem

Figure 4.30 Artificial tunnel of Huecomadura (8). Idem

Figure 4.31 Trokoniz tunnel (9). Idem the gypsum existing in the area. Meanwhile, the Laminoria tunnel went across the mountain range of Andia, where the two mentioned rivers are born, achieving the highest point of the railway in the middle of the tunnel (728.70 m above sea level) (fig. 4.29). Mass concrete vaults were built in its entire route, but as Mendizábal noted, abutments were only created when necessary. This tunnel is one of the longest tunnel of narrow gauge in Spain (Olaizola, 2002), in addition to the longest of the Vasco-Navarro Railway (2193.7 m). It was perforated using two fronts and its construction took two years. It is said that there were several bets related to the error in distance between the two sides, or to whether the two fronts were going to meet or not (Suso, 2009d). Finally, the artificial tunnel of Huecomadura headed the railway again towards plain terrains) (fig. 4.30). Despite the reduced length of the tunnel (73.5 m), it was one of the most difficult to erect, since the trench where the tunnel was located was unstable and had soft grounds. Accordingly, the cross-section of the tunnel was oval, expect in the bottom part where inverted vaults were used, and appropriate drainages were included.

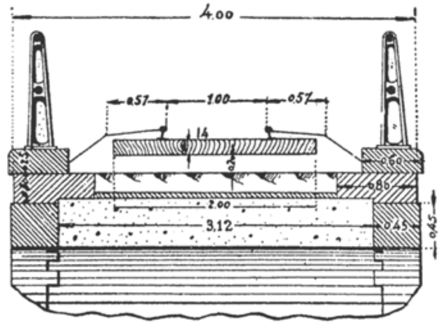
From Uribarri-Jauregi to the end of the southern section in Vitoria-Gasteiz, only one tunnel was necessary to built. It was located in Trokoniz and was 158.8 metres long (fig. 4.31).

In addition to tunnels, two types of bridges and viaducts were built as principal infrastructures in the southern section. On the one hand, masonry arch bridges were used. Although different number and size of arches, or total heights were adopted, a common section of platform was used in these cases (fig. 4.32). Nevertheless, according to the engineer, most of the bridges of the Vasco-Navarro Railway were reinforced concrete girder bridges composed of two longitudinal beams located below the rails and culminated by a reinforced concrete slab and lateral cantilevers (fig. 4.33). The concrete structure rested on ashlar piers, which in turn were often founded on Indian caissons.

Main bridges or viaducts in the southern section of the railway were 12 and they comprised a total span of 326 m. The first one, located in Lizarra, was a concrete girder bridge of three stretches of 10 metres each. Additionally, other two concrete bridges (2 x 10 m) were built in Zubielqui and Granada. Caissons were located at 4.5-5.5 m in the three cases.

On the other hand, the most important bridge or viaduct of the Vasco-Navarro Railway was built in the abrupt area of Arquijas. The viaduct of Arquijas (fig. 4.34, fig. 4.35, fig. 4.36 and fig. 4.44) was 157 metres long and 30 metres high, and was composed of nine semicircular arches (11 metres each) grouped in threes and separated by pilasters (Mendizábal, 1926). The arches were comprised of ashlar voussoirs and mass concrete vaults. Furthermore, although rough ashlar was used in the external facing, the construction was cost effective, since stone from nearby quarries was employed and those ashlar walls operated as formwork for the cyclopean concrete in pillars.

Having entered in the province of Araba/Álava, eight bridges or viaducts were constructed, all of them in the area of Kanpezu and Maeztu. The first three were reinforced concrete girder bridges with spans of 8 m. The Orbiso bridge had only one stretch, while Santa Cruz and Tarifa bridges had two. Accordingly, Indian caissons were employed in the latter two cases. Afterwards, the Santa Cristina viaduct, which was more than 10 metres high (Suso, 2009d), was constructed in order to cross the Ega River obliquely (fig. 4.37). In this regard, it had a total length of 36.6 m divided in 5 semicircular arches of 5.5 metres each, in addition to a gradient of 18 thousandths. This gradient was achieved including an extra voussoir in one of the



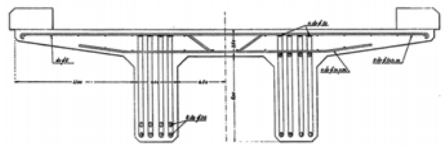
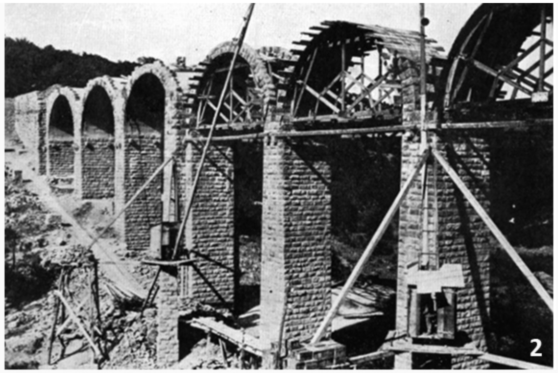
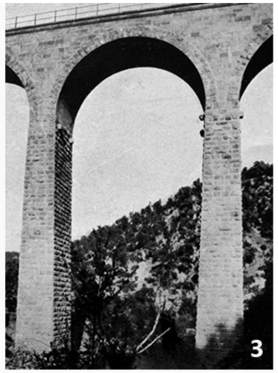


Figure 4.32 Cross-section of masonry bridges (above). Railing was only necessary in large infrastructures (Mendizábal, 1926)

Figure 4.33 Cross-section of reinforced concrete bridges (below). (Mendizábal, 1926)





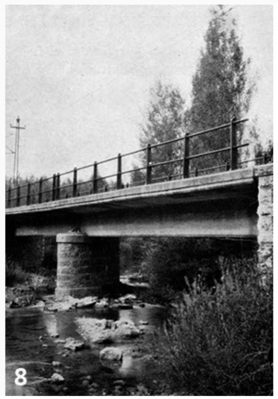


Figure 4.34 Viaduct of Arquijas, general view (1).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.35 Construction of the viaduct of Arquijas (2).
Mendizábal, A. (1923) Annual report of the Board of Works of the Railway from Lizarra to Vitoria-Gasteiz and from Oñati to San Prudencio. ABRM

Figure 4.36 Viaduct of Arquijas, one of the arches (3).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.37 Viaduct of Santa Cristina (4). Idem

Figure 4.38 San Saturnino bridge (5). Idem

Figure 4.39 Atauri bridge, general view (6). Idem

Figure 4.40 Atauri bridge, one of the arches (7). Idem

Figure 4.41 Peñasalada bridge (8). Idem sides of the arches (Mendizábal, 1926). The abutments and piers of the viaduct founded directly on the limestone terrain. Another masonry arch bridge was located in Antoñana, which was composed by a single arch of 12 metres. Ashlar was used in voussoirs and at the crown, while rubble masonry spandrel walls and a mass concrete vault completed the structure. Foundations were completed similarly to the previous case.

There were other two concrete bridges and the viaduct of Atauri before reaching the town of Maeztu, all of them described in the construction report of Mendizábal. San Saturnino (fig. 4.38) and Peñasalada (fig. 4.41) bridges were reinforced concrete girder bridges of two stretches and spans of 8 and 10 metres respectively. The concrete structures rested on ashlar piers, which in turn were founded on Indian caissons. In the case of the San Saturnino bridge, due to the soft clays and sands that comprised the terrain (over 100 metres deep), a large reinforced concrete slab (41.2 m x 5.4 m x 1 m) that rested on the caissons was built in order to support the upper structure. The construction of this slab made it possible to maintain the designed route. Meanwhile, the viaduct of Atauri (fig. 4.39, fig. 4.40 and fig. 4.42) was a masonry arch bridge composed of five central segmental arches of 7.5 metres each over the river and other two lateral arches in the abutments over the road between Vitoria-Gasteiz and Lizarra and a small path. Furthermore, the viaduct followed a curved path of 200 m radius, using trapezoidal piers and creating segmental barrel vaults, except in the case of the road where an oblique-segmented barrel vault was created (Mendizábal, 1926).

There was not any important bridge or viaduct from Maeztu to the end of the southern section in Vitoria-Gasteiz. There were, however, several overpasses or underpasses. Accordingly, there was an important overpass in the triangle of Vitoria-Gasteiz, where the two railways crossed (fig. 4.3). It was a reinforced concrete girder bridge of two stretches.

By and large, in addition to the main bridges and tunnels, different structures, such as retaining walls, overpasses and underpasses, trenches, etc. were built. A type of overpass that was compiled in the construction report, for example, was usually repeated along the southern railway track. This type (fig. 4.43) included a mass concrete vault (40 cm thick) rested on its starting points and rubble masonry spandrel walls. For a general overview of the size of the structures of a railway linear infrastructure, it can be said that there were seventy structures in the small branch to Oñati: five bridges, three main overpasses, eight main walls and other minor structures (Maluquer y Salvador, 1923).

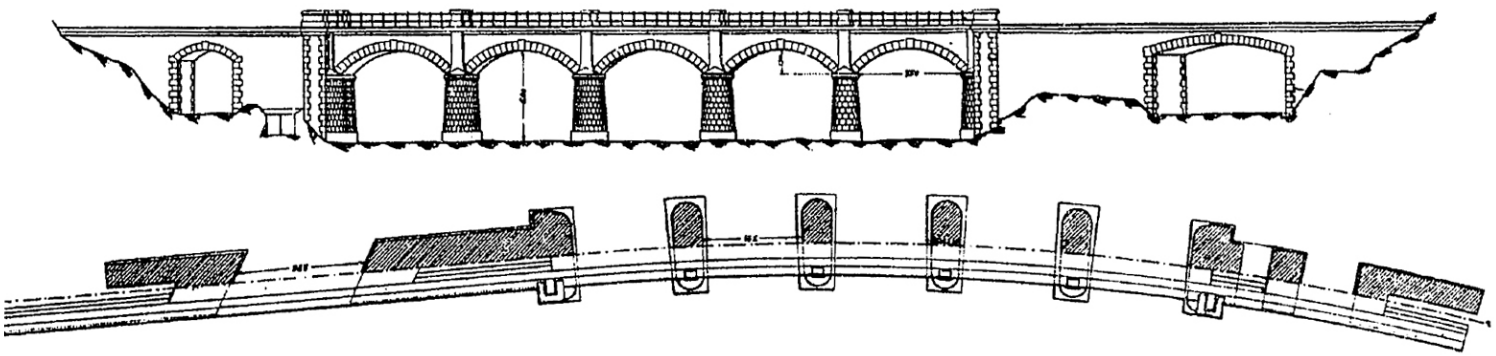


Figure 4.42 Elevation and plan of the viaduct of Atauri (left) (Mendizábal, 1926)

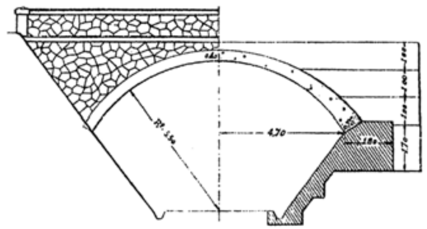


Figure 4.43 Cross-section of typical overpasses (bellow) (Mendizábal, 1926)

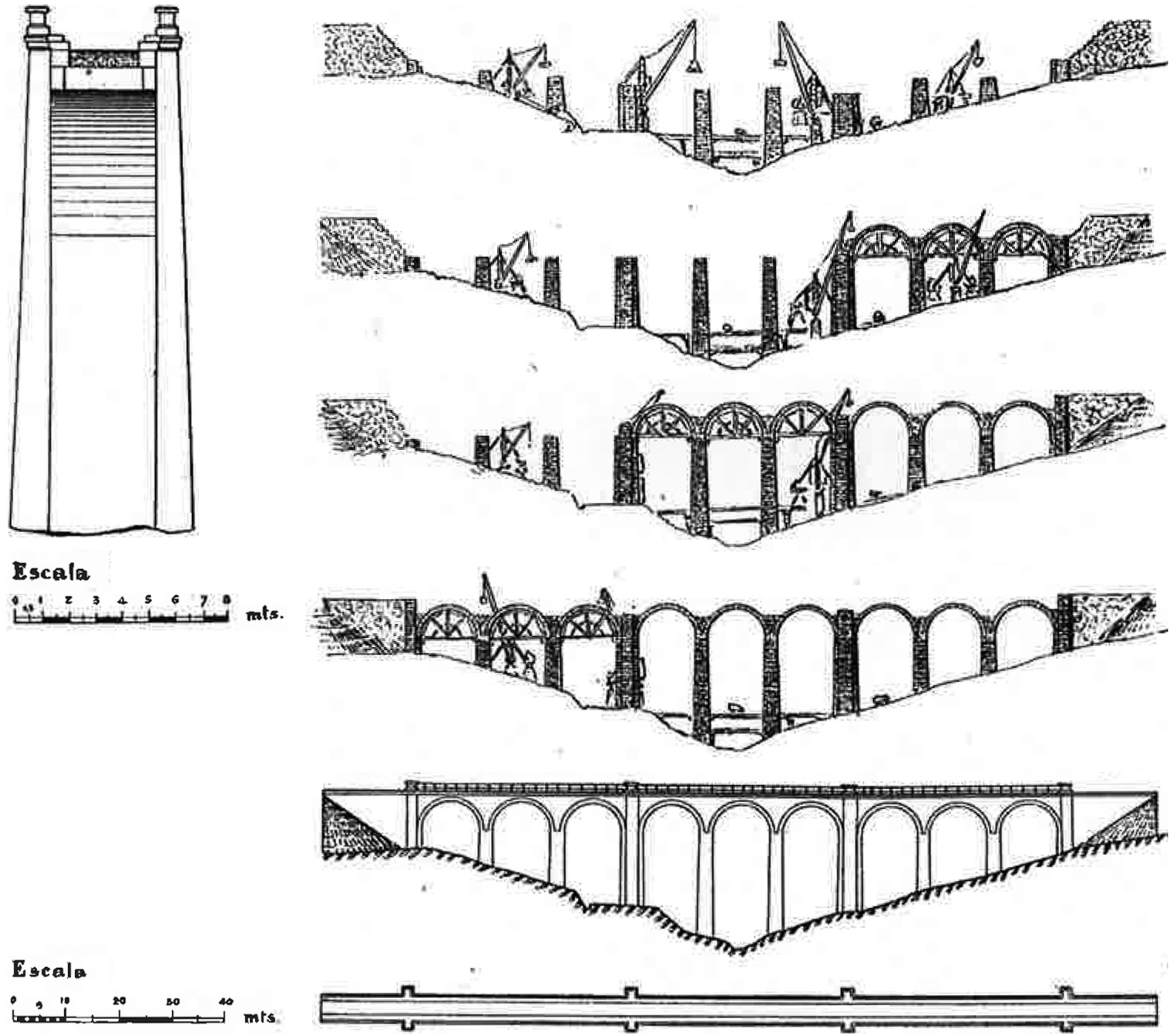


Figure 4.44 Construction process of the viaduct of Arquijas. Mendizábal, A. (1923) Annual report of the Board of Works of the Railway from Lizarra to Vitoria-Gasteiz and from Oñati to San Prudencio. ABRM

Furthermore, several buildings were also erected for the proper functioning of the railway itself. On the one hand, although level crossings were generally avoided, several of them were finally built (fig. 4.49). Most of them were controlled from the different railway stations, but others need a specific building for the employee of the crossing, such as in the case of Los Martires (Maltzaga-Zumarraga Railway), where a small building was built. On the other hand, several houses for the employees and workers were included all over the railway. The railway stations also included one or two houses for the stationmasters and their families, however, these buildings will be considered as railway nodes in the next section of this chapter. Nevertheless, there were specific buildings for the workers that ensure the maintenance of the railway track distributed along the railway and in consequence, the longitudinal flows or links that the railway created, such as in Granada, Arquijas, Orradicho, Fresnedo, Zekuiano, Laminoria, Gauna, Trokoniz, Vitoria-Gasteiz, Zarimuz or Maltzaga (fig. 4.48). According to the engineers report, the ones located in the southern section, although different in appearance, were composed of symmetrical houses with respect to the normal axis of the track, and the entrances were private and separated from each other (fig. 4.46 and fig. 4.47).

In addition to all these structures and buildings, electrification elements were also essential for the modernisation and functioning of the railway in its longitudinal axis. The electrification system of the Vasco-Navarro Railway was composed by elements of different scale, from the electric metal poles embedded in concrete blocks located all along the railway track to the transforming stations of each railway station or the electrical substations located in few specific strategic points (fig. 4.45).

As reported by Alejandro Mendizábal, the substation of Burba (Antzin) (fig. 4.52) and Rotalde (Uribarri-Jauregi) (fig. 4.50 and fig. 4.54) supplied power to the transforming stations of the southern section of the Vasco-Navarro Railway. The power originated in the waterfall of Artabia (Navarra) and the hydroelectric power plant of the same name connected to a tower in Antzin, where the link to the substation of Burba was created. Afterwards, the substation of Rotalde was supplied from there by means of a three-wire overhead line. Three-phase alternating current of 30000 volts was used in those two stages.

The two substations were identical taking into consideration both architectural and electrical elements. Rubble masonry walls, reinforced concrete roofs and metallic carpentries were used for the construction of the buildings, while semi-automatic electric systems with duplicate machines were included in the electric part.

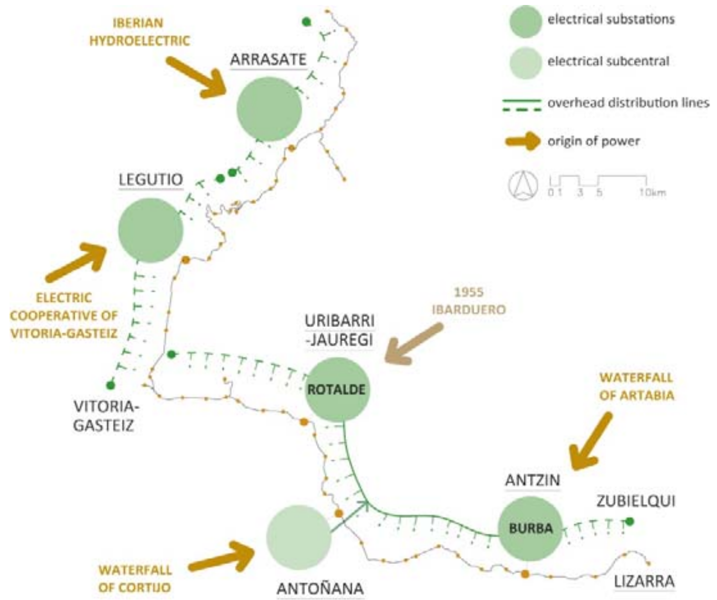
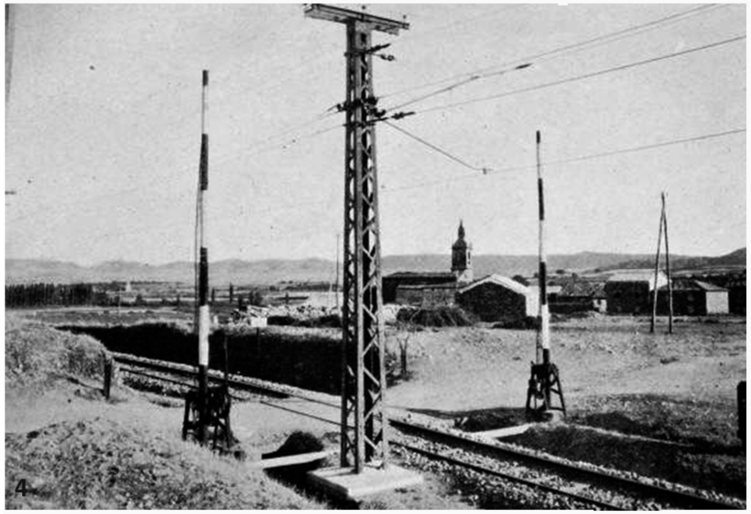
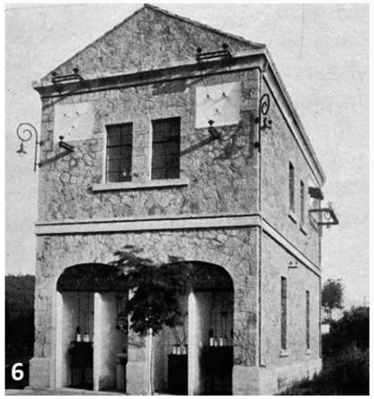


Figure 4.45 Electrification scheme of the Vasco-Navarro Railway





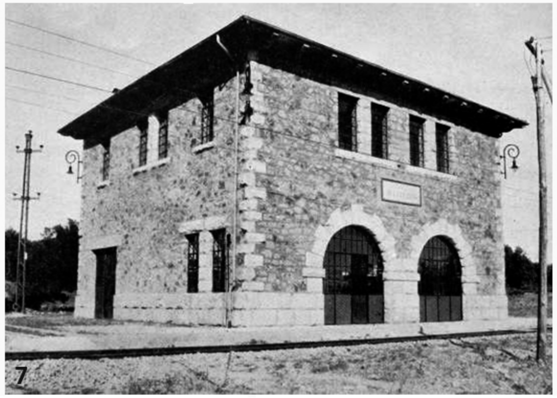


Figure 4.46 Workers´ housing in Fresnedo (3 dwellings) (1).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.47 Workers´ housing in the exit of the Laminoria tunnel (4 dwellings) (2). Idem

Figure 4.48 Workers´ housing in Zarimuz (3). E. Guinea, MAV

Figure 4.49 Level crossing and an electric metal pole in Antzin (4).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.50 Substation (front) and passenger building (back) in the railway station area of Uribarri-Jauregi (5). Idem

Figure 4.51 The subcentral of Antoñana (6). Idem

Figure 4.52 The substation of Burba in Antzin (7). Idem

Figure 4.53 The substation of Legutio in 2015 (8).

In a third stage, railway stations and operators' residences located between Antzin and Uribarri-Jauregi were directly supplied from the three-wire overhead line, while auxiliary lines that came from the previous two substations were used in others. Accordingly, two auxiliary lines, from Antzin to Zubielqui and from Uribarri-Jauregi to Vitoria-Gasteiz (fig. 4.45), supplied the rest of the transforming stations of the southern section in order to provide service for lighting, bells, interlocks and light signals. The railway station of Lizarra was the only that took power from local electricity suppliers.

Nevertheless, and in order to overcome any interruption in the previous supply, the reserve subcentral of Antoñana was built (fig. 4.51 and fig. 4.63). The power, originated in the waterfall of Cortijo (Ebro River) and linked to the subcentral by means of the main energy line from Logroño to Beasain, was 60000 volts (three-phase). The transformation of the energy (30000 volts) permitted the connection to the main distribution line between the two substations of the southern section. In this regard, the subcentral of Antoñana was a completely industrial building. As in the previous cases, rubble masonry walls, reinforced roofs and metallic carpentries were used, but wood was not used in floors or secondary structures in order to prevent fires. Moreover, heavy machines were located in the different cubicles located in the facades in order to enable their movement or relocation.

In 1955, another energy supply connection was included in the southern section. In this case, the high voltage power line between Ormaiztegi and Vitoria-Gasteiz of Iberduero was used to create a new connection to the substation of Rotalde (Olaizola, 2002).

A similar scheme of energy supply was used in the northern section of the railway. The substations were located in the station areas of Arrasate and Legutio, and the distribution of the energy was carried out from them (fig. 4.53). However, the energy supply connections were different in both cases: Cooperative Eléctrica de Vitoria (Electric Cooperative of Vitoria-Gasteiz) in Legutio and Hidroeléctrica Ibérica (Iberian Hydroelectric) in Arrasate (Olaizola, 2002).

4.3.2. Railway nodes or station areas

In addition to the linear infrastructure and all its elements, railway nodes are the second element that conform the railway system. These nodes refer to the railway station areas that connect the longitudinal system with the surrounding territory in specific points, creating crosscutting links and in turn generating a second influencing area around them. According to the construction of the Vasco-Navarro Railway, and taking into consideration that it was developed in different periods and by different designers, the node areas can be easily differenced between them.

Although several railway stations were created in the initial period, managed by The Anglo Vasco-Navarro Railway Company Limited, only one of them had special interest: Vitoria-Ciudad (fig. 4.58). Located in Vitoria-Gasteiz, this node was the main station of the northern section, comprising not only all necessary areas for it, but also the offices of the company. The main building was a two-floor building that included a metal canopy to cover the main platform (Olaizola, 2002).

The other buildings (in Durana, Erretana, Urbina, Legutio, Arlaban and Landa) were very small stations that did not include any room for passengers. Although they were all expanded in 1910, they were single storey buildings that fulfil the minimum

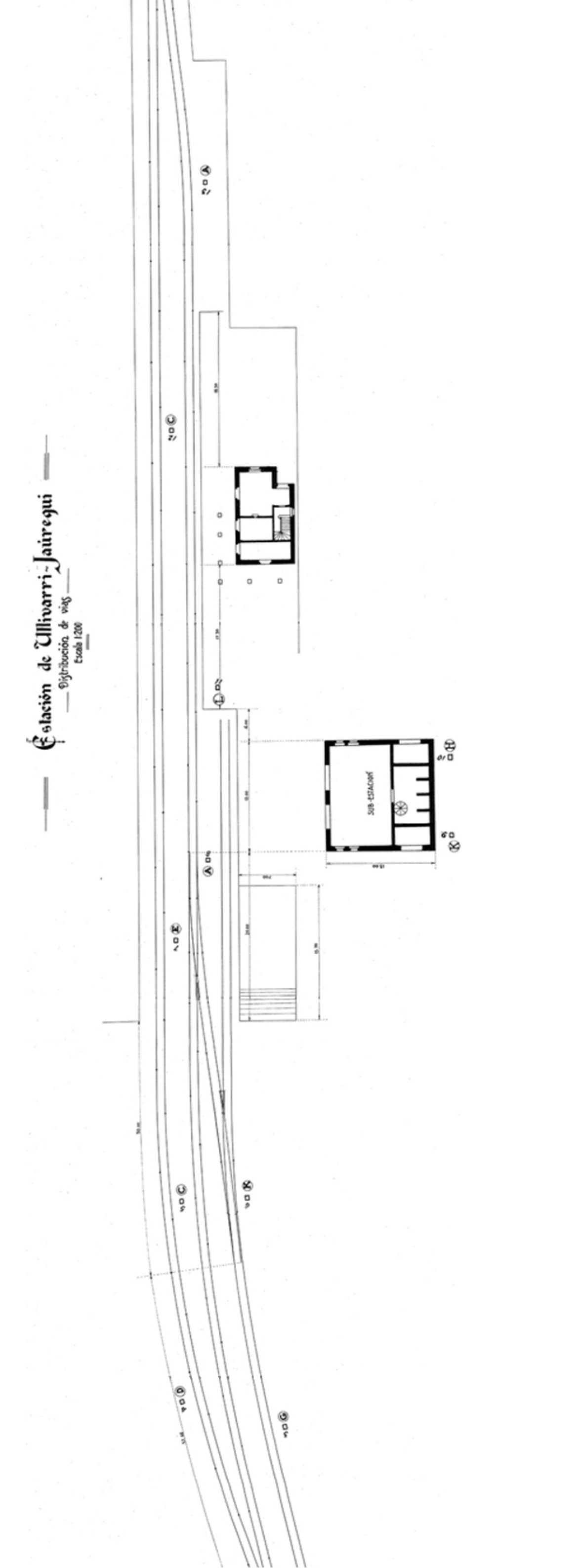


Figure 4.54 Railway station area of Uribarri-Jauregi composed of passenger building, electrical substation and uncovered loading bay (left). Alejandro Mendizábal, FEVE´s Collection in RMA

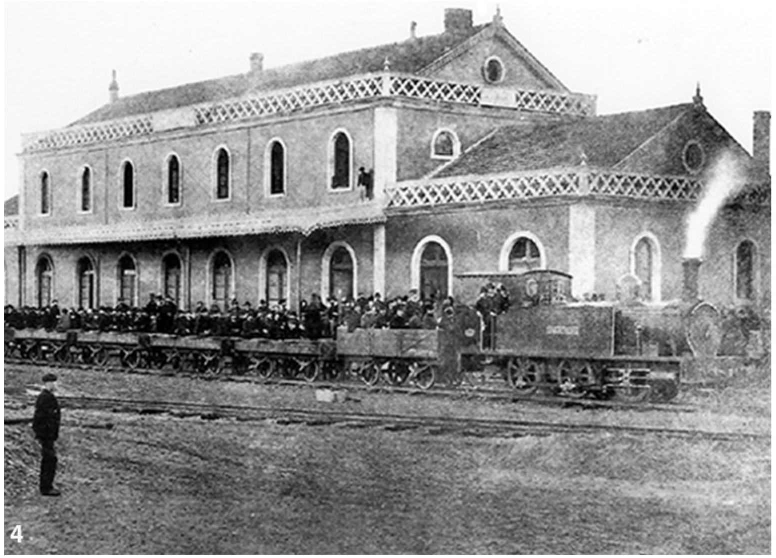


Figure 4.55 Railway station of Durana (1). Archive of Javier Vivanco Ruiz

Figure 4.56 Railway station of Urbina (2). Archive of Javier Vivanco Ruiz

Figure 4.57 Railway station of Legutiano (3). Archive of Javier Vivanco Ruiz

Figure 4.58 Railway station of Vitoria-Ciudad (4). ABRM

Figure 4.59 Railway station of Retana, composed of the new passenger building and the primitive building (5). ABRM

Figure 4.60 Railway station of Landa (6). Archive of Javier Vivanco Ruiz

Figure 4.61 Railway halt of Leintz-Gatzaga (7). Archive of Javier Vivanco Ruiz

Figure 4.62 Railway halt of Marin (8). Archive of Javier Vivanco Ruiz services and necessities of passengers and workers. A unified model of 113 square metres with a waiting room (20 m^2), storage room (9 m^2), office, kitchen and three bedrooms was used for those expansions. Afterwards, new passenger buildings were built in most of the station areas (Durana, Erretana, Legutio and Landa) during the electrification period of the northern section and hence, the primitive stations were used as warehouses since then (Olaizola, 2002). The new passenger buildings were two or three storey neo-basque style constructions (fig. 4.55, fig. 4.56, fig. 4.57, fig. 4.59 and fig. 4.60).

After the seizure of railway by the state simple but elegant stone and brick finished buildings were erected in the northern section of the line. The size of the passenger building of each station area was related to the town that was going to serve and all main stations have warehouses (Olaizola, 2002). Moreover, they included an industrial-type metal canopy that although could not match with the architectural style of the passenger building, was the most functional (Suso, 2009c).

The railway stations of Eskoriatza, Aretxabaleta, Arrasate and Bergara were built in an eclectic style, inspired by the Old-English style architecture and using industrial features (fig. 4.64 and fig. 4.65). Accordingly, these buildings were characterised by steeply pitched roofs; flat tiles; large eaves supported by struts; brick in corners, lintels and imposts; ashlar in walls (Suso, 2009c) or eaves of different inclination in the gable roofs. The stations of Bergara and Arrasate were the most important and in consequence, the most significant ones. Both had two gable roof volumes of three storeys linked with a lower central body (fig. 4.69 and fig. 4.70).

On the other hand, different railway stations were built in the branch to Oñati. The railway station of San Prudencio (where the connection was made) and the railway halt of Zubillaga had eclectic style buildings that include regional features, such as plastered walls in the upper floors or the use of false timber frameworks (fig. 4.66). Meanwhile, the passenger building of the railway station area of Oñati was inspired by the palatial architecture of the town of Oñati (fig. 4.67 and fig. 4.68). A symmetrical ashlar two-storey building with lateral towers (three storeys) was erected, where the centrality of the façade and the entrance was achieved by means of the use of pilasters and a classic pediment. Furthermore, both round or semicircular arches and lintels were used in door and windows. Finally, in this case, low pitch hipped roofs with curved tiles and eaves were built (Suso, 2009c). The palatial style of the building (especially showed in the city façade) was combined with the industrial metal canopy (located in the railway platform façade) that represented the functionality of the building.

Those railway stations areas built by the state included a small building that held the WCs. In the case of the main railway line, those buildings had hipped roofs of two different inclinations (fig. 4.64), while the WC buildings of the branch presented gable and valley roofs (fig. 4.66). The latter were changed to the initial shape after some years.

In addition to the main railway stations, small railway halts were also included in the northern section of the railway. Two small railway stations (Marin and Mazmela) and other two simple shelters (in Leintz Gatzaga, in 1938, and Castañares) were located in the mountain pass between the two provinces. The building of Mazmela was a single floor small building, while in Marin (fig. 4.62) a singular construction of two storeys (it looked like a single floor building from the railway platform) was created (Suso, 2009c). On the other hand, several halts and

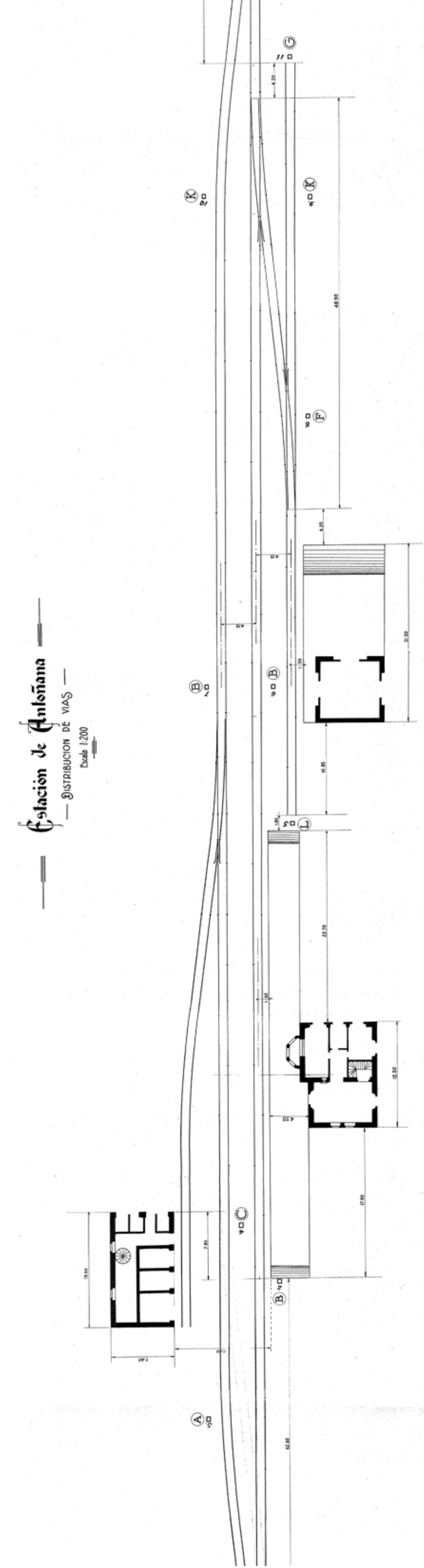


Figure 4.63 Railway station area of Antoñana composed of loading bay, passenger building and electrical subcentral (left). Alejandro Mendizábal, FEVE´s Collection in RMA

Figure 4.64 Railway station of Eskoriatza (1). E. Guinea, MAV

Figure 4.65 Railway station of Aretxabaleta (2). Municipal Photographic Archive of Aretxabaleta

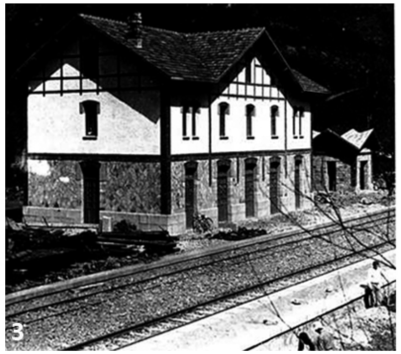
Figure 4.66 Railway station of San Prudencio (3).
Mendizábal, A. (1923) Annual report of the Board of Works of the Railway from Lizarra to Vitoria-Gasteiz and from Oñati to San Prudencio. ABRM

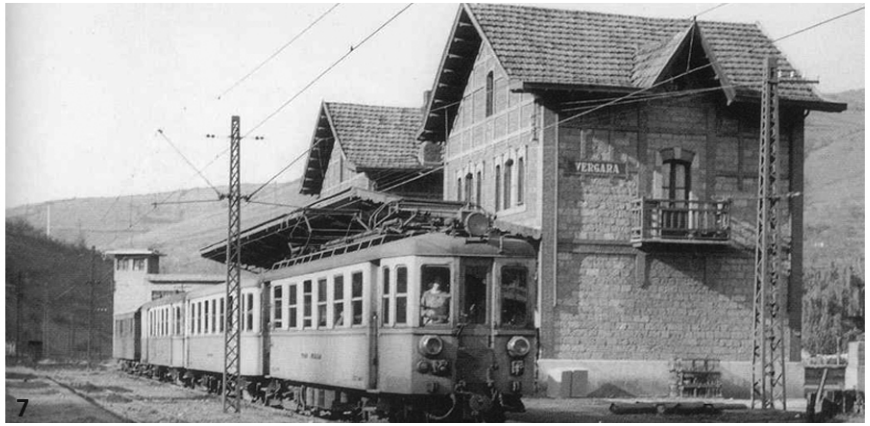
Figure 4.67 Railway station of Oñati in 1923 (4). Ricardo Marin´s Collection, Gure Gipuzkoa

Figure 4.68 Railway station area of Oñati composed of passenger building, two loading bays and a railcar shed (5). Jesus Mª Arzuaga´s Collection, Gure Gipuzkoa. Part of a larger photo

Figure 4.69 Railway station of Arrasate (6). E. Guinea, MAV

Figure 4.70 Railway station of Bergara (7). Jeremy Wiseman





rail sidings were also built for freight transport and for service of limited passenger traffic areas (Altos Hornos, Ulgor, Landeta-Marianistas and San Pedro).

Finally, small simple buildings were built for the railway service in between the broad rail yard in Mekoalde, the north end of the Vasco-Navarro Railway and the connecting point with the Maltzaga-Zumarraga Railway. Once in the Maltzaga-Zumarraga Railway, a railway halt with a shelter (Los Martires) and two railway stations (Soraluze and Maltzaga) were located along the linear infrastructure for the connection of the Bilbao-Donostia axis. The railway station of Soraluze was initially comprised of a small building but a two-storey passenger building and a warehouse substituted it in 1889. On the other hand, the initial small repair workshop of Maltzaga was supplemented by a two-storey building in 1925 (including a third floor in 1942) (Olaizola, 2007).

The repair workshops and maintenance facilities of the northern section of the Vasco-Navarro Railway were located in the capital of Vitoria Gasteiz. Although the station area initially comprised little equipment for that purposes, new workshops were necessary to erect during the operation years of the railway (Olaizola, 2002). In the extension project of 1945, several new buildings that completed the final station area can be identified. Furthermore, railcar sheds were also located in Mekoalde and Oñati.

In the southern section of the Vasco-Navarro Railway, main railway stations were located in Lizarra, Kanpezu and Olarizu, where in addition to the passenger buildings and warehouses, railcar and wagon sheds were included. Nevertheless, main maintenance infrastructures were the ones located in the capital.

The other railway station areas that were built in the southern section had a passenger building and a loading bay that was partially covered (previously named as warehouse) or not. Zubielqui, Murieta, Antzin, Acedo, Zuñiga, Antoñana, Maeztu and Erentxun were part of the first group, while Zufia, Atauri, Laminoria, Uribarri-Jauregi, Andollu and Aberasturi had uncovered loading bays. On the other hand, the railway station of Otazu, as a railway halt, included only the passenger building and did not have any facilities for good transport. Finally, the worker residences that had been presented in the previous section can also be considered as railway nodes (fig. 4.95), since they were also used as railway stops and consequently, the crosscutting relations between the railway and the territory also happened in those points.

Being the main engineer in the last construction period of the Vasco-Navarro Railway, Alejandro Mendizábal created a specific design for each passenger building, as it was unusual in most of the Spanish railways, with serial and identical buildings (Olaizola, 2012). His annotations have been also used for the descriptions of the text below[25].

As in the northern section, an eclectic style inspired by the Old English was used, but in this case, different sections and façades were used (in several cases the four façades were different) in order to obtain irregular buildings that were far from the typical simple railway architecture (fig. 4.72). Accordingly, multiple perspectives were created in each building and it was impossible to visualize the edifice from a single point of view (Olaizola, 2002). Furthermore, station buildings were characterised by steeply pitched roofs, flat tiles, large eaves supported by struts, plastered walls, ashlar in corners,

[25] Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

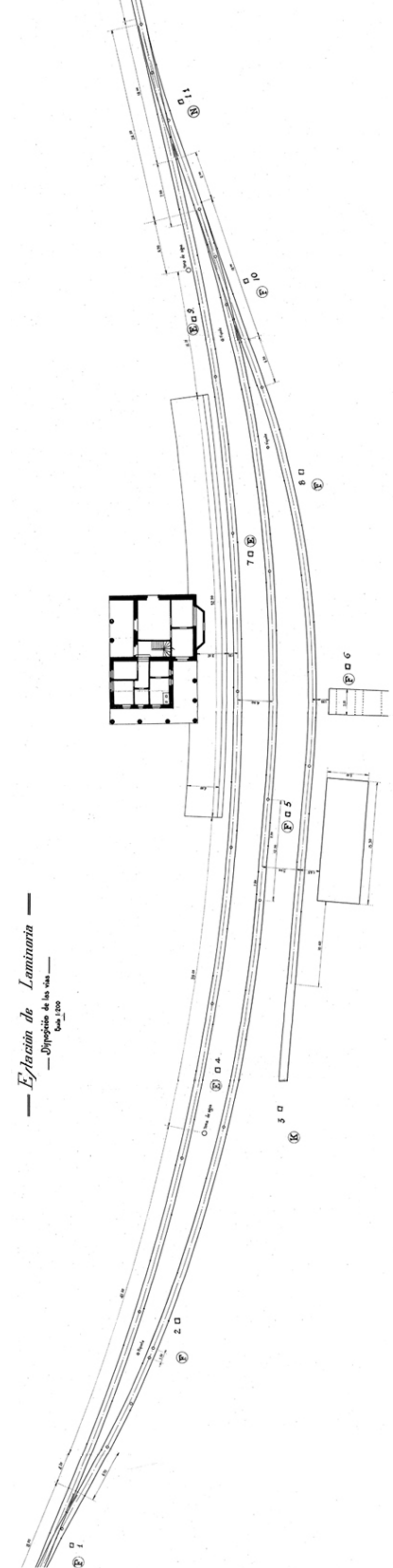


Figure 4.71 Railway station area of Laminoria composed of passenger building and uncovered loading bays (left). Alejandro Mendizábal, FEVE´s Collection in RMA

Figure 4.72 Passenger building of the railway station of Zubielqui (1).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.73 Passenger building of the railway station of Murieta (2). Idem

Figure 4.74 Passenger building of the railway station of Antzin (3). Idem

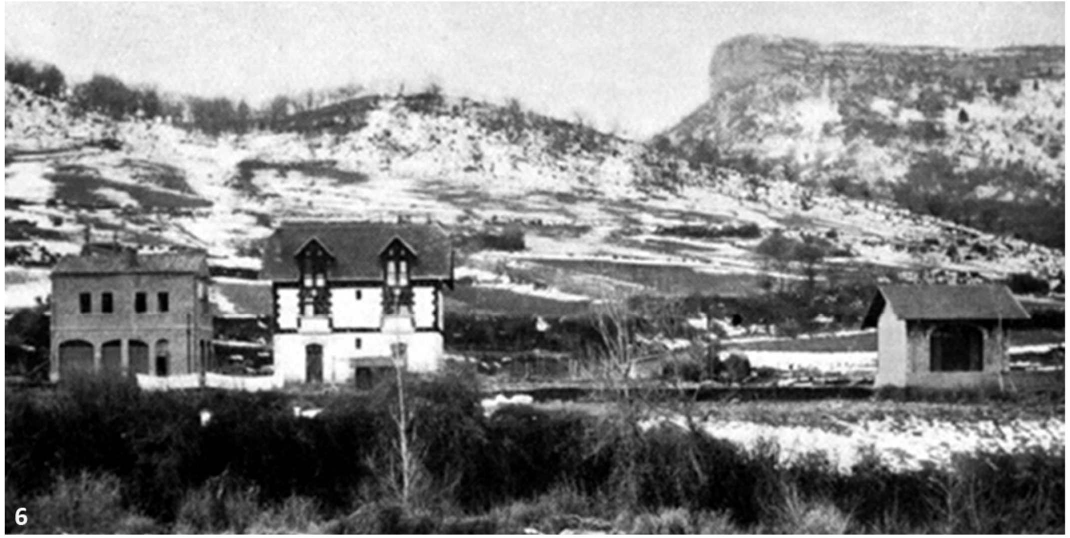
Figure 4.75 Passenger building of the railway station of Antoñana (4). Idem

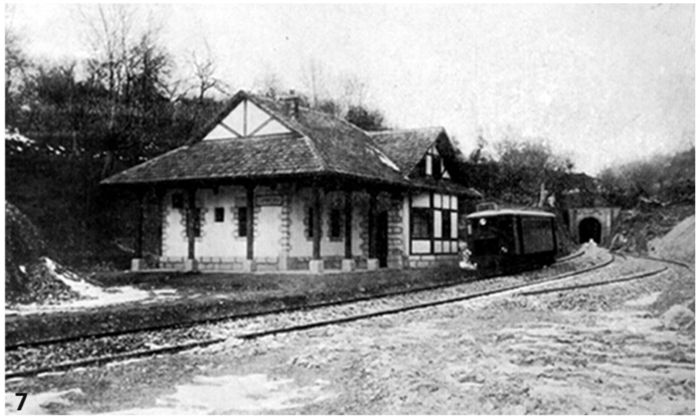
Figure 4.76 Passenger building of the railway station of Atauri (5). Idem

Figure 4.77 Railway station area of Antoñana with the electrical subcentral (left), the passenger building (middle) and the loadin bay (6).
Mendizábal, A. (1926) Annual report of the Board of Works of the Railway from Lizarra to Vitoria-Gasteiz and from Oñati to San Prudencio. ABRM

Figure 4.78 Railway halt in Laminoria (7). Idem

Figure 4.79 Passenger building of the railway station of Andollu (8).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV





baseboards and lintels or segmental arches of doors and windows, etc. (Suso, 2009d). Likewise, the use of sloping ceiling rooms or local architectural features, such as false timber frameworks, strengthened those scenic constructions (Olaizola, 2002).

In Murieta and Antzin for example (as in several other cases), a tower was included to the main construction of the passenger building (fig. 4.73 and fig. 4.74). What is more, both buildings had identical distribution except of the shape of the tower: hexagonal in Murieta and squared in Antzin. The railway service areas were sited in the ground floor, while four worker dwellings were accommodated in the two upper floors. Furthermore, the loading bays of both station areas were also identical, with closed, covered and uncovered areas. Meanwhile, in Antoñana, Atauri and Maeztu, the use of brick as decorative element can be highlighted, due to the ashlar scarcity of the area[26] (fig. 4.75, fig. 4.76 and fig. 4.77).

Using the same Old English inspiration, the railway halt of Laminoria was the only predominantly horizontal building (fig. 4.71 and fig. 4.78). Although it was a two-storey construction, the steeply pitched roof and the large eaves covered the entire second floor, where two dwellings were located. In addition to the railway service facilities, another residence was included in the ground floor. The later was also protected by the large eaves that created a porch.

The eclectic style, however, changed its approach in the railway stations of Kanpezu, Maeztu, Andollu and Olarizu, which evoked a palatial architecture converted into a bourgeois villa. Unlike the previous passenger buildings, those were characterised by low pitch roofs with curved tiles and eaves supported by struts, and the use of semicircular or segmental arches in doors and windows (Suso, 2009d).

In the case of the passenger building of the railway station of Kanpezu (fig. 4.81), the construction was composed of a two-storey central volume that included a large hall that was highly decorated according to the importance of the station (fig. 4.84). Furthermore, two lateral towers culminated the building with all necessary elements for the railway service (ticket and baggage areas, offices, storage areas, WC, etc) in the ground floor and four dwellings (composed of kitchen, dining room, three bedrooms and toilet) in the second and third floors.

Moreover and as previously mentioned, a loading bay or warehouse, a wagon shed and a railcar shed were also included in the station area, enclosed by a fence (annex 2.1.2). The loading bay was composed of two double closed areas (16 x 8 m), a double covered area (8 m) and an uncovered area[27] (fig. 4.91). Stone and brick walls, and metal pillars and roof structures were used for the creation of the closed and covered areas. Similarly, the wagon shed was a simple building (19.40 x 18.10 m) of stone walls and metal pillars and roof structure that was able to accommodate four wagons in independent tracks (fig. 4.87 and fig. 4.93). Both warehouses and wagon sheds included segmental arches in the embrasures. Finally, the railcar shed was a singular building consisted of a gable roof ground-floor building and a transversal second floor gable roof volume (fig. 4.88 and fig. 4.94). The first volume (19.4 x 12.8 m) had two tracks with pits for the cleaning and repair work. Meanwhile, the second floor included two worker dwellings of kitchen-dining room, three bedrooms and WC. The access of the second floor was made by an external staircase from the exterior or the

[26] Idem

[27] The same type of loading bay was used in the entire section of the railway, which was adapted in size (number of modules) according to necessitiess.

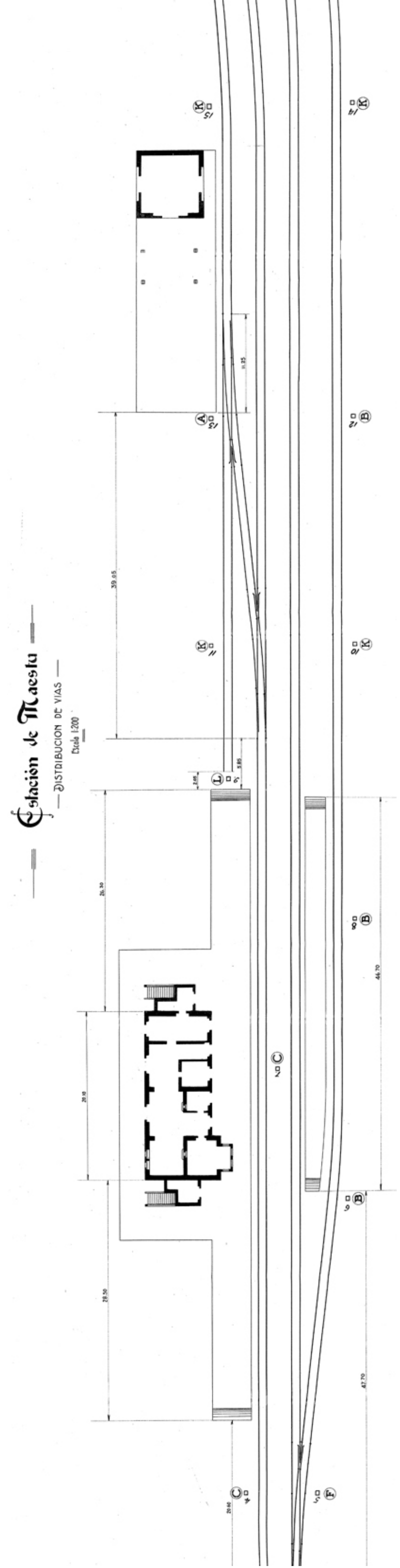


Figure 4.80 Railway station area of Maeztu composed of loading bay and passenger building (left). Alejandro Mendizábal, FEVE´s Collection in RMA

Figure 4.81 Passenger building of the railway station of Kanpezu (1).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

Figure 4.82 Passenger building of the railway station of Maeztu (2). Idem

Figure 4.83 Service building of the railway station of Olarizu (3).
Mendizábal, A. (1926) Annual report of the Board of Works of the Railway from Lizarra to Vitoria-Gasteiz and from Oñati to San Prudencio. ABRM

Figure 4.84 The hall of the passenger building of the railway station of Kanpezu (4).
Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

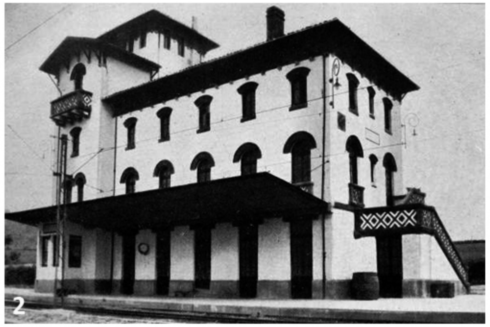
Figure 4.85 The hall of the passenger building of the railway station of Lizarra (5). Idem

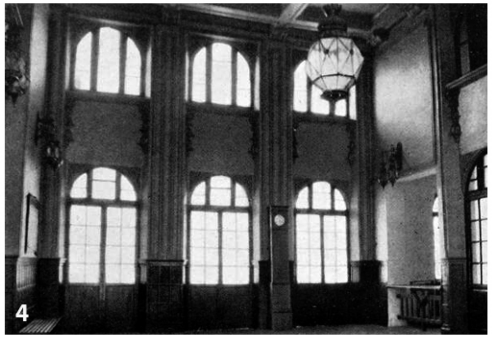
Figure 4.86 Passenger building of the railway station of Lizarra (6). Idem

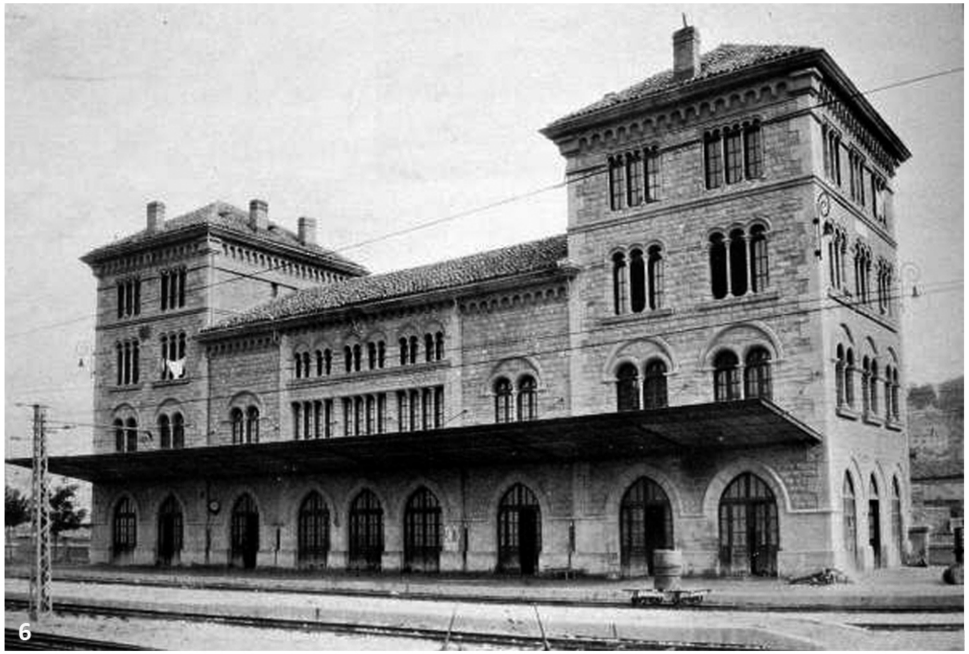
Figure 4.87 Wagon shed of the railway station of Kanpezu (7). Idem

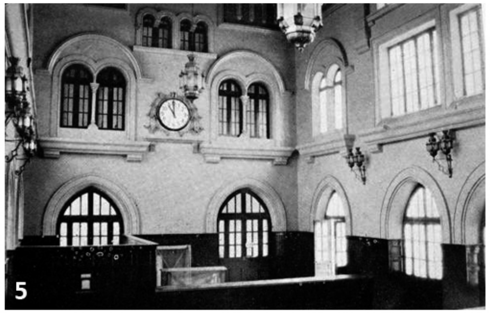
Figure 4.88 Railcar shed of the railway station of Kanpezu (8). Idem

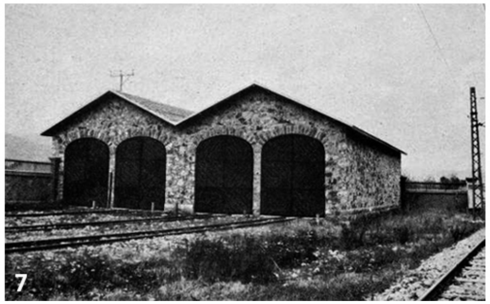
Figure 4.89 Loading bay of the railway station of Olarizu (9). Idem











station area fence. The later volume was supported by a concrete slab that lay down on the external walls of the lower space and intermediate pillars[28].

On the other hand, the passenger building of the railway station of Maeztu (fig. 4.82 and fig. 4.92) was an irregular building composed of a main volume of three storeys and a four-five-storey[29] tower located in its south. The passenger and railway service facilities were located in the ground floor (hall, offices, baggage check-in area, WCs, storage areas, etc.) and as common in the southern section of the Vasco-Navarro Railway, the office of the station manager was strategically placed in a visually privileged area (in this case, the tower area) (Olaizola, 2012). Furthermore, accessing from two external staircases, which were located in each side of the building, five dwellings were distributed among the upper floors: two in each floor and another one in the fourth and fifth floors of the tower.

In Maeztu, the palatial style architecture was reinforced with the use of Roman resources, such as cross-type railing or semicircular brick arches (Suso, 2009d). Accordingly, the simplicity of the plastered walls was highlighted by the use of red brick in constructive elements and wide eaves supported by timber structures. In addition, the use of balconies and outdoor staircases added rhythm to the building (Olaizola, 2012).

The station area was completed by three continuous railway tracks, one siding and a spacious loading bay with a double closed area (8 x 8 m), a double covered area (8m) and an uncovered area (fig. 4.80). According to the designer, with the construction of the road of the station area, it was one of the highest performance railway stations.

The railway station of Andollu also showed some influence of the palatial architecture by means of the use of the same features of low pitch roofs with curved tiles and semicircular arches. The passenger building (fig. 4.79), which was the only building of this station area, was composed of two attached volumes of two storeys each. The first one included the railway service elements in the ground floor and a worker dwelling in the second, while the other comprised two residences. Another small volume was attached as storage.

Finally, the station area of Olarizu was also a singular example in the Vasco-Navarro Railway. In its service building[30] (fig. 4.83) curved tiles and timber struts were used in low pitch roofs and semicircular arches were included in doors and windows, although segmental ones were also used. However, the most particular feature of this construction was the use of balconies, porches or terraces to represent movement in the building, which was composed of a main two-storey volume and a three-storey tower. According to the construction report, the ground floor accommodated the transfer office in the tower area with an independent entrance, while other offices and railway facilities were included in the rest. On the second floor, the residence of the supervisor and part of another house that had its bedrooms in the tower were built.

The station area of Olarizu was an important point in the Vasco-Navarro Railway since the transfer between the Railroad of the North and the narrow railway itself was developed. Therefore, in a similar way than in Kanpezu, in addition to the service building, loading bays and wagon and railcar sheds were located

[28] Mendizábal, A. (1931) General report of the Board of Works on the Railway from Lizarra to Vitoria-Gasteiz. MAV

[29] Four in the railway platform façade and five in the façade that was linked to the city.

[30] There was not any passenger service and building in this station. Its aim was to make transfers between railways and sections of railways. Idem

in a fenced station area (annex 2.1.2). The railcar-shed building was identical to the one in Kanpezu, while the wagon shed, although similar in appearance, was longer but with only two tracks (34 x 9.4 m). Meanwhile, the uninterrupted loading bay was 100 metres long, including three double closed areas, a triple covered area and uncovered areas (fig. 4.89). Finally, a mineral loader that came from the Traslaviña-Castro Railway was included in 1940 for the transfer of sugar beet from the Vasco-Navarro Railway to the Railroad of the North (Olaizola, 2002). The whole area comprised four narrow tracks, two broad tracks, one transfer track and others for storage and sheds.

Nevertheless, one of the main railway station areas and the most monumental passenger building of the Vasco-Navarro Railway was located in the south end of the line. The railway station of Lizarra (fig. 4.86) was built in a neo-Romanesque style taking into consideration previous monuments of the city itself and as an example a particular medieval construction, the Palace of the Kings of Navarre. Accordingly, the main formal features of the passenger building were low pitch roofs with curved tiles, eaves with false machicolations, ashlar walls and Romanesque style windows with semicircular arches that could be double or triple, which were substituted by ogival arches in the ground floor (Suso, 2009d).

Together with the passenger building of Kanpezu, it was the only station of the southern section that had a building symmetrical in shape, strengthening their palatial style. For that purpose, the construction was composed of a main central building and two lateral towers. All the railway service area was located in the ground floor, where a large decorated hall (fig. 4.85) comprised the entire central building. On the other hand, four worker dwellings were accommodated on the upper floors of each lateral construction. On the second and third floors, a house for a supervisor or similar status worker were built in each floor, while other two houses were created in the next two floors, divided into kitchen, dining-room and WC in the first and three bedrooms in the second.

Besides the passenger building, the railway station area consisting of loading bays and wagon and railcar sheds showed similar features than in Kanpezu and Olarizu (annex 2.1.2). In this case, the railcar shed was equal to those in both of them, while the wagon shed was the same as in Olarizu. In contrast, the loading bay included two double closed areas, a fourfold covered area and an uncovered area. Lizarra was one of the full service nodes that create a structuration along the Vasco-Navarro Railway, creating a service scheme represented in fig. 4.90.

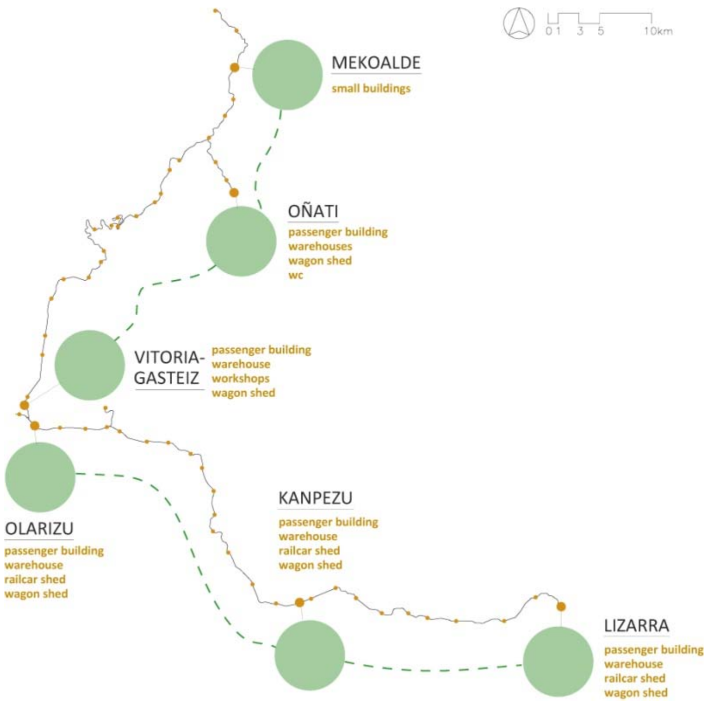
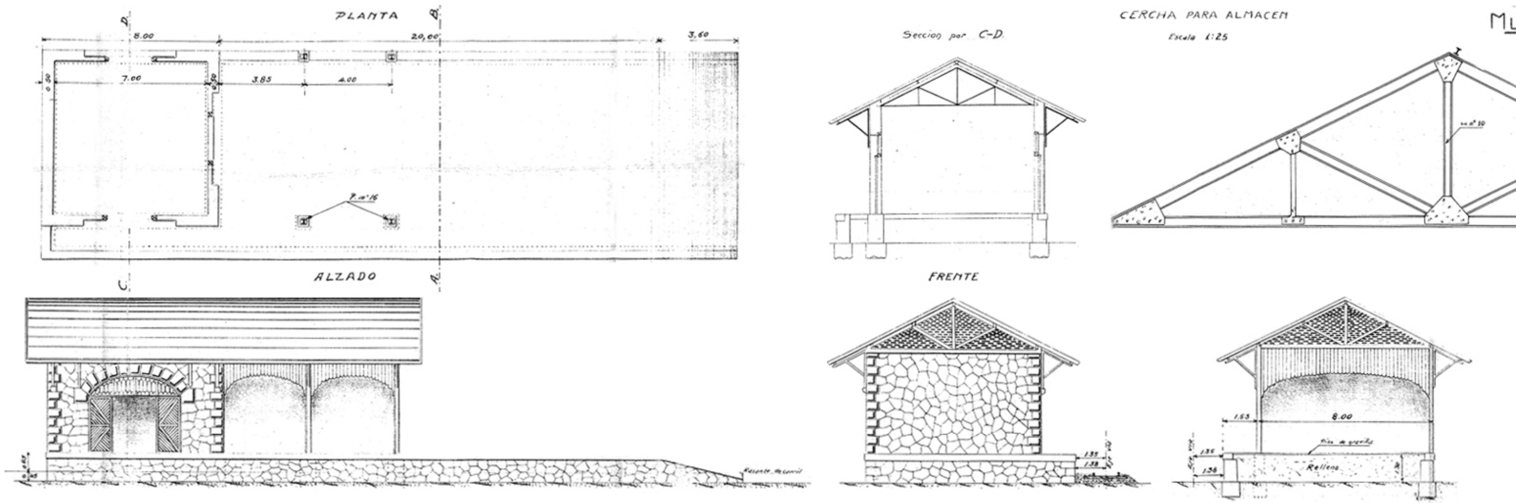


Figure 4.90 Structuration of the Vasco-Navarro Railway according to its full service node areas



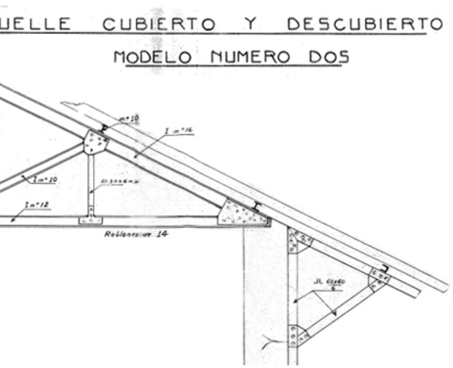
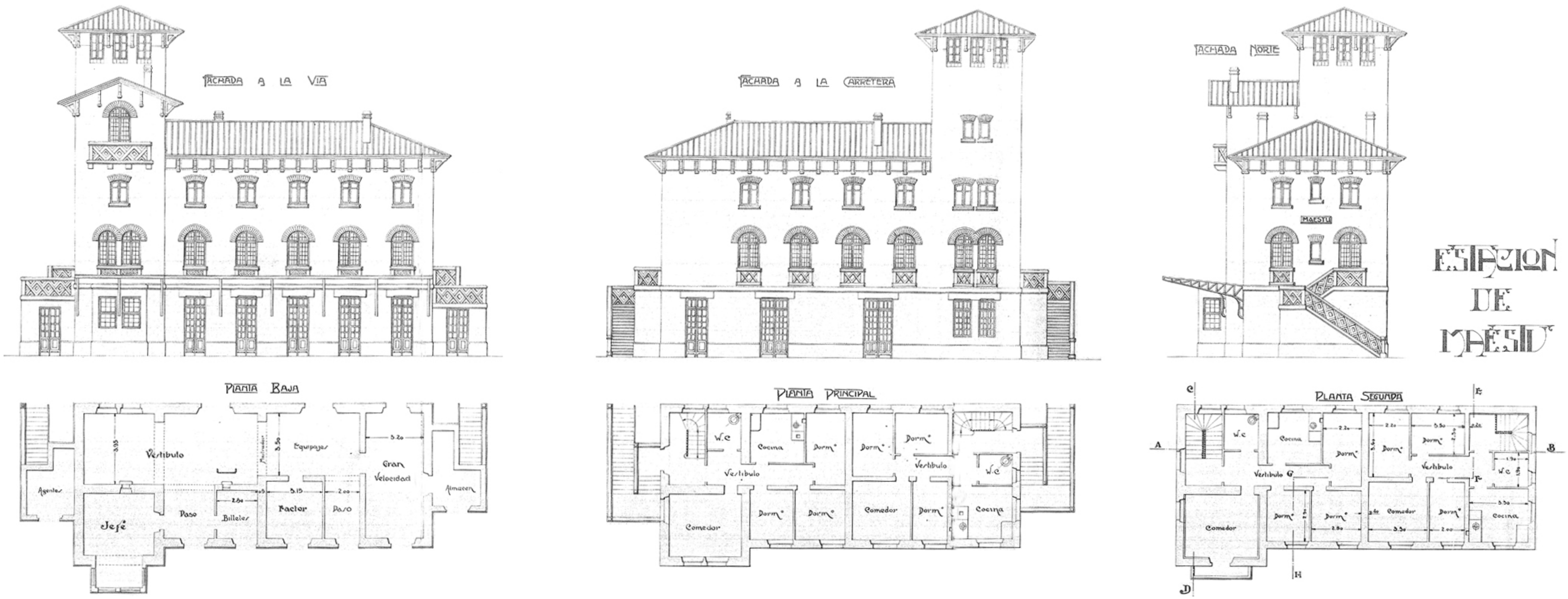
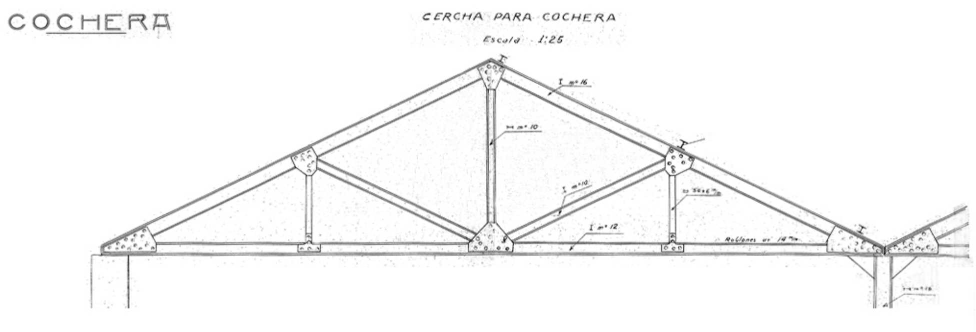


Figure 4.91 Closed (doble), covered (doble) and uncovered loading bay model (left). Alejandro Mendizábal, 1926, FEVE´s Collection in RMA





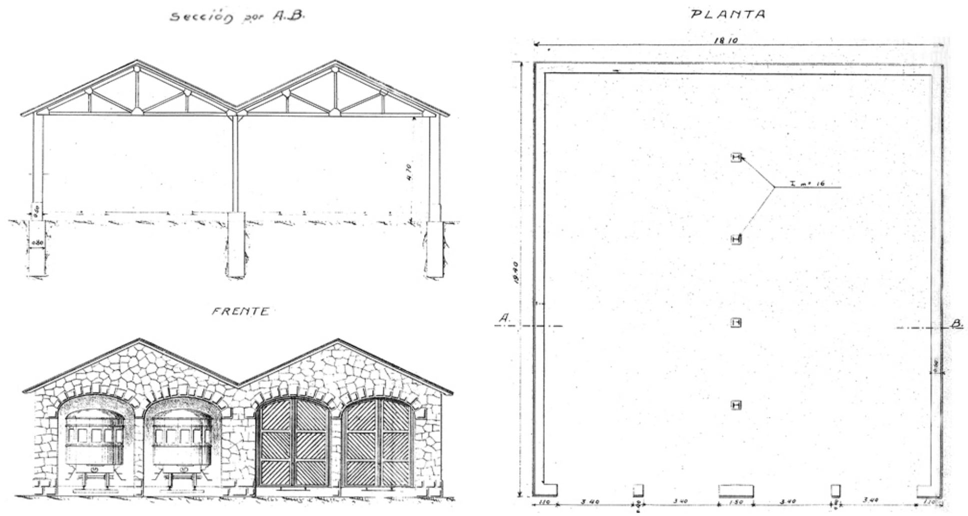
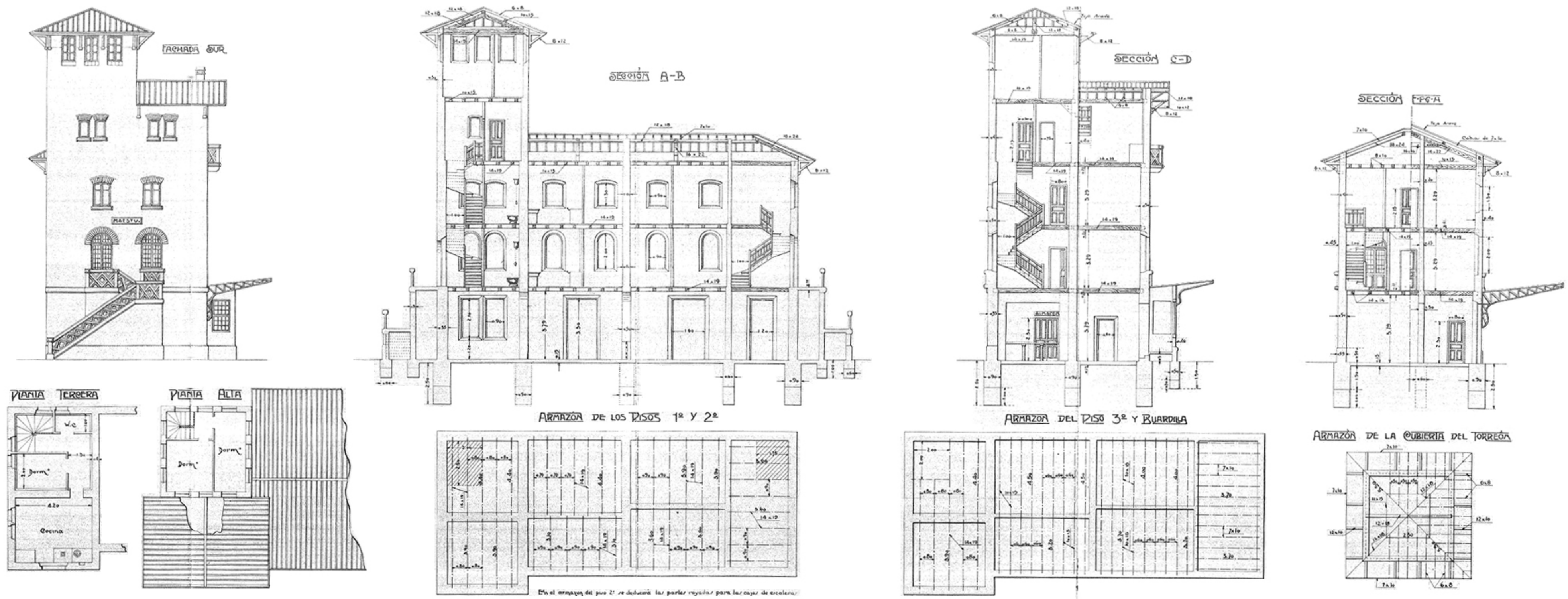
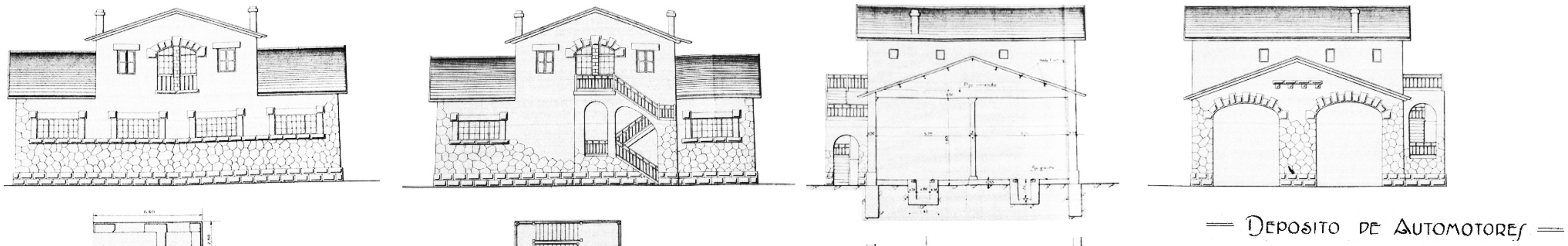


Figure 4.92 Passenger building of the railway station of Maeztu (below). Alejandro Mendizábal, 1928, FEVE´s Collection in RMA

Figure 4.93 Wagon shed of the railway station of Kanpezu (above and right). Alejandro Mendizábal, 1926, FEVE´s Collection in RMA





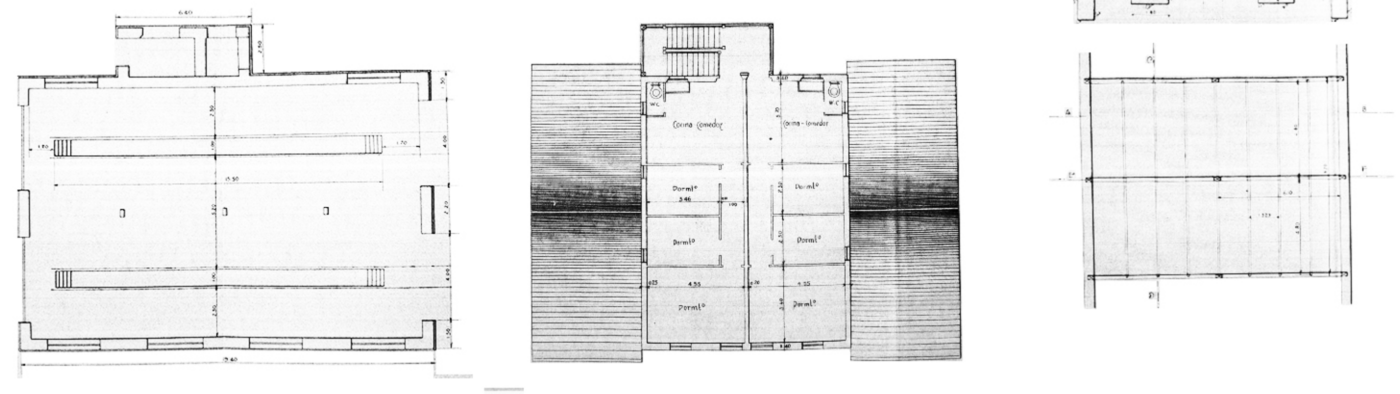
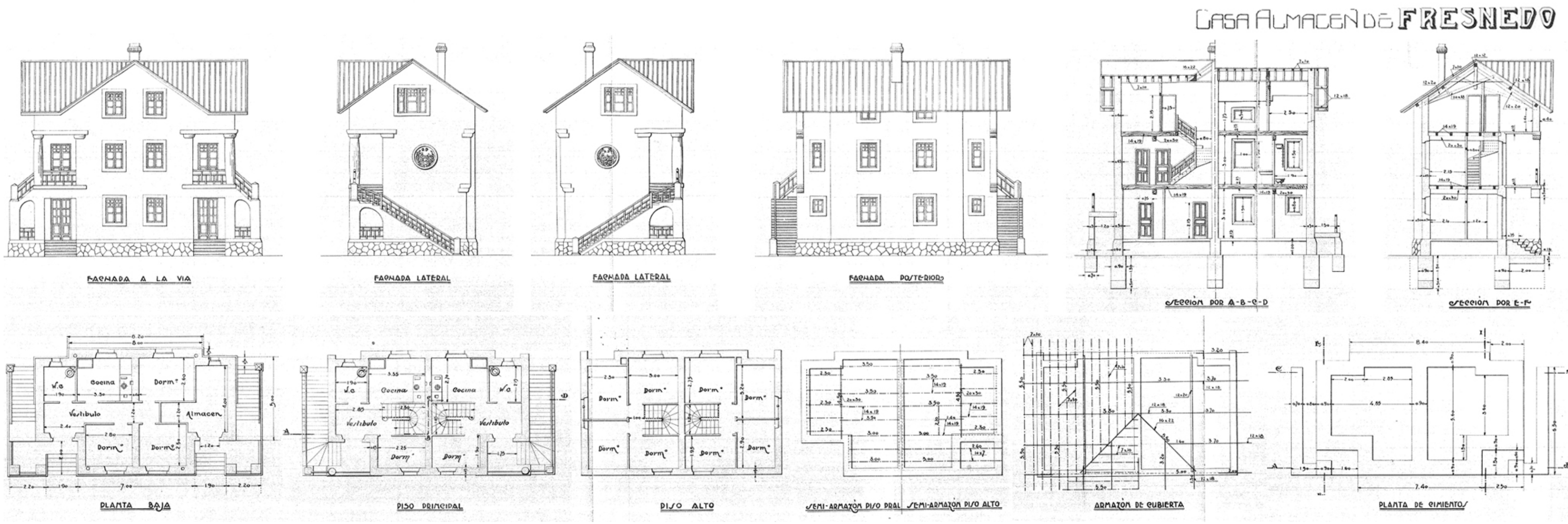


Figure 4.94 Railcar shed model repeted in Olarizu, Kanpezu and Lizarra (left). Alejandro Mendizábal, 1929, FEVE´s Collection in RMA

Figure 4.95 Worker residence and occasional railway stop in Fresnedo (bellow). Alejandro Mendizábal, 1928, FEVE´s Collection in RMA



In addition to the railway station of Lizarra, the stations of Murieta, Antzin, Acedo, Kanpezu, Atauri and Maeztu included a metal canopy that covered the main railway platform, combining the different architectural styles with the functionality of this industrial element, as in the case of the northern section of the line.

Futhermore, different construction materials were also used for the different building structures. On the one hand, foundations and exterior or interior bearing walls were made of stone. On the other hand, timber structures were used in the interior of the railway stations in order to built pillars and floor and roof structures. Finally, reinforced concrete was used in specific elements, such as pillars, beams or slabs of exterior porches.

Eventually, the last railway node of the Vasco-Navarro Railway (built in 1948) was the halt located in the Sanctuary of Estibaliz. Although there was not any railway building, a stone retaining wall with ashlar arches and a staircase that connected the halt with the sanctuary area were built. Taking into consideration all the station buildings of the southern section of the railway, the size of buildings were remarkable comparing to the number of citizens or the town they served (Olaizola, 2012). In several of them, the railway station was the tallest building (excluding churches) and, needless to say, the most singular construction. Although they seemed disproportionate to their role, they were adequate for market or fair days, as noted by Mendizábal for the railway station of Kanpezu.

Figure 4.96 General view of Soraluze in of 1959. Paisajes industriales

4.3.3. Surrounding territory

The Vasco-Navarro Railway crossed three different provinces that are from two different hydrographical areas, which makes the territory different along the rail line. The Cantabrian side, which comprised the railway area that was located in Gipuzkoa, was composed of narrow valleys of high population density. Meanwhile, in the Mediterranean side (Araba/Álava and Navarre), the railway usually went through broad plains, and disperse and rural settlements, since population was concentrated in few main cities. This clear distinction brought about important differences in the landscapes of the two sections and in consequence, in the image of the territory observed from the train.

The northern section of the Vasco-Navarro Railway went through the narrow valley of the upper course of the Deba (fig. 4.96) following the river that is located in the bottom of the valley, as shown in the first three sections of fig. 4.97. A main road that reached the watershed in the mountain port between the provinces of Gipuzkoa and Araba/Álava was the only significant infrastructure along the upper course of the valley at the arrival of the railway. The motorway that links Gipuzkoa with Vitoria-Gasteiz was built in 2009.

Furthermore, the north end of the analysed line (Vasco-Navarro and Maltzaga-Zumarraga railways) connected to the transport axis towards Bilbao (Bizkaia) in Maltzaga, in addition to the lower course of the Deba that was also linked to Donostia. Main transport infrastructures between the two capitals, composed of the main road and the Donostia-Bilbao Railway and complemented by the AP-8 motorway in 1974, passed through Maltzaga.

The main urban settlement or towns were also sited in the bottom of the valley and had a sizeable population when the railway arrived. Accordingly, all cores had more than 1700 inhabitants while the main ones had more than 4500. The only exception was Leintz Gatzaga which, being located in the ascent of the watershed mountain port, linked to the salt production and previously known as an important point in the royal road, had only 500 inhabitants at the arrival of the railroad.

The Cantabrian side landscape was mainly composed of urban areas in the bottom of the valley, including urban settlements or the early industries of the area, and rural and natural areas in the surrounding areas. The latter principally comprised pastures and forests.

In the highest areas of the river course, the Vasco-Navarro Railway adapted to the rugged terrain by means of constant turns in order to ascent to the mountain port of Arlaban that separates the provinces of Gipuzkoa and Araba/Álava (the fourth section in fig. 4.97). Once the train had left the watershed, it headed towards Vitoria-Gasteiz across plain terrains and following the axis of the Zadorra river, as represented in the fifth and sixth sections in fig. 4.97.

From Vitoria-Gasteiz to the south extreme of the railway in Lizarra, the rail track crossed three different counties: the plain

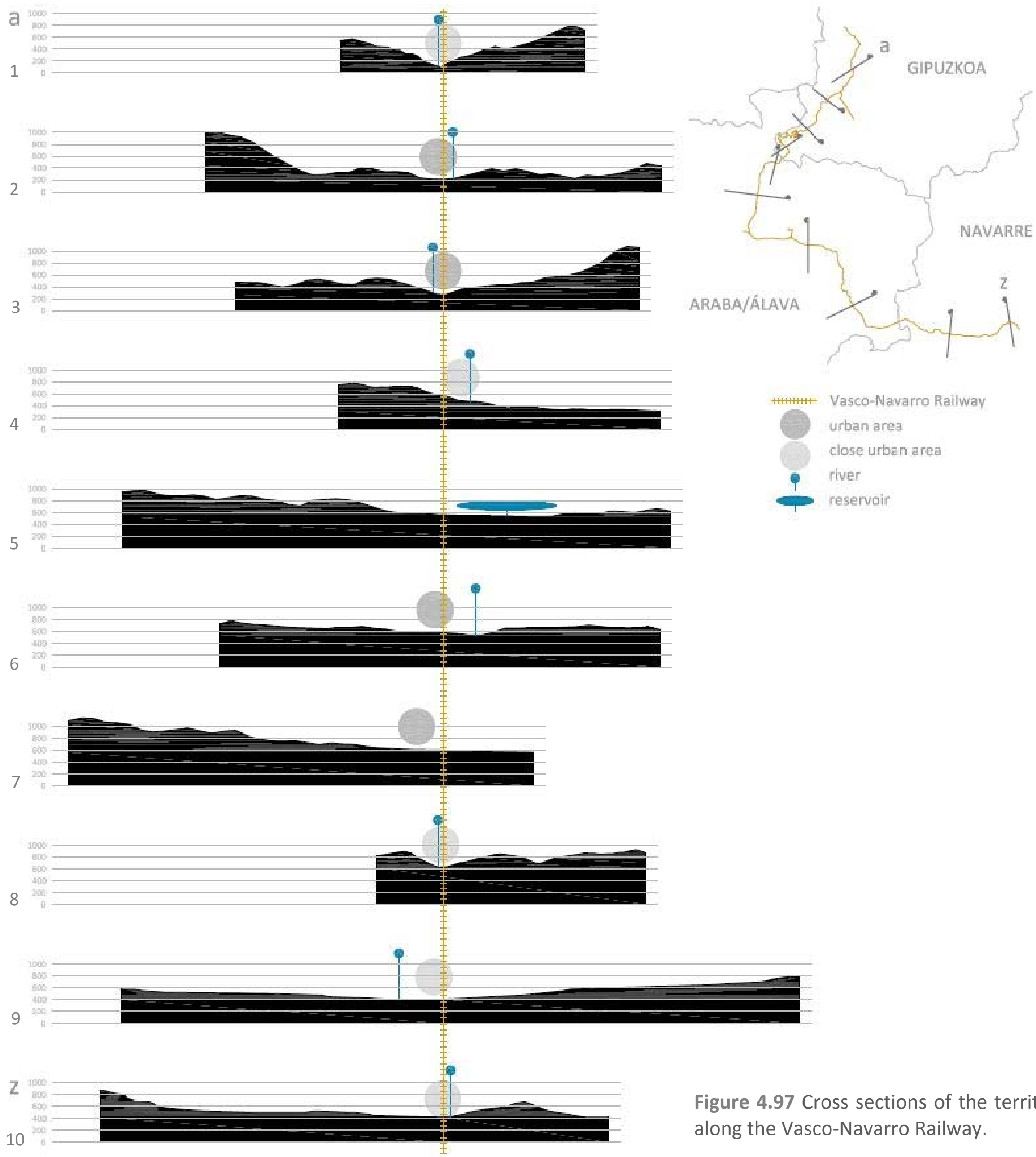


Figure 4.97 Cross sections of the territory along the Vasco-Navarro Railway.

terrains of Araba/Álava, the mountains of Araba/Álava and the area of Lizarra. By and large, the territory of Araba/Álava and Navarre was characterised by broad plains and agricultural landscapes, as in two of the previous counties. Nevertheless, in the area of Kanpezu or the watershed between the Zadorra and Ega rivers located in the mountains of Araba/Álava, the orography was similar to Gipuzkoa, although the population cores settled in both of them had nothing to do with each other. Accordingly, in the southern section of the line, there were generally small rural towns of less than 1000 inhabitants, except Lizarra and the main city of Vitoria-Gasteiz, which had more than 5000 and 30000 inhabitants respectively when the railway arrived.

In this regard, the railway left Vitoria-Gasteiz and headed east through the plains located around the city. There was a similar landscape until Uribarri-Jauregi, with mountains in the south all along its route, which crossed the province from west to east (seventh section in fig. 4.97). Afterwards, the track turned south entering the in the valleys of the mountains of Araba/Álava and reaching the watershed between Zadorra and Ega rivers in a tunnel. Accordingly, it reached the boundary between Araba/Álava and Navarra nestled between mountains and following the Ega river (eighth section in fig. 4.97). Once in Navarre, the Vasco-Navarro Railway continued along the same river axis until the end of the line. Although there was a mountain area located north of the line, it went through plain terrains (ninth and tenth sections in fig. 4.97). All the territory around the railway is represented in annex 2.1.3 in 1929.

Over the life of the railway however, the territory itself and the population living in those regions changed. Variations produced in population levels can be divided in two primary trends depending on the size of the existing settlements. On the one hand, population increased in main cities or towns since the arrival of the railroad, due not only to this but also to the industrial process that occurred in them and the high immigration rates that the latter provoked. However, this tendency changed in the 1980s due to the industry decline and falling birth dates, in addition to the closure of the railway in the late 1960s. It especially happened in highly industrialised areas, such as Bergara, Arrasate, Aretxabaleta o Eskoriatza. Vitoria-Gasteiz, Lizarra or Oñati however, have maintained an upward trend.

On the other hand, the small rural settlements located along the railway line, particularly in Araba/Álava and Navarre, have suffered a general depopulation, reaching their minimum population values in the 1980s or even nowadays. In the case of Navarre, although towns have reached the maximum population rates during the railway years in several cases, the minimum values were also obtained in the 1980s (after the closure of the line). The lack of suitable transport infrastructures or public facilities and the people in search of employment opportunities triggered the population movement towards main cities. It should be noted that some rural settlements or towns have slightly increased their population since then.

In addition to the population evolution and related to it, there were other changes along the territory around the railway line during its operational period.

On the one hand, several cities or towns have grown considerably since the arrival of the railway. The most representative case was Vitoria-Gasteiz, which initially grew south due to the creation of the two railways (the Railroad of the North and the Vasco-Navarro Railway) and then developed north in the 1970s (fig. 4.98 and fig. 4.99). The city has widely expanded over the years without orographic constrains. On the contrary, the northern towns of Gipuzkoa had a lineal sprawl that coincided with the river and the axis of transport infrastructures, including the Vasco-Navarro Railway. This is the case of Bergara, Arrasate, Aretxabaleta, Eskoriatza and Soraluze (fig. 4.100, fig. 4.101 and fig. 4.102). Oñati, being out of the main county axis, had an expansion in different directions.

Furthermore, these urban sprawls included also new industrial areas. Most of them were built in the surrounding lands of the railway track and located close to Vitoria-Gasteiz, such as Olarizu and Gamarra-Betoño, or in the towns of Gipuzkoa, such as Bergara, Arrasate, Eskoriatza or Oñati (fig. 4.103, fig. 4.104 and fig. 4.105). In addition, in the latter case, the industrial areas were sited between towns at the years of the closure of the railway, creating long urban areas of more and more density along the river course. Accordingly, new industrial areas close to the former railway were created between Arrasate and Aretxabaleta or Aretxabaleta and Eskoriatza, in the south or north areas of Bergara and along the branch to Oñati.

On the other hand, other towns or population settlements have not grown since the beginning of the twentieth century, but new transport infrastructures have been built around them. For instance, Urbina, Otazu, Gauna or Uribarri-Jauregi showed this particular aspect (fig. 4.109, fig. 4.110 and fig. 4.111). The new facilities were usually increasingly faster transport elements that permit travellers not to cross each urban core. In this regard, the improvement of the quality of the road network and subsequent transport competition produced, among others, the closure of the railway. This territorial approach was moreover enhanced by the construction of motorways in the following years.

Finally, there are urban or rural cores that have barely grown since the railway period and maintain similar territorial features during the entire twentieth century, such as Aberasturi, Kanpezu or Zuñiga (fig. 4.106, fig. 4.107 and fig. 4.108).

Figure 4.98 Orthophoto of Vitoria-Gasteiz of 1956 (left). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.99 Orthophoto of Vitoria-Gasteiz of 1977 (right). Idem

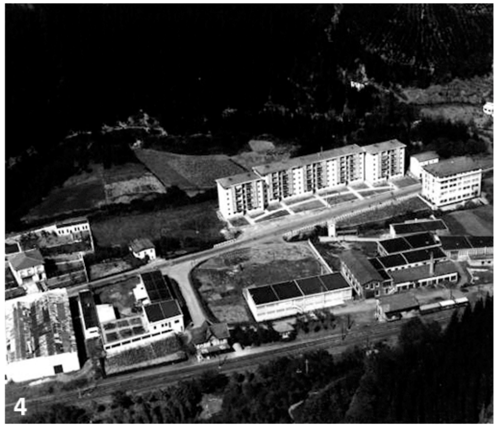


Figure 4.100 General view of Eskoriatza in 1970 (1). Paisajes Españoles

Figure 4.101 Orthophoto of Aretxabaleta of 1956 (2). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.102 Orthophoto of Aretxabaleta of 1977 (3). Idem

Figure 4.103 General view of the station area of Eskoriatza surrounded by industries (4). Juan Mª Zubia´s collection

Figure 4.104 Orthophoto of the blust furnaces of Bergara in 1956 (5). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.105 Orthophoto of the blust furnaces of Bergara in 1977 (6). Idem

Figure 4.106 General view of Kanpezu in 1970 (7). Paisajes Españoles

Figure 4.107 Orthophoto of Kanpezu of 1956 (8). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.108 Orthophoto of Kanpezu of 1977 (9). Idem



Figure 4.109 Orthophoto of Urbina of 1977 (left). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.110 Orthophoto of Otazu of 1977 (middle). Idem

Figure 4.111 Orthophoto of Gauna of 1977 (right). Idem

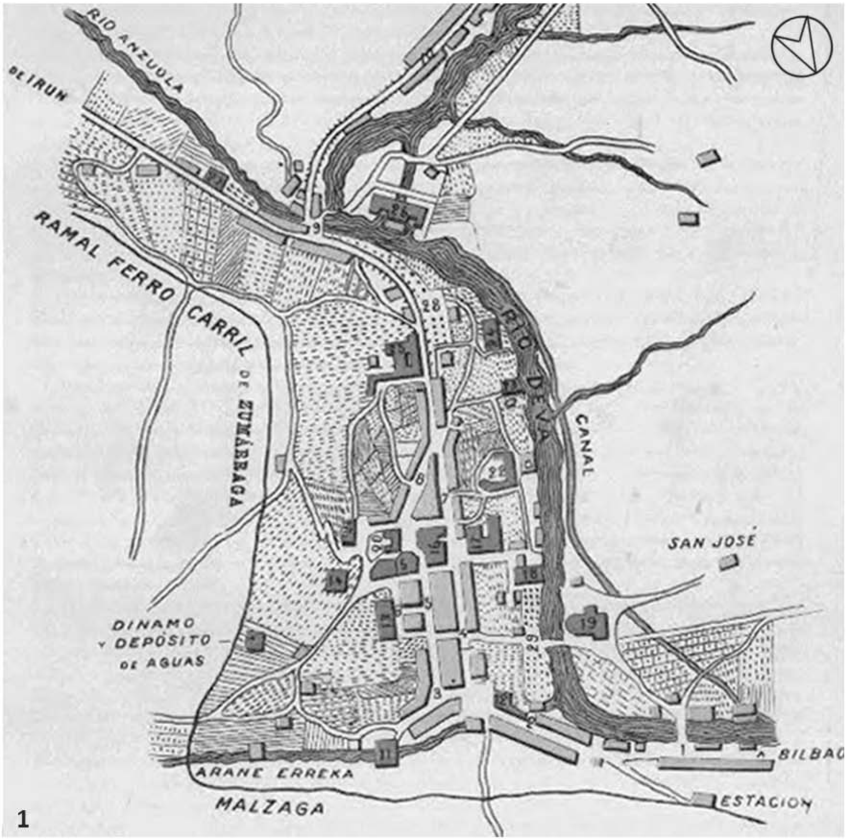
Referring to the urban areas that had an expansion in the railway period, different approaches have been identified. In general, the location of the railway and especially its station made the city expand in that direction. Nevertheless, in several cases, the location of the railway station conditioned the city sprawl creating a new street or axis that connected the old city to the station area, where the station itself acted as the driving force for its surrounding development. Furthermore, in many urban areas, the construction of the railway line created a new boundary, which does not only attracted the expansion, but also limited it. The urban expansions of four of the cities or towns according to the railway are described bellow as examples.

In Bergara and Arrasate, located in the upper course of the Deba River, the old city was sited close to the river but not next to it. In the case of Bergara, the old town was east of the river, while one of the churches was located west of the river (fig. 4.112 and annex 2.1.3). In the middle of the 19th century the municipality had 3785 inhabitants and 600 buildings, although only 300 were located in the city (Madoz, 1946-50).

Meanwhile, in the beginning of the 20th century, there were 334 buildings in the city (744 in the whole municipality) (Múgica, 1918), 6196 inhabitants in 1900 and 7345 inhabitants in 1920[31]. In addition to the arrival of the railway, the lands between the old city and the river were built or used in this period, although without any certain planning. Accordingly, the railway station was sited south of the city but next to the river, and was linked with a new street to the old town (fig. 4.113). This diagonal axis however, would never organise its surrounding development. That is why it would disappear with the new urban plan of the end of the 20th century.

Several industrial facilities were already started up in the beginning of the 20th century, more specifically, there were 22 of them in 1915[32]. Most of them were related to yarn or derivative products, such as the cotton industry of San Antonio created in 1846. However, there were also important industries of the metal sector, such as the blast furnaces of the Unión Cerrajera, which were established in Bergara in 1900. In this regard, there were 15 mechanical carpentry workshops and 7 blacksmith's workshops in 1923[33].

[31] Spanish Statistical Office (INE)
[32] Factories and mechanical workshops in Gipuzkoa, 1915. Gipuzkoa General Archive (AGG-GAO), JDSM38,19_00-17
[33] Industrial production statistics (Gipuzkoa), 1923. AGG-GAO, JDIT2799,2_01-13



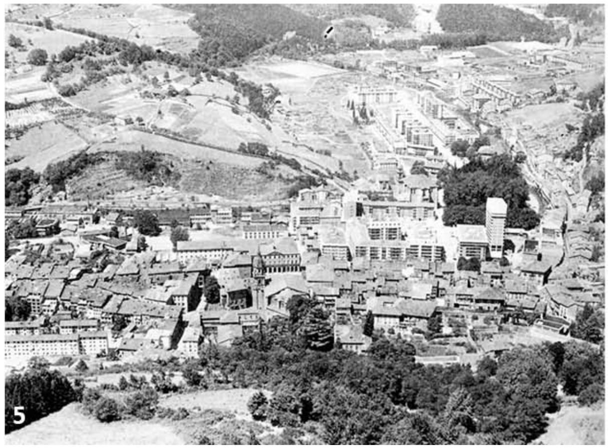


Figure 4.112 Bergara in the beginning of the 20th century (1). Part of a plan published in Múgica (1918)

Figure 4.113 General view of the station area of Bergara with the old city behind (2). ABRM

Figure 4.114 Orthophoto of Bergara of 1956 (3). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.115 Orthophoto of Bergara of 1977 (4). Idem

Figure 4.116 General view of Bergara (5). Paisajes Españoles

Afterwards, during the operational years of the railway, the urban core joined with existing small neighbourhoods in the south (by the fifties) and first industrial sites also appeared both in the south (by the forties) and in the north (by the fifties) of the city (fig. 4.114).

Finally, in the sixties and seventies, and coinciding with the closure of the railway, the city had its mayor urban sprawl, which was located north of the city, out of the attraction of the railway station that was declining or already closed. Accordingly, a new large residential and service area was created and the industrial area of San Lorenzo was concluded (fig. 4.115 and fig. 4.116).

In the case of Arrasate, the almond-shaped old city was located in the north of the river but separated from it and protected by the Santa Barbara hill. The first small expansions were located east and west, along the roads to Bergara and Kanpazar (Unzurrunzaga & Urteaga, 1972) (fig. 4.117). As in the case of Bergara, the main road along the valley went through the middle of the old city.

In this regard, in the middle of the 19th century the municipality had 2114 inhabitants and 410 buildings, although only 206 were located in the city (Madoz, 1946-50). Meanwhile, in the beginning of the 20th century, there were 3713 inhabitants in 1900, 5915 in 1920[34] and 224 buildings in the city (473 in the whole municipality) (Múgica, 1918). The difference between buildings is low taking into account that some of the important industries (e.g. the later Unión Cerrajera) were already located next to the Aretxabaleta river and south to the city by the end of the century (fig. 4.118). Accordingly, there were 12 industrial facilities in 1915[35], while there were 7 mechanical carpentry workshops and a blacksmith's workshop in 1923[36].

With the arrival of the railway and taking into consideration the industrial growth that was happening in the city, an expansion plan was developed by Cipriano Artetxe in 1905 (Unzurrunzaga & Urteaga, 1972). A new axis from the east side of the old city to the southeast was created in order to connect the railway axis and reach the railway station. The station area was located far east from the city, since the first industrial expansion took the lands that seem to be appropriate for the station. Nevertheless, the connection axis was changed south, so the connection between the railway station and the city was indirect. However, the development attraction of the railway was clear. Industrial areas were created close to railway station, but two residential areas or working-class districts[37] were also included between old city and the station area (between the railway and the road) (fig. 4.119). Another second axis from the middle of the old part to the south was also designed by Artetxe, but it was not developed due to the industrial areas that were sited in its end. If the railway station area had been sited there, the second axis would have organised the new development. Nowadays a small pedestrian axis exists there.

From the middle of the last century, further terrains were occupied in the east and new residential areas were created north of the road. In this regard, the largest urban expansion was developed in the sixties and seventies[38], when the entire east zone was built and other new urban sprawls were created

[34] INE

[35] Factories and mechanical workshops in Gipuzkoa, 1915. AGG-GAO, JDSM38,19_00-17

[36] Industrial production statistics (Gipuzkoa), 1923. AGG-GAO, JDIT2799,2_01-13

[37] One was composed of multi-dwelling buildings while the other was a garden city.

[38] From 14148 (1960) to 22421 (1970) inhabitants. INE

Figure 4.117 Arrasate in the beginning of the 20th century (1). Plan published in Múgica (1918)

Figure 4.118 General view of the city of Arrasate with the first industries behind (2). Indalecio Ojanguren´s Collection, Gure Gipuzkoa

Figure 4.119 Orthophoto of Arrasate of 1956 (3). Last seen April 2017, in: http://www.geo.euskadi.eus/informazioa/ortoargazkien-konparatzailea/s69-geocont/eu/

Figure 4.120 Orthophoto of Arrasate of 1977 (4). Idem in the west (fig. 4.120). In the latter, both northern and southern terrains were built and new industrial sites were also created. This period corresponded to the largest industrial development and immigration rates of the municipality. Furthermore, the closure of the railway also occurred then. Accordingly, new expansion areas were located far from the railway station areas, since it did not produce any attraction.

In Lizarra, in the south end of the line, the main part of the old city was sited in the north of a meander of the Ega river and other urban areas were also located both north and south of the next meander in the east, creating a main west-east configuration (annex 2.1.3). In the zone between the city and the first meander, there was a large green area and a path along the river called Los Llanos (the plains). Lizarra was, in addition, an important point in the Way of St. James, which went through the south part of this second meander.

In the middle of the 19th century, the city had 5759 inhabitants and 1100 buildings (Madoz, 1946-50). Meanwhile, in the beginning of the 20th century, there were 5736 inhabitants in 1900, 5603 in 1920[39] and 1114 buildings in the city (Altadill, 1918). Therefore, Lizarra did not grow as the cities of Gipuzkoa, what is more, population decreased.

Nevertheless, in the second half of the 19th century, the Inmaculada street or Anden[40] was built from west to east side of the first meander, creating a new south boundary of the city and appearing new buildings (fig. 4.121). Afterwards, the railway and its station area (1927) were located parallel to the Anden street, but not next to it (fig. 4.122). Hence, the large open area was divided into two: the northern zone will be filled by new constructions over the years, while the southern will keep its open space concept. In this regard, although several urban planning proposals were presented for the organisation of the new area, none of them was approved. Only the connection between the Anden and the station was finally supported in order to create a suitable link between the city and the railway station. Accordingly, the initial buildings were sited in the first line of the Anden; the axis of the station was concluded then[41] and finally, workshops and other storehouses were built chaotically in the other terrains (fig. 4.123). It can be said that the railway station organised the urban planning of its surrounding areas. In this regard, there was an important increase in population due to the arrival of the railway in the thirties[42].

The other main population increase happened between 1960 and 1980, when the railway closed and new expansions occurred, because people from the surrounding small towns moved to Lizarra. On the one hand, the closure of the railway supposed that there was not south limit in the city. Fortunately, the north side of the station was completed but the imaginary border was conserved due to the citizen pressure, so the open areas of Los Llanos were maintained. On the other hand, new urban sprawls in the north of the city were built and first buildings in the east of the city (on the other side of the river) appeared which will become an important residential and service district over the years.

After the examples of the towns of Gipuzkoa and the main town along the Vasco-Navarre Railway in Navarre, Vitoria-Gasteiz is the only city that had a significant urban growth for its study.

[39] INE
[40] (Road platform). Called like this because of the coaches stoped there.

[41] The new axis was created after the opening of the railway.
[42] From 5972 (1930) to 7384 (1940). INE

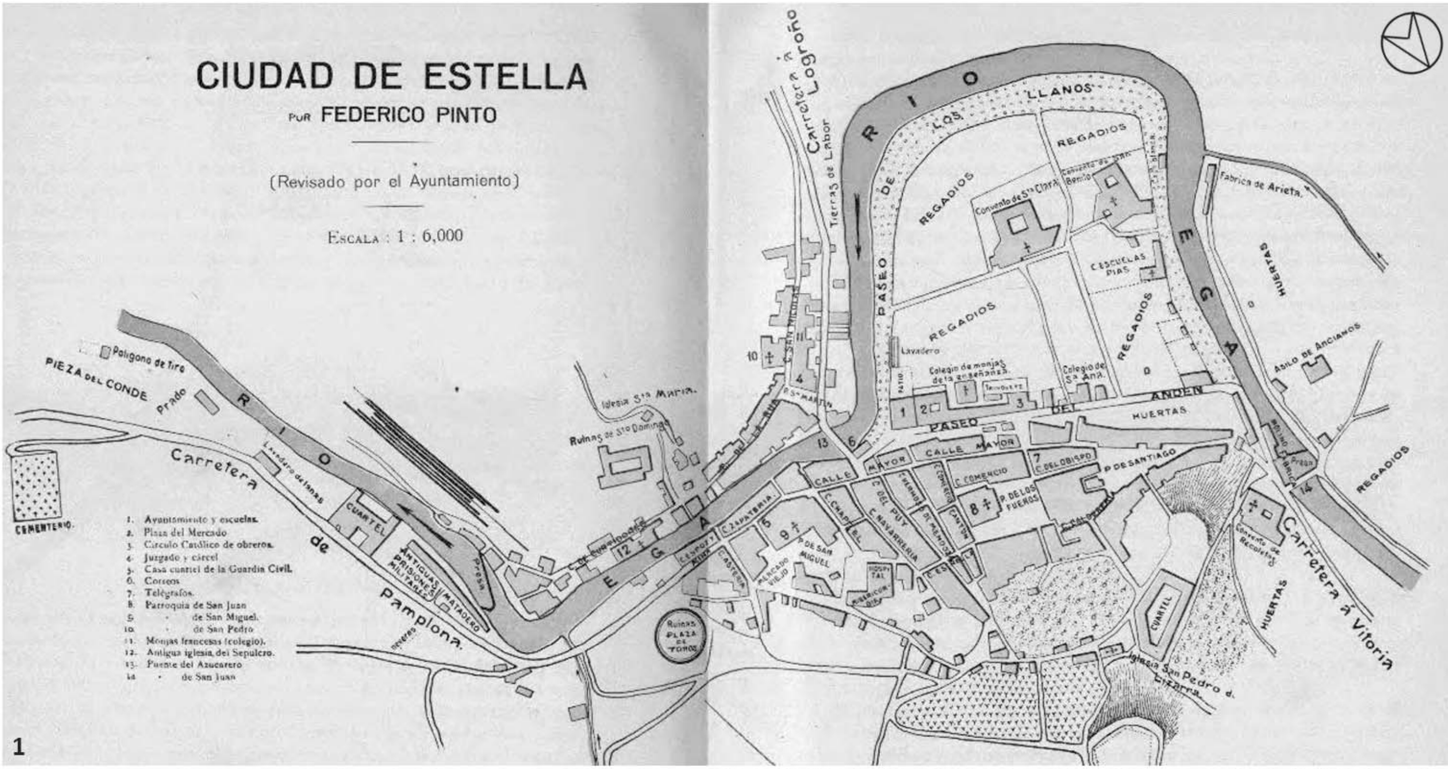


Figure 4.121 Lizarra in the beginning of the 20th century (1). Plan of Federico Pinto published in Altadill (1918)

Figure 4.122 General view of the city of Lizarra at the arrival of the railway, where the railway station area was separated to the old city (behind) (2).
Last seen April 2017, in:
http://estella.info/estella/articulo.asp?f=losllanos&n=Los%20Llanos%20I

Figure 4.123 Orthophoto of Lizarra of 1956 (3). Last seen April 2017, in:
http://sitna.navarra.es/navegar/

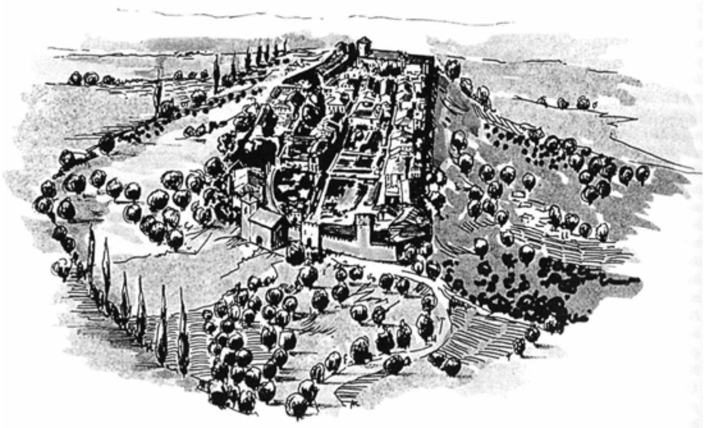
Vitoria-Gasteiz was formed by an almond-shaped old city until the 18th century. The initial settlement was comprised by three straight streets (fig. 4.124), which were included an expansion of three curved streets in the west and east in the 13th century (fig, 4.125 and fig. 4.126), thus creating the almond shape. Afterwards, from the 14th to the 18th century, the city maintained almost the same extension (Vera, 1915-21). It is in that time when the city started to open and expand with the creation for example, of the New Square (annex 2.1.3).

In the middle of the 19th century, the city had 10266 inhabitants and 1221 buildings. The main industrial facilities were related to the craft industry, since there was not coal or waterfalls nearby, and the commerce was almost null because of the relocation of customs in the coastal area of the Basque-Navarre territory (Madoz, 1946-50).

In this context, the first railway (Railroad of the North, 1864) arrived to the city. As mentioned before, Vitoria-Gasteiz was going to be a railway node were it not for the Bilbao-Tudela Railway that went through Miranda. This made impossible to recover the commerce routes that previously the city had. What is more, it brought the competence of external products to the capital itself (Rivera, 2008).

The railway crossed the city from west to east and the station was located south of the urban area. In this regard, a new axis that connected the New Square with the station was created (the previous Station street or the current Dato street), where the first new significant urban expansion was developed around (fig. 4.127). Nevertheless, the street was not aligned to the square axis due to private interests and the lack of an urban planning (Rivera, 2008).

After the influence of the first railway, in the beginning of the



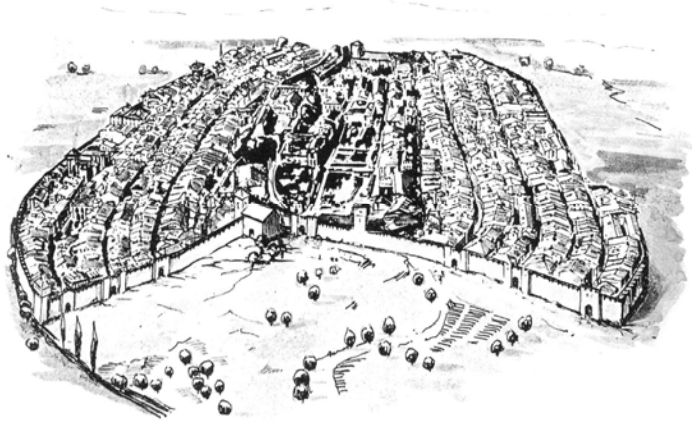
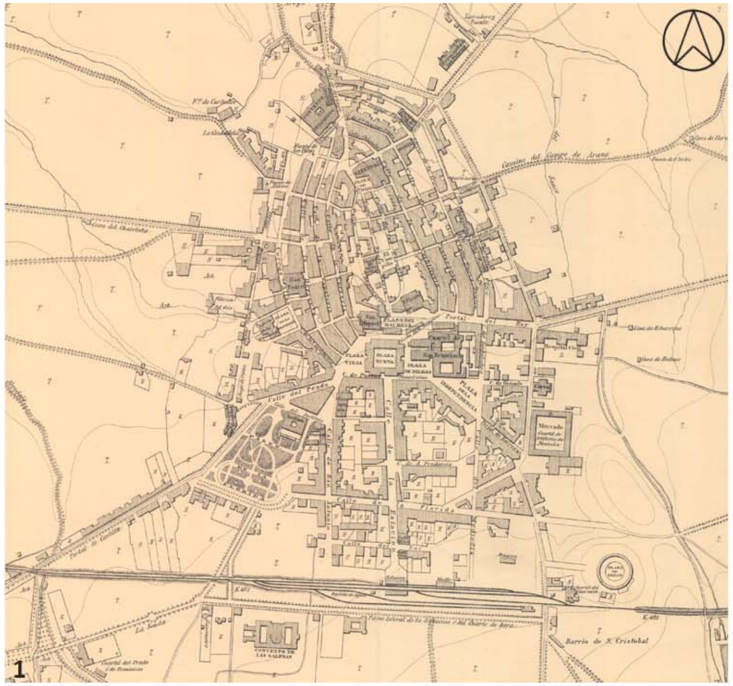


Figure 4.124 Vitoria-Gasteiz in 1181 (above). Victor Ugarte Gejega

Figure 4.125 View of the old city of Vitoria-Gasteiz (middle). Victor Ugarte Gejega

Figure 4.126 Vitoria-Gasteiz in 1256 (below). Victor Ugarte Gejega



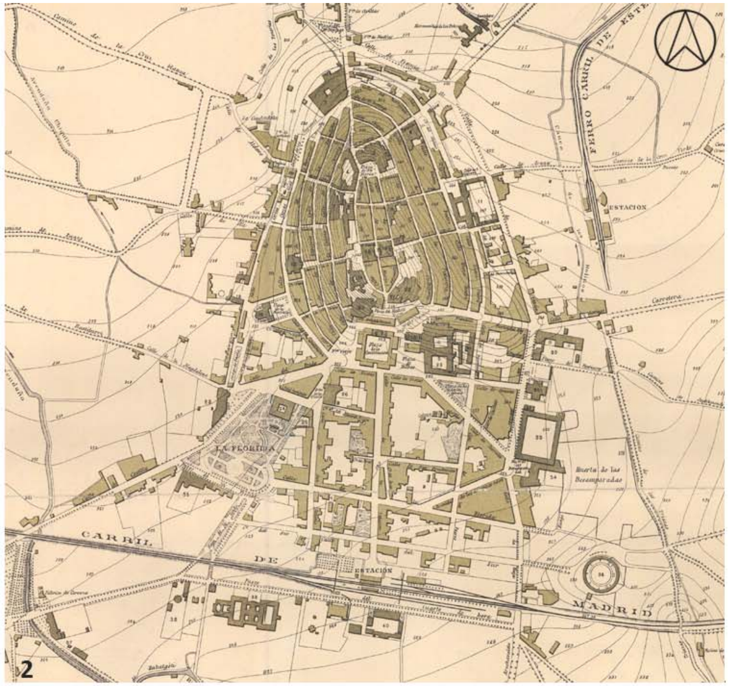


Figure 4.127 Plan of Vitoria-Gasteiz in 1886 with the Railroad of the North (1). Part of a plan of a commission of Officials of the Army General Staff, IGN

Figure 4.128 Plan of Vitoria-Gasteiz in 1888 with the Railroad of the North and the Vasco-Navarro Railway (2). Part of a plan of Dionisio Casañal y Zapatero, IGN

Figure 4.129 Orthophoto of Vitoria-Gasteiz of 1932 (3). Last seen April 2017, in: http://www.vitoria-gasteiz.org/we001/was/we001Action.do?idioma=eu&nuevaPag=&uid=u7aab4052_128ec9a42d2_7fa9&aplicacion=wb021&id=&tabla=contenido

Figure 4.130 Orthophoto of Vitoria-Gasteiz of 1956 (4). Idem

Figure 4.131 Orthophoto of Vitoria-Gasteiz of 1968 (5). Idem

20th century, there were already 30701 inhabitants in the municipality in 1900, 34785 in 1920[43] and 1616 buildings in 1900 in the city (2811 in the whole municipality) (Vera, 1915-21).

Although the first part of the northern section of the Vasco-Navarro Railway was opened in 1889 and Vitoria-Gasteiz had accordingly its second railway, the real influence of this railway was not activated until 1915, when the complete northern section was opened. The railway and its station were sited north-south in the east side of the urban area, coinciding with the main axis of the old city (fig. 4.128). Nevertheless, and although new buildings appeared in the east side of the city attracting new expansions, a new axis between the railway station area and the old city was not created. This is mainly related to the small and local influence that the Vasco-Navarro Railway could have comparing to the Railroad of the North and the construction of the railway in different stages, which took 40 years.

Once the entire railway was built (1927), the city was limited in the south (by the Railroad of the North) and in the east (by the Vasco-Navarro Railway) (fig. 4.129 and fig. 4.132). Accordingly, the area between the two railways was completed and the terrains in the north and west of the city started to be occupied by the fifties. However, other construction zones, such as the university area or a garden-city style neighbourhood were developed out of the railway boundaries (fig. 4.130).

In the north, the first large industrial park (Gamarra) was created in the sixties and the construction of a huge residential and social area (Lakua) started in the seventies (fig. 4.131). Accordingly, the main expansion of the city coincided with the closure of the Vasco-Navarro Railway as in previous cases, where the expansions were translated to other areas far from the railway or its station area. It should be finally added that the city of Vitoria-Gasteiz has continued growing since then due to the immediate availability of plain terrains (fig. 4.133).

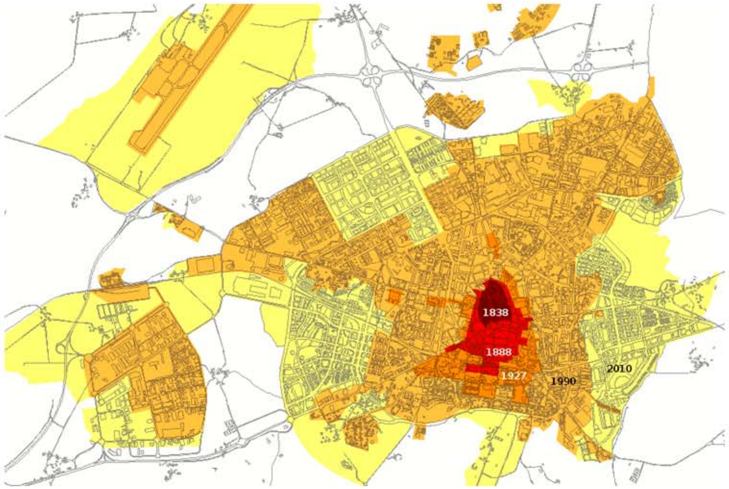


Figure 4.132 View of Vitoria-Gasteiz in 1969, where the railway tracks of the two railways are shown in the lower part of the image (left). Paisajes Españoles

Figure 4.133 Evolution of the old city of Vitoria-Gasteiz over the years (right). Asier Sarasua

- 1838
- 1888
- 1927
- 1990
- 2010

[43] INE

4.4. Development and results of the current state

In addition to the analysis of the historical state of the Vasco-Navarro Railway, the study of the current state of those elements is essential for their possible reuse in the future. For that purpose, the two main elements that compound the railway and the surrounding territory have been again taken into consideration.

After the closure of the railway in 1967, the linear infrastructure has been oriented to non-motorised transport systems in most of its sections, although it was initially abandoned or new roads and buildings were built in it in some sections. Meanwhile, the evolution of the railway nodes or buildings have been quite different, since their possible reuses have not been redirected to similar uses or even approaches, and thus, there are currently from disappeared to totally restored nodes.

For the analysis of the current state, private initiatives and institutional projects or laws have been identified and described on the one hand, while the current state of preservation and uses have been studied on the other hand.

4.4.1. Linear infrastructure and its elements

After several years of abandonment of the railway, the linear infrastructure is the worst conserved element of the Vasco-Navarro Railway. Accordingly, new residential and industrial areas, new road infrastructures or crops have made the railway line disappear in several sections (fig. 4.135). This has especially occurred in the Deba Valley, where the urbanisation process affected the infrastructure due to the narrowness of the valley and the lack of plain terrains for new development areas, or in the capital of Vitoria-Gasteiz due to its significant and rapid urban growth. Meanwhile, the railway infrastructure has been more easily maintained in the rural areas, where urban development has remained low. Nevertheless, railway tracks have disappeared all along the Vasco-Navarro route, which in turn, facilitates new uses along the linear infrastructure.

Figure 4.134 Current cycling and walking path over the original railway route in the north entrance of Bergara (left)

Figure 4.135 The new industrial area built in the terrains of the railway route and the railway station area of Mekoalde (right)

In the nineties, however, first initiatives were developed for the creation of new walking and cycling routes (fig. 4.134). On the one hand, the company LKS carried out an adaptation project for the Vasco-Navarro Railway along the Deba valley as a cycling lane (1994), commissioned by the Basque Government. On the other hand, the creation of the Spanish Greenway Programme (1993) and the subsequent new non-motorised routes created in the Spanish disused railway lines redirected the future of the Vasco-Navarro Railway in that period.

In this regard, the construction of the greenway, by the Provincial Council of Araba/Álava started in 1992. Araba/Álava is the province where more effort has been put into the conversion of the route and the legislation of it. The principal rural character of the province and the consequent high level of preservation of the railway linear infrastructure could explain this.

For that purpose, the Act 1/2012, of January 24, on the Green Routes[44] of the Historic Territory of Araba/Álava was created and consequently, the Decree 42/2013, of December 10, accepted the creation, management and operation of the administrative register called "Catalogue of Green Routes in Araba/Álava". It is in 2014 when the provincial council declared the Vasco-Navarro Greenway as Green Route[45] and included it in this catalogue.

The catalogue distinguishes three types of Green Routes (Greenways, Green Tracks and Green Paths) depending on their technical features, such as path wide and slope or type of pavement[46]. Accordingly, the Vasco-Navarro was classified as Greenway in the 70.2% of the route, while the rest was included as Green Track (fig. 4.136). Furthermore, all lands where the route passes through are in public ownership. In the case of the Vasco-Navarro, in addition, the 69% of the route run through important natural areas, such as protected areas or ecological connectors (Provincial Council of Araba/Álava, 2014).

Furthermore, the Partial Regional Plan (LPP) of the central area of Araba/Álava established some criteria for the reuse of the disused infrastructure as an alternative route in one of its landscape and environmental structural actions. The criteria are based on the use of different thematic areas that show the exploitation of the territory, the understanding of the linear infrastructure as the main axis of the route and the promotion of facilities related to the cycling and walking activities, such as small hostels or camping areas (Provincial Council of Araba/Álava, 2004).

In the case of Navarra, Supramunicipal Sectorial Plans and Projects (PSISs) have been created in order to manage former infrastructures that have an influence beyond municipalities, such as railways. Although several PSISs were created regarding

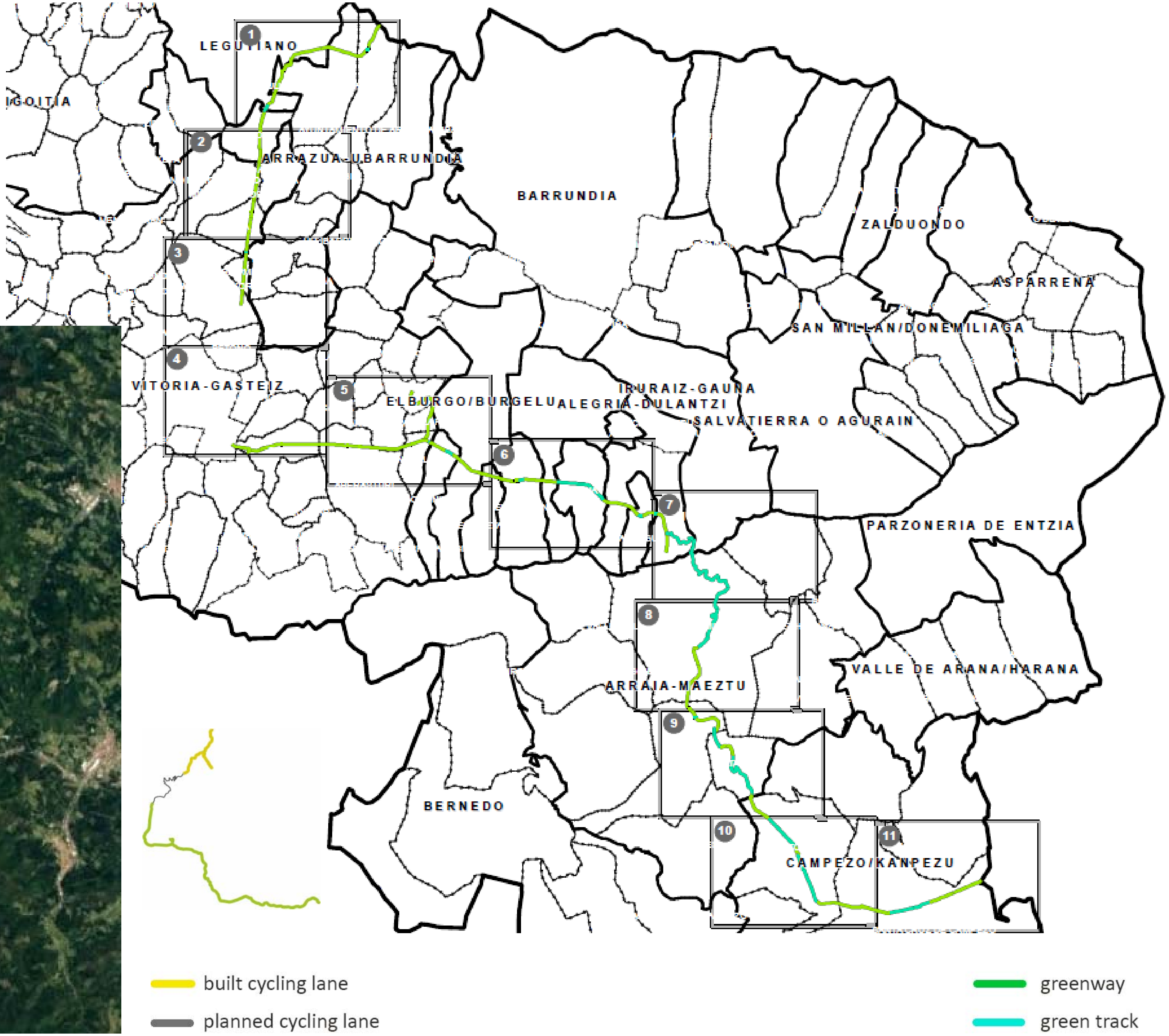
[44] Green routes: communication infrastructures built in former linear infrastructures that have been adapted for non-motorised transports regarding leisure activities and supporting the natural and cultural heritage of its territory (Araba/Álava, 2012)

[45] Agreement 753/2014, of December 30. Department of Enviroment and Urban Planning of the Provincial Council of Araba/Álava. File nº: 13/394

[46] Greenway: paths reserved for non-motorised transports with suitable technical features that ensure its utilisation by any user.
Minimun path wide: 2.5 m; Maximun slope: 6%; Pavement type: asphalt, concrete, cobblestone or compact arid.
Green Track: paths adapted for non-motorised transports that can include some particular motorised transport related to rural activities or paths without the technical features of the greenweys due to their topographical conditions.
Minimun path wide: 1.5 m; Maximun slope: no limit; Pavement type: any stabilised pavement with drainage system.
Green Path: paths in natural or rural areas that have technical features or pavements that correspond to natural lands, which are of lower quality than in previous types and need minimum maintenance.
(Araba/Álava 2012, Provincial Council of Araba/Álava, 2014)

Figure 4.136 Type of green routes according to the Catalogue of Green Routes in Araba/Álava (right) (Provincial Council of Araba/Álava, 2014)

Figure 4.137 Cycling lanes in the upper couse of the Deba valley (below). Information available in (last seen April 2017): http://www.gipuzkoabizikletaz.eus/eu



former railways, the PSIS of the Vasco-Navarro Railway Path Recovery has not been created yet. Nevertheless, the infrastructure has been already transformed into a greenway in several sections (except in some areas where the road made it disappear) as part of the Vasco-Navarro Greenway and by means of the Spanish greenway programme. The whole greenway that goes through the provinces of Araba/Álava and Navarre has been divided in five sections that comprise 84 km[47]:

- Section 0: 6.4 km in the urban area of Vitoria-Gasteiz, in which only 2.2 km correspond to the former railway infrastructure.

- Section 1: 15.2 km from Vitoria-Gasteiz to the mountain port of Arlaban, between Araba/Álava and Gipuzkoa (fig. 4.138 and fig. 4.139).

- Section 2: 22.4 km from Vitoria-Gasteiz to the tunnel of Laminoria (including the branch to Estibaliz).

- Section 3: 37 km from Zekuiano (Araba/Álava) to the tunnel of Murieta in Navarre (fig. 4.140).

- Section 4: 3 km between Zubielqui and Lizarra in Navarre.

An alternative route of 8 km of higher gradient slopes links the sections 2 and 3, since the tunnel of Laminoria has not been adapted for transport use. Furthermore, the Spanish Ministry of Environment and Rural and Marine Areas endorsed the Section 3 as the Natural Path of the Vasco-Navarro Railway. It should be mentioned that the Vasco-Navarro Greenway won the third place for excellence in the Sixth European Greenway Award in 2013.

Finally in Gipuzkoa, by means of the Act 1/2007 on the Cycle Path Network in Gipuzkoa and the Regional Sectorial Plan of the Cycle Path Network in Gipuzkoa of the Department of Mobility and Infrastructures of Gipuzkoa (2013), the disused linear infrastructure has been adapted as cycling lanes in several sections. 81.2 km were projected in total all along the Deba Valley, 65,1 in the river axis, where 20.1km were built by 2013 (Regional Council of Gipuzkoa, 2013) and 34.2 km are currently built, all of them in the upper course[48] (fig. 4.137 and fig. 4.141).

Figure 4.138 Current path over the railway route in the descent from the mountain port of Arlaban to the province of Araba/Álava (left)

Figure 4.139 Current greenway over the railway route close to the station area of Legutio (right)

[47] Last seen May 2017, in: http://www.viasverdes.com/itinerarios/itinerario.asp?id=1

[48] Last seen May 2017, in: http://www.gipuzkoabizikletaz.eus/eu/gure-bidegorriak

Unlike in the case of the green route in Araba/Álava, all the path sections adapted as cycling lanes have been asphalted. Nevertheless, one-third of the built or projected cycling lane kilometres in the upper course of the valley do not correspond to the former railway route, since as mentioned before, the construction of new buildings, roads or other elements have made the route useless. Accordingly, renovated, disappeared and abandoned sections are located one after the other.

To sum up, whether being greenways or cycling lanes, the adapted sections have focused on non-motorised transports. On the contrary, there are still disused and abandoned sections, such as the mountain port of Arlaban or the Laminoria tunnel. Most of them have certain technical or accessibility difficulties if compared with previous sections. There are also disappeared route segments, especially in urban or industrial areas, or in the parts where the former infrastructure was used for the creation of new roads, such as in the zone of Zufia. Finally, the construction of new large infrastructures, such as highways of high-speed railways, should also be taken into consideration, since they have crossed and totally damaged several sections of the former linear infrastructure of the Vasco-Navarro Railway.

For the definition of the current state of the linear infrastructure, in addition to the current use or the conservation level of the path, its interaction with the surrounding areas and the existing type of pavement have been studied and represented in fig. 4.142. On the one hand, five types of routes have been defined regarding the relations or interactions: sections with mainly road traffic, impassable sections, isolated passable sections (with certain accesses to the surrounding areas), accessible sections (with constant access and interaction to the surrounding areas) and overlapped sections (the former route completely joins the current use, as in the case of a street). Moreover, the sections that have a bypass due to the disappearance or poor condition of the original track have been also defined. On the other hand, four types of pavements have been distinguished: asphalt or concrete, compact arid or gravel, unpaved (natural surface) and unsuitable surfaces (due to terrain features or existing traffic).

Figure 4.140 Current greenway over the original railway route close to the railway area of Zuñiga (Navarre) (left)

Figure 4.141 Current cycling lane over the Maltzaga-Zumarraga Railway route in Soraluze (right)


MALTZAGA
SORALUZE
LOS MARTIRES
MEKOALDE
BERGARA
ALTOS HORNOS
SAN PRUDENCIO
ARRASATE
ARRASATE
ULGOR
ARETXABALETA
LANDETA-MAR.
ESKORIATZA
CASTAÑARES
MAZMELA
ZARIMUZ
ZARIMUZ
MARIN
LEINTZ-GATZAGA
ARLABAN
LANDA
LEGUTIO
URBINA
URBINA
RETANA
DURANA
VITORIA-APEADERO
VITORIA-GASTEIZ
OLARIZU
OTAZU
ABERASTURI
ABERASTURI
ANDOLLU
TROKONIZ
ERENTXUN
GAUNA
URIBARRI-JAUREGI
BRIGADA TUNEL
LAMINORIA
ZEKUIANO

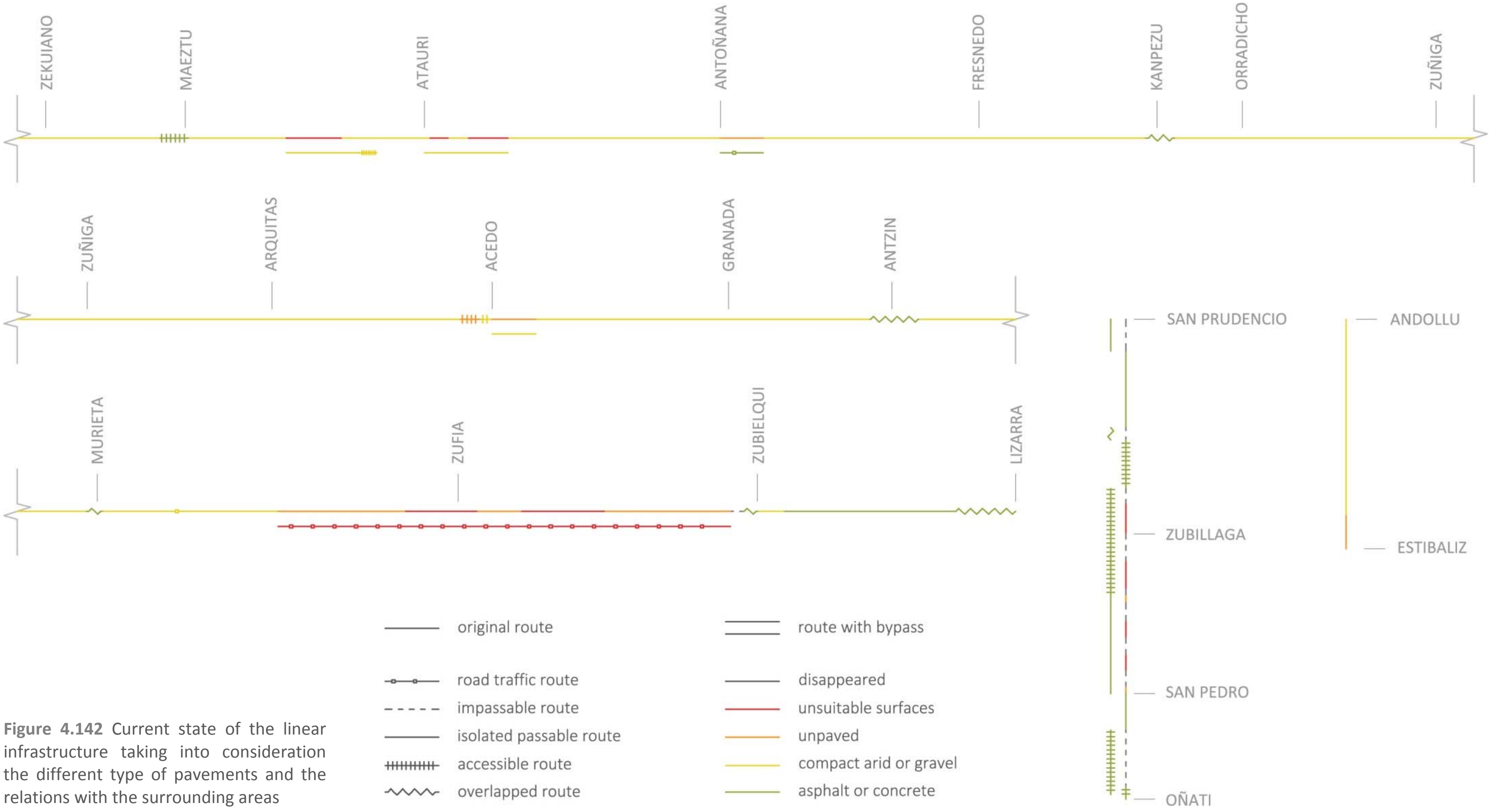


Figure 4.142 Current state of the linear infrastructure taking into consideration the different type of pavements and the relations with the surrounding areas

According to the analysis, almost the 80% of the route is composed of isolated paths, where the connection of the surrounding areas is limited to certain points. These sections are mainly related to leisure activities and there is not a constant interaction between the non-motorised transport route and its territory. Their use also depends on the character of their surrounding territories (urban or rural areas) and their urbanisation processes. 14% of these isolated paths are asphalted, while the 60% have a compact arid or gravel pavement. The latter generally correspond to greenways, which comprise nearly half of the entire route.

On the other hand, the two types of routes that facilitate the interaction (accessible sections and overlapped sections) are similar in length, comprising in total about the 12.5%. They are usually located in urban or urbanised areas, where activities mainly happened and in consequence, interaction can result more successful.

Finally, the 9% of the route is impassable or has road traffic and the 25% of the isolated passable sections have not a suitable pavement, which are also for the time being practically impassable.

The current state of the linear infrastructure has been already described in detail in the Inventory of Industrial Landscapes within the Autonomous Community of the Basque Country, exactly in the document related to the Landscape of the Vasco-Navarro Railway (Herreras, 2011-2012), which is included in annex 2.2.1. Furthermore, the Spanish Greenway Program and the Catalogue of Green Routes in Araba/Álava also include information of the routes that have been adapted to those purposes, including technical features and description of the route or the natural and cultural heritage (including former railway stations) located around them.

The detailed description shows the preservation of the former railway track and its current use, including the coordinates of the main points of the route, such as initial or final point of disappeared or adapted sections, or the location of the elements that are part of the linear infrastructure. Furthermore, the existence or changes are described for each mentioned element, in addition to their main features and its current use (Herreras, 2011-2012). Nevertheless, it should be added that the study only included the railway section located in the Basque Country.

Finally, data sheets related to each auxiliary element of the linear infrastructure and each railway node are also annexed in the same study.

AUXILIARY ELEMENTS

According to the elements that enable the conception of the railway track, their preservation level is mainly linked to the current use of the route. Although the railway tracks have usually disappeared, the main structures such as tunnels or bridges are nowadays standing, especially in the sections turned into greenways or cycling lanes.

In the northern section of the Vasco-Navarro Railway, the tunnels show different present conditions depending on the section. Accordingly, the ones located in the mountain port between the two provinces are neglected while the ones located in the valley are generally well maintained.

In this regard, none of the twelve tunnels of the mountain port is fitted out. However, several of them still present a good state of preservation. Nevertheless, five of them are basically

Figure 4.143 Tunnel nº6 in the mountain port of Arlaban (1). Last seen June 2017, in: https://www.youtube.com/watch?v=l-esqmvputo

Figure 4.144 Interior of the tunnel nº6 (2). Idem

Figure 4.145 Interior of the tunnel nº4 in the mountain port of Arlaban (3). Idem

Figure 4.146 Tunnel nº4 (4). Idem

Figure 4.147 Interior of the tunnel nº9 in the mountain port of Arlaban (5). Idem

Figure 4.148 Tunnel nº 13 (Olazar) in Eskoriatza (6)

Figure 4.149 Tunnel nº 14 (Errekabatz) between Arrasate and San Prudencio (7)

Figure 4.150 Tunnel nº 16 in Bergara (8) impassable due to the collapses that they have suffered, such as in the cases of the tunnels nº 1, 2, 5 and 6 (fig 4.143 and fig 4.144). Furthermore, the tunnel nº 11 in Zarimuz was blocked off in order not to damage the valuable building located above it (Suso, 2009c). The other tunnels that have not been fitted out can be travelled or adapted, although they are not currently suitable (fig 4.145, fig 4.146 and fig 4.147).

Nevertheless, three of the five tunnels located along the valley have been adapted, and covering elements have been used in order to prevent falling drops of water related to moisture and protect users. In this regard, the tunnels nº 14 and 15 have some plastic covering in their upper area while the nº 13 has been covered by metal plates all along its section and length (fig 4.148 and fig 4.149). Meanwhile, from the other two tunnels (located in Bergara), one was extended with a different section stretch due to the construction of a road (fig 4.150) and the other was blocked off.

In the case of the viaducts and bridges of the northern section, their conservation mostly depends on the construction of new infrastructures or buildings along or around them, disabling a section where the bridge is located. Accordingly, some of those structures have been substituted or demolished, but the ones located in the new non-motorised routes have been generally maintained.

In the primitive section of the railway, the two concrete bridges located between Vitoria-Gasteiz and Landa that substituted the previous metal bridges are part of the greenway, and consequently, show a good state of conservation. Moreover, both of them have a local heritage protection in their corresponding urban planning documents. In addition, the viaduct of Castañares also remains standing due to its suitable gauge referred to the road, although is not in use or even maintained (fig. 4.151). However, the route is cut before and after the viaduct, becoming it useless for now. Finally, a small bridge of the primitive section in Eskoriatza still conserves the original metal structure (fig. 4.152 and fig. 4.153).

Hereinafter, the bridges located in Gipuzkoa are concrete girder bridges resting on ashlar piers, which present diverse current preservation levels. In Arrasate, for example, the bridge of the south entrance is standing, while the three ones located in the urban area have disappeared due to the new urban layout and the river channelling. The two bridges located in the north entrance were also demolished in order to make the river area wider and prevent floods (Herreras, 2011-2012). Otherwise, the two bridges between Arrasate and San Prudencio and the four bridges located in Bergara have been maintained (fig. 4.154, fig. 4.155 and fig. 4.156).

Furthermore, one of the five bridges located in the branch to Oñati is currently a road bridge and other two are non-motorised ones. Meanwhile, there is one bridge in disuse and consequently, in a regular state of conservation (fig. 4.157) and another one that was demolished. It should be added that according to the heritage catalogue of Oñati (2006), all of them have local heritage protection.

Finally, half of the elements or structures (one bridge in Maltzaga and a tunnel in Soraluze) of the section of the Maltzaga-Zumarraga Railway that have been included in the study have disappeared.

Regarding the southern section of the Vasco-Navarro Railway, the preservation level of the tunnels is generally good, since they are fitted out for the greenway route (fig. 4.158 and fig. 4.159). In addition, the tunnels that have certain length also

Figure 4.151 Viaduct of Castañares (1). Last seen June 2017, in: https://www.youtube.com/watch?v=l-esqmvputo

Figure 4.152 Primitive metal bridge in Eskoriatza (2)

Figure 4.153 Primitive metal bridge in Eskoriatza (3). Last seen June 2017, in: https://www.youtube.com/watch?v=l-esqmvputo

Figure 4.154 Bridge nº10 between Arrasate and San Prudencio (4)

Figure 4.155 Bridge nº10 between Arrasate and San Prudencio (5). Last seen June 2017, in: https://www.youtube.com/watch?v=l-esqmvputo

Figure 4.156 Bridge nº 13 in the blust furnaces of Bergara (6). Idem

Figure 4.157 Bridge in the branch to Oñati (7). Idem

Figure 4.158 Artificial tunnel of Fuenfria (1)

Figure 4.159 Artificial tunnel of Granada (2)

Figure 4.160 Interior of the tunnel of Atauri (3)

Figure 4.161 Tunnel of Arquijas (4)

Figure 4.162 Tunnel of Zubielqui (5)

Figure 4.163 Interior of the tunnel of Zubielqui (6)

Figure 4.164 Viaduct of Arquijas (1)

Figure 4.165 Viaduct of Arquijas (2)

Figure 4.166 Viaduct of Atauri (3)

Figure 4.167 Demolition of a bridge in Lizarra in 2003 (4). Last seen June 2017, in:http://www.sasua.net/estella/articulo.asp?f=tren&n=El%20Ferrocarril

Figure 4.168 Viaduct of Atauri (5)

Figure 4.169 Overpass of the mill in Maeztu (6). Street view of google maps have artificial lighting, such as in the cases of the tunnels of Zubielqui, Arquijas o Atauri (fig. 4.160, fig. 4.161, fig. 4.162 and fig. 4.163).

Nevertheless, Laminoria and Huecomadura tunnels are not part of the greenway route, so their state of preservation can deteriorate over the years because of the lack of maintenance. As an alternative, and due to the impassable condition of the Laminoria tunnel, a bypass of 8 km overpasses this section. However, the Huecomadura is easily passable.

The tunnel of Laminoria was closed because of the several collapses caused by the water basins of the quarry and the fact that it was used as a water pipe in the eighties and nineties to transport water to the northern areas or between the Ega and Zadorra rivers. In 1998, a refurbishment study of the tunnel, commissioned by the Department of the Environment of the Provincial Council of Araba/Álava, was made in order to reopen the route, but it was dismissed due to the elevated costs. In this regard, ten years after (in 2008), there was an attempt to travel across the tunnel, but the collapses were larger, making it impossible that time (Herreras, 2011-2012).

It is clear that this tunnel is the most difficult element to refurbish or fit out of the complete studied line due to its length (2193.7 m). Nonetheless, there are longer tunnels in other disused railways that were adapted to a greenway route, such as the Uitzi tunnel (2680 m) in the Plazaola Railway, which is the longest greenway tunnel in Europe and is part of the Ederbidea and Eurovelo 1 projects[49].

As in the case of tunnels, most of the viaducts and bridges have maintained a suitable conservation level, since they are part of the greenway (fig. 4.164 and fig. 4.165). The viaduct of Atauri is the only that is located out of the route and moreover, it was modified by opening its biggest arch to make the road below wider (Suso, 2009d). Otherwise, it is also well conserved and it has been adapted as a resting area, since the alternative greenway route joins again the railway route just after the viaduct (fig. 4.166 and fig. 4.168). Nevertheless, a steep slope that is not accessible for all type of users makes the connection of both routes (Herreras, 2011-2012). Together with the viaduct of Arquijas, the viaduct of Atauri is the only infrastructural element that has heritage protection, which is at local level.

In addition, the bridge of Lizarra was demolished in 2003 and substituted by a new one (fig. 4.167), while the overpass of the mill in Maeztu was also partially demolished during the road construction. Nowadays, a new walkway that only preserves one of the initial arches has been built (fig. 4.169).

As in the case of the main structures, the current state of retaining walls, overpasses and underpasses, trenches, etc. depend on the current use of the linear infrastructure itself. On the other hand, the auxiliary buildings (gatekeeper's houses, worker housing or electrical substations and subcentrals) have been included as railway nodes in the next section, since they are able to create transversal relations between the disused infrastructure and its surrounding environment and in turn, they can act as node in the whole system.

Finally, it should be added that certain information about each infrastructure element is compiled in different data sheets, such as the mentioned document of the Landscape of the Vasco-Navarro Railway, the heritage data sheets developed by María Larrañeta in 2008 or the official information panels of the

[49] Last seen in: http://www.viasverdes.com/noticias/noticia.asp?id=640

greenway realised also by Larreñeta. The latter only refer to the historical state of the elements.

4.4.2. Railway nodes or station areas

As defined in the previous chapter, disused railway nodes are composed of any railway building in the current state, such as former railway stations, worker's houses or electrification buildings. Several of these buildings have been restored and adapted to new uses, but others have already disappeared or are in a dilapidated state.

The previously mentioned greenway programme promotes the recovery of the former railway nodes in addition to the linear infrastructure, but in practice, only few nodes have joined the greenway. However, it should be added that information panels on existing railway buildings were included along the greenway in order to show greenway users historical data about them (annex 2.2.2).

Furthermore, a single protection proposal that takes into consideration a comprehensive nature of the whole railway system was created in the document of the Industrial Landscape of the Vasco-Navarro Railway (Herreras, 2011-2012). In this regard, railway nodes or buildings were also included in the description of the current state included in the document or in the data sheets included in its annexes. Taking into account the heritage aspect of these railway buildings, information was also compiled in the data sheets created by Larrañeta.

On the other hand, initiatives at local level and private initiatives have been developed. With the creation of the greenway, tourist accommodation uses were promoted in the existing railway buildings, but most of them were finally adapted to private housing. Moreover, several buildings disappeared or were demolished in the nineties and the beginning of the century. Accordingly, there are significant differences between the current state of the railway nodes and the descriptions of Olaizola of 2002 or Suso of 2009. Nevertheless, there are also several buildings that have been adapted to public uses, particularly in the case of Navarre and the valley of Gipuzkoa. There is more diversity in the case of Araba/Álava, but the number of private houses located in railway buildings is high due to the existence of lots of rural towns. This is associated with current preservation level of these buildings.

The conservation level is higher in rural areas because of the lack of urban development pressure, but in these cases, public investment is also low. Meanwhile, fewer railway buildings have been preserved in larger urban areas, such as Vitoria-Gasteiz or the main towns of Gipuzkoa. In this regard, the preservation level has been classified in five categories in this study: disappeared; ruin (there is no roof, so the conservation of the building is not ensured; only few elements are conserved); bad (even with damages the roof is able to protect the building and the structure is preserved, but restoration is need for its use); regular (structural and main elements are well preserved but enhancement are needed for the correct use of the building) and good (it has been restored or has got constant maintenance and all the elements are well conserved).

In the case of the Deba Valley in Gipuzkoa, the only elements that have been preserved are the passenger buildings of Eskoriatza, Arrasate and Oñati, in addition to a wagon shed in the railway station area of Oñati and a small building in a bad state of preservation that was a gatekeeper's house in Los Martires (fig. 4.170, fig. 4.171, fig. 4.173 and fig. 4.174). The existing buildings of Oñati and Arrasate have a good state of conservation and all of them have public uses, such as post or employment offices. The station of Arrasate was refurbished by a trade school in 1996, which included a new floor and a new façade, modifying significantly the original building (Olaizola, 2002). In the mountain port of Arlaban however, two of the four former railway buildings are used as private houses and have a good state of preservation (Mazmela and Zarimuz), but another one is disused and the other has disappeared (fig. 4.175 and fig. 4.176).

The number of disappeared railway buildings is much higher in the valley, where the pressure of the urbanisation processes has made their conservation unfeasible (fig. 4.172). For instance, the railway station of Bergara was demolished in 2000 (Suso, 2009c), after being a bus station, and a new residential area is currently located there (fig. 4.177).

In the northern section located in the province of Araba/Álava, the only buildings that have disappeared are the new passenger building of the railway station of Durana and all the buildings and infrastructures of the main railway station located in the capital, where all elements were demolished in order to facilitate the city's expansion. On the contrary, the railway station areas of Urbina, Retana and Landa have been restored and present a good state of preservation. The first two are currently residential buildings (fig. 4.178 and fig. 4.179), while the third one is a local service building. The latter was refurbished and reconverted for that purpose after a fire (Suso, 2009c), but the primitive building was not, which is disused and in a bad state of conservation (fig. 4.180 and fig. 4.181). Finally, all the buildings of the railway station area of Legutio are preserved (primitive railway station, passenger building and electrical substation), although they show a dilapidated or bad state, since they are disused (fig. 4.182, fig. 4.183 and fig. 4.184).

In the southern section of the Vasco-Navarro Railway, different zones can be identified taking into consideration the preservation of the railway nodes. First of all, there is only a railcar shed in a ruin state in the railway station area of Olarizu in the capital (fig. 4.185). Furthermore, the Urban Development General Plan does not foresee its preservation in the future, since the area is represented as part of a new road system (Vitoria-Gasteiz, 2003).

Afterwards, the nodes located from Otazu to Trokoniz, in the rural areas of the central area of Araba/Álava, have been reused with different purposes and accordingly, they present a good conservation state. Aberasturi was turned into a house, while the other three have currently public uses, such as a hostel in Otazu or a probation centre in Andollu. The worker's housing building of Trokoniz was refurbished by a former railroad worker's children in the nineties (Suso, 2009d) and adapted into Waldorf education school (fig. 4.186 and fig. 4.187).

Moving away from the capital and out of the influence of major towns, most the former railway nodes have disappeared or are in a dilapidated state until the county of Maeztu. The worker's house in Gauna was demolished by FEVE after the closure of the railway and the passenger building of Uribarri-Jauregi in 2000 (Suso, 2009d). The buildings of the railway station of Erentxun and the worker's housing building of the Laminoria tunnel (in ruins) and the electrical substation of Uribarri-Jauriegi (regular state) still remain (fig. 4.188, fig. 4.189 and fig. 4.190).

Once in the area of Maeztu and Kanpezu, at least one building of each railway station area is maintained, but only one of the three workers' housing buildings have been preserved. In this regard, the construction of Zekuiano (fig. 4.191) was refurbished at the beginning of this century and it maintains its

Figure 4.170 Passenger building of the railway station area of Eskoriatza surrounded by industrial buildings (1)

Figure 4.171 Passenger building of the railway station of Oñati (2).

Figure 4.172 Disappeared warehouse of the railway station of Arrasate in the nineties (3). Basque Government

Figure 4.173 Passenger building of the railway station of Arrasate in the nineties (4). Basque Government

Figure 4.174 Current state of the passenger building of the railway station of Arrasate. The white painted area was built in the refurbishment (5)

Figure 4.175 Railway station of Marin (6). Basque Government

Figure 4.176 Worker's housing building in Zarimuz (7). Basque Government

Figure 4.177 Disappeared passenger building of the railway station of Bergara in the nineties (8). Basque Government residential nature. Meanwhile, the railway area of Maeztu was abandoned for several years, but the passenger building was restored in the nineties (not the warehouse, which disappeared) in order to comprise an agricultural study centre first and the city hall of the county now (Olaizola, 2012) (fig. 4.192 and fig. 4.193). On the contrary, the railway station of Atauri is in a dilapidated state and disused, but it remains and there are promises that it will be restored and conserved (Suso, 2009d) (fig. 4.194). Furthermore, Antoñana and Kanpezu were two of the railway station areas that were going to comprise tourist accommodation (Olaizola, 2002), but finally were transformed into private housing units. In the case of Antoñana, all former railway buildings are preserved, but the warehouse does not have any use (fig. 4.195, fig. 4.196, fig. 4.197 and fig. 4.198). Moreover, the interpretation centre of the Vasco-Navarro Greenway was created in 2012, which is composed of three railway wagons located in the railway station area of Antoñana. Meanwhile, the railcar shed that was restored is only preserved in the large station area of Kanpezu. However, the building does not maintain its whole original image, since the volume of the building was changed (fig. 4.202). At the beginning of the century the passenger building that was in ruins was demolished, as well as the warehouse and the wagon shed that were used as barns, while the railcar shed was restores by a private owner. According to Javier Suso (IV), there were at least eight projects for the restoration of the passenger building, but none of them finally achieves its purpose.

In Navarre, railway buildings with different conservation levels can be currently found. On the one hand, the railway station of Zufia have disappeared and the buildings of the railway station of Zuñiga and the workers' housing buildings in Arquijas and Granada are in a dilapidated state (fig. 4.199 and fig. 4.200). On the other hand, several passenger buildings have been reconverted for private or public uses. In the cases of the railway station areas of Acedo and Zubielqui, the main buildings have been turned into houses, but the warehouses remain in a bad or ruin state (fig. 4.201). Meanwhile, the passenger building of Zubielqui was the other construction that was going to comprise a hostel but finally changed this direction (Olaizola, 2002). Nevertheless, the former passenger buildings of Antzin and Murieta, which were almost identical, are currently the city halls of each municipality. In the case of Antzin, a new entrance and a lift have been included and the stone façades have been partially discovered in the previous decade (fig. 4.205). In Murieta, the façades have been totally discovered (fig. 4.204). It goes without saying that both present a perfect conservation state. In addition to the passenger building, the electrical substation and the water tower have also been conserved in Antzin. In this regard, the substation functions as facilities of the municipal outdoor swimming pools located nearby (fig. 4.203).

Finally, the monumental passenger building is the only element that has been preserved in the large station area of Lizarra. As in previous cases, one of the former sheds remained as a municipal warehouse at the beginning of the century (Olaizola, 2002), but it has already disappeared. Nowadays, the existing building comprises the bus station (including a bar) and some municipal services, such as the municipal music school. A crowded square creates the connection between the building and the old city, and as in the railway period, the metal canopy[50] covers the passengers that are waiting for the bus (fig. 4.206).

To sum up, half of the railway station nodes have some building in a good or regular state of conservation (most of them in a good state), while the other half is divided into thirteen

[50] The passenger building of Lizarra, Maeztu and Eskoriatza are the only ones that preserve the canopy.

Figure 4.178 Railway station of Urbina (1)

Figure 4.179 Railway station area of Rentana with the primitive building on the right and the posterior passenger building on the left (2)

Figure 4.180 Warehouse of the railway station area of Landa (3)

Figure 4.181 Passenger building of the railway station area of Landa (4)

Figure 4.182 Passenger building of the railway station area of Legutio (5)

Figure 4.183 Electrical substation of the railway station area of Legutio (6)

Figure 4.184 Primitive railway station of Legutio (7)

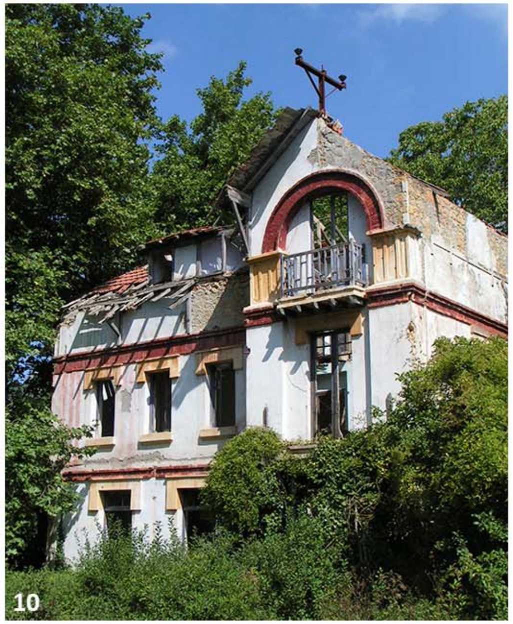


Figure 4.185 Railcar shed of the railway station area of Olarizu (1)

Figure 4.186 Railway station of Aberasturi (2)

Figure 4.187 Worker's housing building in Trokoniz (3). Basque Government

Figure 4.188 Passenger building of the railway station of Erentxun (4). Basque Government

Figure 4.189 Worker's housing building next to the Laminoria tunnel (5). Basque Government

Figure 4.190 Electrical substation in the railway station of Uribarri-Jauregi (6). Basque Government

Figure 4.191 Worker's housing building in Zekuiano (7). Basque Government

Figure 4.192 Disappeared warehouse of the railway station area of Maeztu (8). Basque Government

Figure 4.193 Passenger building of the railway station area of Maeztu (9). Basque Government

Figure 4.194 Railway station of Atauri (10). Basque Government

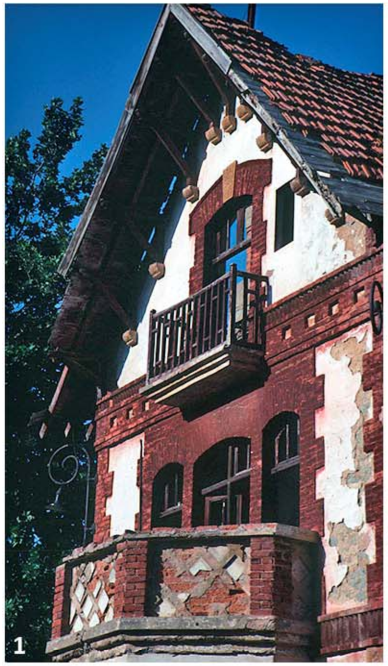


Figure 4.195 Passenger building of the railway station of Antoñana before the refurbishment (1). Basque Government

Figure 4.196 Passenger building of the railway station of Antoñana after the refurbishment (2). Basque Government

Figure 4.197 Current passenger building of the railway station of Antoñana (3). Basque Government

Figure 4.198 Electrical subcentral of the railway station of Antoñana (4). Basque Government

Figure 4.199 Warehouse of the railway station area of Zuñiga (5)

Figure 4.200 Passenger building of the railway station area of Zuñiga (6)

Figure 4.201 Passenger building of the railway station area of Acedo (7)

Figure 4.202 Railcar shed of the railway station area of Kanpezu (8)

Figure 4.203 Electrical substation of the railway station area of Antzin (9). Javier Suso, 2011

Figure 4.204 Passenger building of the railway station area of Murieta (10)

Figure 4.205 Passenger building of the railway station area of Antzin (11)

Figure 4.206 Passenger building of the railway station area of Lizarra (12). Daniel Luengas, 2016

disappeared railway stations nodes and six dilapidated or bad preservation state nodes. Regarding the worker's housing, five of them have disappeared, three are in ruins, one in a bad state and other three show a good state of preservation and, hence, the latter are in use. In the case of the electrical substations, there are one disappeared, in bad conservation level and in a regular state respectively, and other two in good state and in use.

Nevertheless, results are more alarming taking into consideration all existing elements in each node area, since most of the auxiliary buildings, such as warehouses or loading bays have disappeared. Looking at the figures, we can see that almost half of the elements have disappeared, almost a quarter is equally divided between dilapidated buildings and bad or regular state buildings, while finally, a little bit more than the last quarter is composed by the buildings that present a good preservation level.

For the identification of all these data, an inventory of the railway node areas has been developed, where historical and current data of each building is represented, including the primitive and existing buildings and their preservation level, use and protections (table 4.2).

Finally, a simple classification that represents the reality has been created considering both the type of current use (public or private) and the current preservation state (fig. 4.207 and fig. 4.208): elements of public and private uses (good preservation level), disused elements with different conservation states (good or regular and bar or ruin) and disappeared elements. Accordingly, all disused railway station areas have a bad or dilapidated preservation level (except the electrical substation

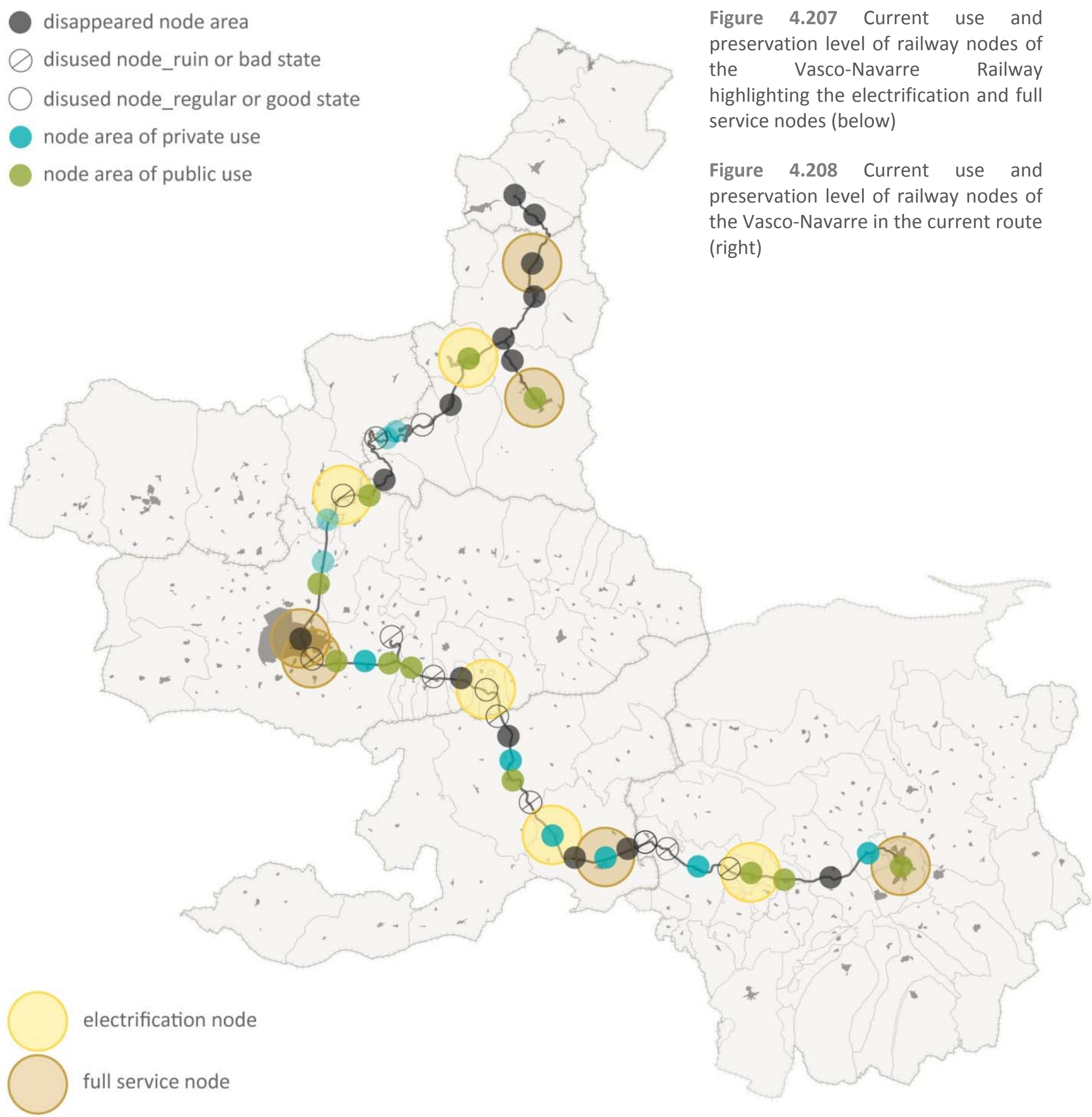


Figure 4.207 Current use and preservation level of railway nodes of the Vasco-Navarre Railway highlighting the electrification and full service nodes (below)

Figure 4.208 Current use and preservation level of railway nodes of the Vasco-Navarre in the current route (right)


MALTZAGA
SORALUZE
LOS MARTIRES
MEKOALDE
BERGARA
ALTOS HORNOS
SAN PRUDENCIO
ARRASATE
ULGOR
ARETXABALETA
LANDETA-MAR.
ESKORIATZA
CASTAÑARES
MAZMELA
ZARIMUZ
ZARIMUZ
MARIN
LEINTZ-GATZAGA
ARLABAN
LANDA
LEGUTIO
URBINA
RETANA
DURANA
VITORIA-APEADERO
VITORIA-GASTEIZ
OLARIZU
OTAZU
ABERASTURI
ABERASTURI
ANDOLLU
TROKONIZ
ERENTXUN
GAUNA
URIBARRI-JAUREGI
BRIGADA TUNEL
LAMINORIA
ZEKUIANO
MAEZTU
ATAURI
ANTOÑANA
FRESNEDO
KANPEZU
ORRADICHO
ZUÑIGA
ZUÑIGA
ARQUITAS
ACEDO
GRANADA
ANTZIN
MURIETA
ZUFIA
ZUBIELQUI
LIZARRA
SAN PRUDENCIO
ZUBILLAGA
SAN PEDRO
OÑATI
ANDOLLU
ESTIBALIZ

of Uribarri-Jauregi with a regular state). In fact, most of them are in ruins. This demonstrates that the usage of a building is the factor that maintains it alive, since it insurances certain tracking and maintaining. It is true, however, that some of the buildings that are nowadays in use were previously in a ruinous conservation state and the ones located in interesting or privileged places were only safeguarded in some cases. That is why the context or the environment of these buildings and the relations that can be created between them should be studied, as it will be shown afterwards.

Furthermore, the current preservation state and use of the railway nodes do not correspond to the historical railway structuration (fig. 4.207) or the current preservation level of the line sections (fig. 4.208). Taking into consideration the electrification system or distribution and the location of the main service nodes areas (different service buildings or a passenger building, warehouse, railcar shed and wagon shed were included), a hierarchy or structuration was identified in the historical state of the railway. Nevertheless, this structuration is not maintained with the existing railway elements, which mainly correspond to the territorial development of surrounding areas. However, relations between the node conservation and line preservation cannot be identified. Accordingly, new developments have maintained the railway nodes and have built in the terrains of the linear infrastructure in some cases, while in others, the line is preserved but the node is demolished.

REGULATORY OPPORTUNITIES

Some regulatory aspects limit the actions that can be taken in specific type of buildings and environments, and in turn, can promote the preservation of the railway nodes and their reconversion into new uses in the foreseeable future. On the one hand, cultural heritage laws and plans ensure the protection of the heritage elements (that are included in their catalogues or inventories) and the preservation of their features. On the other hand, the hydrological legislation can also create some opportunities in the railway station areas located close to rivers.

Not all heritage elements have legal protection and few of the protected elements have regional protection. As presented in chapter 1, there are three main categories of protection: listed at regional level, inventoried at regional level and local protection. In the case of the Vasco-Navarro Railway, the passenger building of the railway station of Oñati is the only that has a regional protection. It was listed in 2011 as part of the monumental set of the historic centre of Oñati with a medium protection.

Beyond that, there are several node buildings that have some heritage protection at local level (table 4.2). That is why the heritage catalogues of the urban planning documents of each municipality have been studied. Accordingly, in the northern section of the Vasco-Navarro Railway, the railway stations of Arrasate and Eskoriatza in Gipuzkoa, and the passenger building and the electrical substation of the railway station area of Legutio in Araba/Álava have local protection. However, the building of the primitive station of Legutio (used as a warehouse after) does not have any protection. Furthermore, the two buildings of the railway station of Landa had been proposed for local protection, but it was not conferred and they were delisted claiming that they had lose heritage value due to the several changes made (Arratzua-Ubarrundia, 2013). The bridges of Durana and Eskalmendi however, have local heritage protection according to the same plan. On the contrary, in the northern section the existing nodes of the mountain port of Arlaban (Mazmela, Zarimuz eta Marin), the railway station of Landa, the primitive station of Legutio and the railway stations of Urbina, Retana and Durana do not have any heritage protection.

In the southern section, several nodes are currently protected by the urban planning in Araba/Álava: the railway station of Andollu; the worker´s house in Trokoniz; the buildings of the railway station of Erentxun (passenger building and warehouse); the electrical substation of Uribarri-Jauregi; the railway stations of Maeztu and Atauri; and the railway node of Antoñana (passenger building, warehouse and electrical subcentral). In Navarre, the railway station of Murieta, the buildings of the railway station of Zubielqui (passenger building and warehouse) and the railway station of Lizarra are protected in the same way. It is remarkable that the railway station of Antzin is almost identical to the one in Murieta but it is not protected. On the other hand, two buildings that have disappeared or do not correspond to the existing buildings are currently protected. One of them is the disappeared warehouse of Maeztu, which according to the urban subsidiary rules of 2003 it has a local heritage protection. The other one is the disappeared warehouse of Kanpezu, which is also protected by the Urban Development General Plan of Kanpezu (2016). It seems that the document wants to refer to the existing and refurbished railcar shed of Kanpezu.

It should be added that in Navarre, the heritage catalogues of urban plans include a data sheet for each heritage element, so the railway stations of Murieta, Zubielqui and Lizarra (and the viaduct of Arquijas) have their own ones (annex 2.2.3).

Nevertheless, several node areas do not have any legal protection regarding their heritage value: the railcar shed of Olarizu; the railway stations of Otazu and Aberasturi; the worker's houses in Laminoria and Zekuiano; the railway station areas of Zuñiga and Acedo (passenger buildings and warehouses); the worker's houses in Arquijas and Granada; and the railway station area of Antzin (passenger building, electrical substation and water tower). Five of them are in a dilapidated state, but other five are in use and in a good state of conservation: the railway stations of Otazu and Aberasturi, the worker's house in Zekuiano and the railway station areas of Acedo and Antzin. The warehouse of Acedo however, is disused and in a bad state of preservation.

In the document related to the Landscape of the Vasco-Navarro Railway of the Inventory of Industrial Landscapes within the Autonomous Community of the Basque Country, the protection of the whole landscape was proposed as Listed Cultural Asset within the category of Monumental Set (Herreras, 2011-2012). Furthermore, a specific protection level (special, medium, basic) was suggested for each element located in the Basque Country. Accordingly, all the existing buildings were listed with a medium protection, even if they are in a dilapidated state. On the contrary, the small shelters of the different halts were listed with a basic protection (table 4.2). Heritage valorisation of each element has not been included for all elements in the analysis. However, the case of the Basque Country shows that being part of the same system would classify them with quite similar results. This approach would be interesting in order to compare different heritage elements of different systems or territories.

Furthermore, the general proposal of the industrial landscape was based on a valorisation of the whole disused infrastructure located in the Basque Country. All the criteria except one (age) was rated 8 or more out of 10. They are summarised below:

Historical criteria	/20
Age	3
Representativeness of the activity	4
Promoters / Owners	5
Continued existence of activity in the territory	5
Technological criteria	/20
Production process	8
Machinery / Infrastructures	9
Morphological criteria	/20
Architectural	4
Constructive	5
Typological	5
Urbanism	4
Criteria of integrity	/20
Maintenance of the production unit	8
Geospatial / Environmental	10
Interpretative keys and capacity	/20
Reading capacities	9
Territorial impact of the activity	9
TOTAL	88/100

In addition to the heritage protection, the legislation regarding the rivers can also create some limitations in the railway station areas located close to them. The main limitation refers to the definition of the areas where the construction of new buildings is limited or prohibited. This, in turn, can become in the main advantage of the railway heritage element, since these measures have a binding character when they refer to actions of preservation or reconversion (Basque Government, 2013). Accordingly, these limitations can be understood as heritage preservation measures, where the construction of new buildings in the areas is excluded and the enhancement of the heritage elements is promoted. One of the limitations in this matter is related to the development character of the riverbank, while another to the flood risk of the analysed area.

In the first case, and referring to the Basque Country, most of the nodes are located out of the minimum distances where limitations are applied. These minimum distances vary from 10 m to 30 m in developed areas and from 15 m to 50 m in rural areas according to the Regional Sectorial Plan (LPS) of the management of the rivers and streams of the Basque Country. Nevertheless, in the rural environment a protection area of 100 m is established where the restrictions of non-developed areas need to be preserved.

In this regard, there are three railway nodes (Otazu, Uribarri-Jauregi and Atauri) in rural nature environments that are located in that 100 m protection area and another one (Zekuiano) in the mentioned minimum distance. Accordingly, the reuse of these railway station buildings prevails over the construction of new structures, encouraging the preservation of the heritage elements. Nevertheless, the electrical substation of Uribarri-Jauregi and the railway station of Atauri are currently in a regular or a dilapidated state of preservation, since the urbanisation process is weak and the urban pressure is not relevant in these rural areas.

On the other hand, the railcar shed of Olarizu is located in the minimum distance established for developed areas according to each defined river flow, so the construction of new buildings is totally forbidden in the area. Being located in the main city of Vitoria-Gasteiz, this limitation can be a suitable measure for the preservation of the building in the new development processes.

In the case of Navarre, the distances are large enough to consider the existing former railway stations to be located out of the river influence according to distances referred to the development character of the riverbanks.

Regarding the flood risk areas, it can be said that the future of the railway nodes is not generally threatened. In the Basque Country, none of the nodes are located in the delimited areas of the probability of flood occurrence, based on 10, 100 or 500 years return periods. Meanwhile, the buildings of the railway station of Zubielqui and Lizarra in Navarre are in the 500 years return period limit. According to the Navarre legislation, both cases show a low risk, but their surrounding areas present a medium risk. Furthermore, in the case of Lizarra, the surrounding area of the station building is located in the 100 years return period limit. Thus, limitations in the uses are established for the development of these railway station areas (Government of Navarre, 2011). Residential or industrial uses, facilities or infrastructures are permitted in these railway buildings, but hazardous or unhealthy industries and vital facilities, such as hospitals or fire station, are not allowed.

VASCO-NAVARRO RAILWAY NODES

ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	CURRENT PROTECTION	PROPOSED PROTECTION LEVEL
1	MALTZAGA	545719.00	4782341.00	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					HOUSE	-					
2	SORALUZE	547774.00	4780407.00	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
3	LOS MARTIRES	548366.10	4778317.10	HALT	-	-	-	-	-	-	-
3	LOS MARTIRES	548213.74	4778243.74	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	WAREHOUSE	BAD	NONE	-
4	MEKOALDE	547644.75	4776826.89	STATION	SMALL BUILDING	-	DISUSED	-	DISAPPEARED	-	-
5	BERGARA	547461.92	4773750.4	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
					WC	-					
6	ALTOS HORNOS DE BERGARA	546652.07	4772167.24	RAIL SIDING	-	-	-	-	-	-	-
7	SAN PRUDENCIO	545114.38	4770035.96	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
					WC	-					
8	ZUBILLAGA	545751.52	4767675.61	HALT	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
9	SAN PEDRO	546803.05	4765932.72	HALT	-	-	-	-	-	NONE	LISTED BASIC
10	OÑATI	547544.94	4764787.54	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	POST OFFICE	GOOD	LISTED MEDIUM	LISTED MEDIUM
					WAREHOUSE	-	-	-	-	-	-
					WAREHOUSE	-	-	-	-	-	-
					WAGON SHED	WAGON SHED	PUBLIC USE	WAREHOUSE	GOOD	-	LISTED BASIC
					WC	-	-	-	-	-	-
11	ARRASATE	542043.31	4768014.91	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	EMPLOYMENT OFFICE	GOOD	LOCAL	LISTED MEDIUM
					WAREHOUSE	-	DISUSED	-	DISAPPEARED	-	-
					ELECTRICAL SUBSTATION	-					
					WC	-					

Table 4.2 Characteristics of the nodes of the Vasco-Navarro Railway

VASCO-NAVARRO RAILWAY NODES											
ID	**NAME**	**LOCATION (X)**	**LOCATION (Y)**	**GENERAL USE**	**BUILDINGDS**	**CURRENT BUILDINGS**	**CURRENT USE**	**SPECIFIC USE**	**CURRENT STATE**	**CURRENT PROTECTION**	**PROPOSED PROTECTION LEVEL**
12	ULGOR	541312.67	4766923.37	HALT	-	-	-	-	-	-	-
13	ARETXABALETA	540454.6	4764617.78	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
					WC	-					
14	LANDETA-MARIANISTAS	539870.79	4763781.16	HALT	-	-	-	-	-	-	-
15	ESKORIATZA	538072.29	4762438.33	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	WAREHOUSE	REGULAR	LOCAL	LISTED MEDIUM
					WAREHOUSE	-	DISUSED	-	DISAPPEARED	-	-
					WC	-					
16	CASTAÑARES	536292.99	4761435.78	HALT	-	-	-	-	-	NONE	LISTED BASIC
17	MAZMELA	536266.41	4762289.06	HALT	PASSENGER BUILDING	PASSENGER BUILDING	PRIVATE USE	HOUSING	GOOD	NONE	LISTED BASIC
18	ZARIMUZ	535672.55	4761525.52	WOKER´S HOUSING	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	NONE	LISTED MEDIUM
19	MARIN	534034.37	4761164.79	STATION	STATION	STATION	DISUSED	-	BAD	NONE	LISTED MEDIUM
20	LEINTZ GATZAGA	534929.86	4759075.98	HALT	-	-	-	-	-	NONE	LISTED BASIC
21	LEINTZ GATZAGA	534655.46	4758006.38	STATION	OLD STATION	-	DISUSED	-	DISAPPEARED	-	-
22	LANDA	533478.94	4756507.61	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	LOCAL SERVICE CENTRE	GOOD	NONE	LISTED MEDIUM
					OLD STATION	OLD STATION	DISUSED	-	BAD		
23	LEGUTIO	531038.73	4756343.17	STATION	PASSENGER BUILDING	PASSENGER BUILDING	DISUSED	-	BAD	LOCAL	LISTED MEDIUM
					OLD STATION	OLD STATION			RUIN	NONE	
					ELECTRICAL SUBSTATION	ELECTRICAL SUBSTATION			BAD	LOCAL	
24	URBINA	529859.12	4754467.01	STATION	OLD STATION	OLD STATION	PRIVATE USE	HOUSING	GOOD	NONE	LISTED MEDIUM
25	RETANA	529250.27	4750876.08	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PRIVATE USE	HOUSING	GOOD	NONE	LISTED MEDIUM
					OLD STATION	OLD STATION					
26	DURANA	528984.34	4749014.88	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					OLD STATION	OLD STATION	PUBLIC USE	BAR	GOOD	NONE	LISTED MEDIUM
27	VITORIA APEADERO	527550.9	4744945.86	HALT	-	-	-	-	-	-	-
28	VITORIA-CIUDAD	527301.08	4744125.1	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
					WORKSHOOPS	-					
					WAGON SHED	-					
28	VITORIA-NORTE	526749.16	4743265.77	STATION	PASSENGER BUILDING	-	-	-	-	-	-
29	OLARIZU	528274.89	4742164.21	STATION	SERVICE BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
					RAILCAR SHED	RAILCAR SHED	DISUSED	-	RUIN	NONE	LISTED MEDIUM
					WAGON SHED	-	DISUSED	-	DISAPPEARED	-	-
30	OTAZU	530695.38	4741959.44	HALT	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	HOSTEL	GOOD	NONE	LISTED MEDIUM
31	ABERASTURI	533145.91	4741854.94	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PRIVATE USE	HOUSING	GOOD	NONE	LISTED MEDIUM
32	ANDOLLU	535230.09	4742021.95	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	PROBATION CENTRE	GOOD	LOCAL	LISTED MEDIUM
33	ESTIBALIZ	535092.04	4743883.89	HALT	-	-	DISUSED	-	REGULAR	NONE	LISTED MEDIUM

VASCO-NAVARRO RAILWAY NODES											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	CURRENT PROTECTION	PROPOSED PROTECTION LEVEL
34	TROKONIZ	536464.98	4741604.26	WOKER´S HOUSING	HOUSE	HOUSE	PUBLIC USE	SCHOOL	GOOD	LOCAL	LISTED MEDIUM
35	ERENTXUN	539093.25	4740610.04	STATION	PASSENGER BUILDING	PASSENGER BUILDING	DISUSED	-	RUIN	LOCAL	LISTED MEDIUM
					WAREHOUSE	WAREHOUSE					
36	GAUNA	541171.55	4740509.14	WOKER´S HOUSING	HOUSE	-	DISUSED	-	DISAPPEARED	-	-
37	URIBARRI-JAUREGI	543336.95	4739426.22	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					ELECTRICAL SUBSTATION	ELECTRICAL SUBSTATION	DISUSED	-	REGULAR	LOCAL	LISTED MEDIUM
38	BRIGADA TUNEL	544424.08	4738056.72	WOKER´S HOUSING	HOUSE	HOUSE	DISUSED	-	RUIN	NONE	LISTED MEDIUM
39	LAMINORIA	545549.63	4735819.98	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
40	ZEKUIANO	545644.18	4733528.49	WOKER´S HOUSING	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	NONE	LISTED MEDIUM
41	MAEZTU	545487.02	4731918.88	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	CITY HALL	GOOD	LOCAL	LISTED MEDIUM
					WAREHOUSE	-	DISUSED	-	DISAPPEARED	LOCAL	-
42	ATAURI	546971.42	4729868.55	STATION	PASSENGER BUILDING	PASSENGER BUILDING	DISUSED	-	RUIN	LOCAL	LISTED MEDIUM
43	ANTOÑANA	549315.35	4726791.79	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PRIVATE USE	HOUSING	GOOD	LOCAL	LISTED MEDIUM
					WAREHOUSE	WAREHOUSE	DISUSED	-	REGULAR		
					ELECTRICAL SUBCENTRAL	ELECTRICAL SUBCENTRAL	PRIVATE USE	HOUSING	GOOD		
44	FRESNEDO	551587.46	4724934.88	WOKER´S HOUSING	HOUSE	-	DISUSED	-	DISAPPEARED	-	-
45	KANPEZU	553919.78	4724977.64	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
					WAREHOUSE	-					
					RAILCAR SHED	RAILCAR SHED	PRIVATE USE	DISUSED	GOOD	LOCAL	LISTED MEDIUM
					WAGON SHED	-	DISUSED	-	DISAPPEARED	-	-
46	ORRADICHO	554980.61	4725390.39	WOKER´S HOUSING	HOUSE	-	DISUSED	-	DISAPPEARED	-	-
47	ZUÑIGA	557358.26	4726436.46	STATION	PASSENGER BUILDING	PASSENGER BUILDING	DISUSED	-	RUIN	-	-
					WAREHOUSE	WAREHOUSE					
48	ARQUITAS	559334.99	4725447.82	WOKER´S HOUSING	HOUSE	HOUSE	DISUSED	-	RUIN	-	-
49	ACEDO	561822.31	4723995.6	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PRIVATE USE	HOUSING	GOOD	-	-
					WAREHOUSE	WAREHOUSE	DISUSED	-	BAD	-	
50	GRANADA	564394.3	4723982.59	WOKER´S HOUSING	HOUSE	HOUSE	DISUSED	-	RUIN	-	-
51	ANTZIN	566373.29	4723515.16	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	CITY HALL_	GOOD	-	-
					WAREHOUSE	-	DISUSED	-	DISAPPEARED	-	
					ELECTRICAL SUBSTATION	ELECTRICAL SUBSTATION	PUBLIC USE	BAR	GOOD	-	
					WATER TOWER	WATER TOWER	DISUSED	-	GOOD	-	
52	MURIETA	569020.01	4723226.46	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	CITY HALL	GOOD	LOCAL	-
					WAREHOUSE	-	DISUSED	-	DISAPPEARED	-	
53	ZUFIA	573665.67	4723237.3	STATION	PASSENGER BUILDING	-	DISUSED	-	DISAPPEARED	-	-
54	ZUBIELQUI	576707.38	4725534.42	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PRIVATE USE	HOUSING	GOOD	LOCAL	-
					WAREHOUSE	WAREHOUSE	PRIVATE USE		RUIN		
55	LIZARRA	579225.58	4724640.46	STATION	PASSENGER BUILDING	PASSENGER BUILDING	PUBLIC USE	BUS STATION, CULTURAL CENTRE	GOOD	LOCAL	-
					WAREHOUSE	-	DISUSED	-	DISAPPEARED	-	-
					RAILCAR SHED	-					
					WAGON SHED	-					

4.4.3. Surrounding territory

The differences in the historical state of the territories around the Vasco-Navarro Railway have remained until the present day. Accordingly, Vitoria-Gasteiz is the main city, followed by Lizarra and the main towns of Gipuzkoa, while all others are rural towns. In this regard, the main city has more than 200000 inhabitants, while the main towns have from almost 4000 to more than 20000. All the other cores (except Legutio, which is out of the railway influence) have less than 1000 inhabitants, or rather less than 500, since Durana and Kanpezu are the only settlements that exceed this number.

In the case of Gipuzkoa, almost all the terrains of the bottom of the valley are built, creating a linear development where mainly towns or industrial areas are located, especially from Arrasate to Eskoriatza. On the contrary, the major urban expansion of Araba/Álava is located in the metropolitan area of Vitoria-Gasteiz and all other urban or rural areas are dependent from it. Finally, the small towns around the Vasco-Navarro Railway in

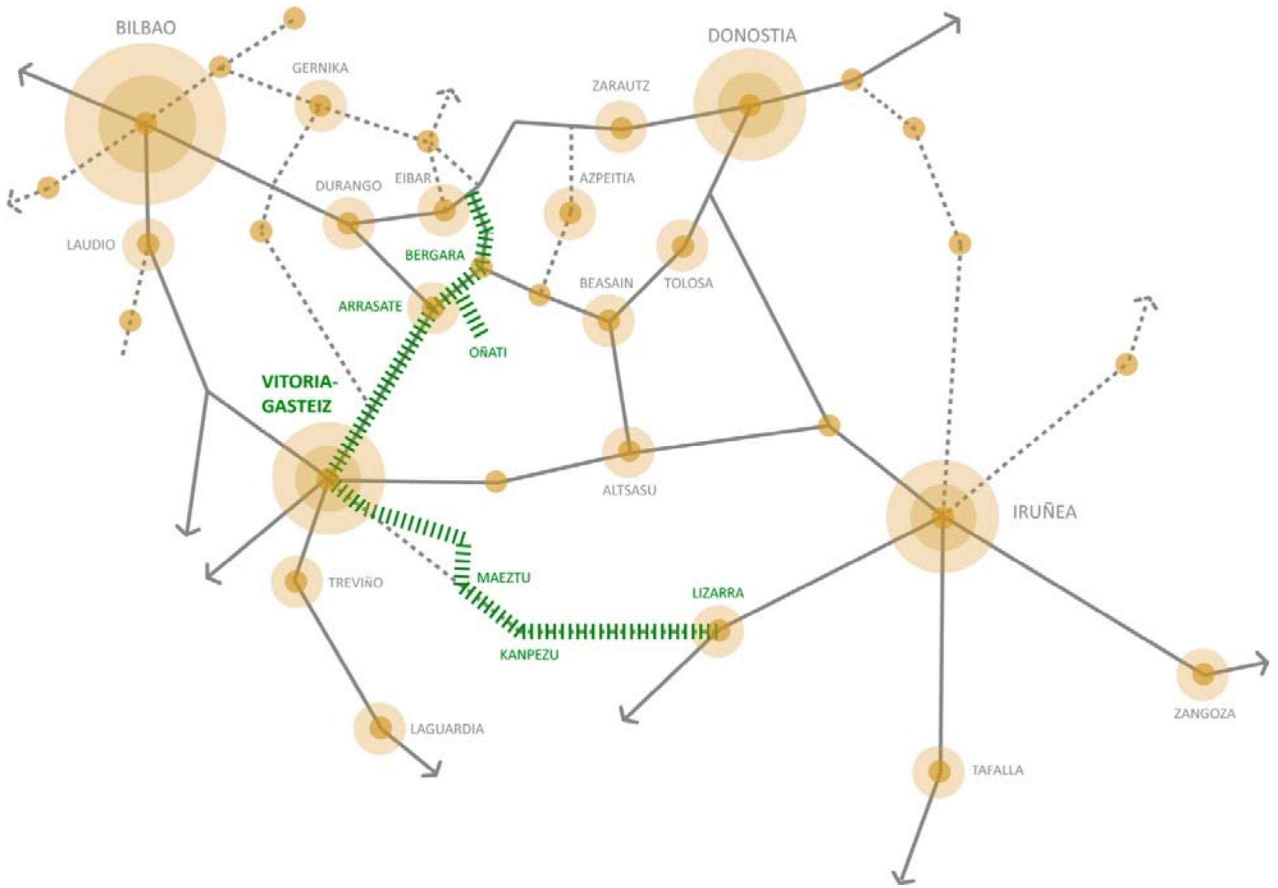


Figure 4.209 Vasco-Navarro Railway in the Basque-Navarre territory where the main settlements and the connections between them are represented

Navarre are influenced by Lizarra, which in turn is under the influence of Iruñea. These main settlements and the connections that are currently between them are represented in fig 4.209. In this regard, the northern section of the railway coincides with one of the Gipuzkoan development axes and a main connection between Gip uzkoa and the capital of Araba/Álava. Meanwhile, although the connection between two capitals (Vitoria-Gasteiz and Iruñea) is promoted in the southern section, this route is comprised by secondary links between cities, since a main road infrastructure is located in the shortest route between the capitals.

It should be added that main transport infrastructures and land uses located in the territories around the railway are studied in the following chapters, where the relations between the railway elements and the territory are illustrated.

4.5. Conclusions

As the initial step of the comprehensive analysis method, the elements that are part of the system are studied in this chapter. Accordingly, the two internal elements (the line and the nodes) are considered on the one hand, while the territory is studied as the external component.

For this purpose, a consideration of the different periods of the system is proposed. The consideration of both the historical and the current state enables to define the historical railway organisation or structuration and its presence in the territory, in addition to identify and study the existing heritage elements that can be promoted in the foreseeable future.

Historical documents and graphical data have been essential for the understanding of the different elements that comprise the system, in addition to a previous literature review. However, the fieldwork has become essential for the correct definition of the current state of the elements.

Furthermore, in addition to the narrative and photographic information usually included in this kind of analysis, other types of representations have been proposed in order to comprehend all groups of components in the different periods. Accordingly, railway structuration schemes have been created for the historical state and graphical representation of preservation level and uses for the current situation. Additionally, an inventory of all node areas has been also created, where all historical buildings are comprised and information related to the current existing buildings is included.

The consideration of the historical and current state in the analysis of the different elements of a system is applicable to and recommended in any disused territorial system. This kind of system is composed of one or more internal elements but the surrounding territory should be always included as the external element.

In this case, the methodology has been applied to the Vasco-Navarro Railway where the linear infrastructure, the railway nodes and the surrounding territory have been studied.

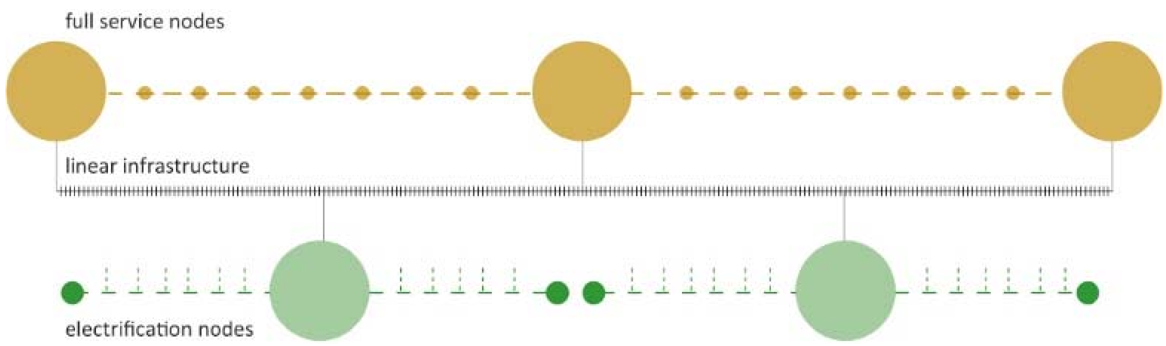
On the one hand, the existing historical data is very precise, especially the part that corresponds to the railway itself, which enables the comprehension of the initial state of the elements, including the disappeared elements. On the other hand, several authors provide suitable information regarding the different periods, especially for the historical state.

In the historical analysis, an evolution in the railway structuration and the construction materials or methods has been identified linked to the different construction periods. The primitive section showed low technical features and an infrastructure and facility concentration in the main city. The posterior construction of the northern section and especially of the branch to Oñati presented new construction systems (Ribera System in bridges) or a certain distribution of services along the territory. On the contrary, high technical features or distribution of strategic node areas are identified in the southern section and during the electrification of the railway. Accordingly, two final railway structurations have been identified taking into consideration full service nodes and electrification elements. The first ones are located at the ends and the middle of a section, while the seconds in the middle of the previous ones, i.e. at a quarter distance from the end and comprising half of a section with each node (fig. 4.210).

Furthermore, as part of the industrialisation process and giving relevance to the functionality of the elements, construction systems and architectural features are repeated, especially in tunnels and bridges, warehouses and sheds, or in the case of some repeated stations in the primitive section and Gipuzkoa, where the passenger building of Bergara and Arrasate or Eskoriatza and Aretxabaleta are almost identical. However, similar style but specific buildings were designed in the southern section, considering the aesthetic and giving prominence to the elements in the territory.

Regarding the current state analysis, protection and reconversion tendencies have been useful to show the future approach of the system. Accordingly, the linear infrastructure is focused towards non-motorised routes, while the nodes present individual approaches. Although a comprehensive protection of the system has been already proposed, in practice, the different elements do not present a system approach, and the line and the nodes are handled independently.

Figure 4.210 Structuration of the Vasco-Navarro Railway according to the full service nodes and electrification nodes



On the one hand, conservation of the linear infrastructure has not been promoted until the end of the previous century and hence, several sections disappeared after the closure of the railway, especially in the urban areas due to the rapid development of new industrial and residential areas.

On the other hand, conservation of a node area does not depend on the relevance or significance of the node area, but on the surrounding territorial or urban pressures. Hence, the railway nodes located in urban areas present lower preservation levels. However, it is true that the passenger building is the construction that is usually preserved in a node area due to its representativeness within the set. Fortunately, at least one of the passenger buildings that are repeated in different nodes is conserved. Unfortunately, several unique buildings have disappeared.

Finally, it should be mentioned that the proposed analysis does not take into consideration the heritage value of each individual element. Nevertheless, the proposed protections for the railway buildings in the Basque Country demonstrate that the elements that are part of the same system show similar technical and composition features.

Contribution 4:

The different elements of DRSs have been studied taking into consideration both current and historical periods, providing historical railway comprehension or structurations and current node distributions depending on their preservation level and use, in order to note the maintenance or mismatches between the initial and current schemes or to compare them.

5. DISUSED RAILWAY LINEAR INFRASTRUCTURES AS NON-MOTORISED TRANSPORT AXES

VASCO-NAVARRO RAILWAY

As part of the comprehensive methodological process, the external relations referred to the line/territory are studied in the following chapter. For that purpose, non-motorised or active accessibility is measured with a multilevel approach in order to show the potential of disused railway lines as non-motorised elements, proposing them as territorial structucturing elements and promoting a more sustainable development.

5.1. Proposed methodology

This research aims to prove that disused railway lines may have potential as non-motorised infrastructures that operate in an urban or interurban scale for a more sustainable development, providing alternatives to private vehicles or motorised public transports in daily relatively short trips. They offer benefits in terms of cost, parking problems or health in addition to environmental advantages.

In this regard, the objective of the chapter is to analyse the accessibility of the disused network, focusing on the possibilities that it could offer in the area and defining in which areas could also support daily activities and uses (trips to work, school, shop, etc.), in addition to leisure or tourism uses.

The literature review includes all kind of studies referred to several types of transports or study levels. This study focuses on a specific transport system (non-motorised) and the possible origins or destinations in their environment. So in this case, accessibility can be defined as the ease, with which any land-use activity can be reached from a certain location and with a certain transport system (Dalvi & Martin, 1976; Morris et al., 1979). Although the theoretical view of the concept is not so broad, it includes the main two components and does not difficult the practical result. Hence, the variation is not in the analysed components, but in the use of different scales of the transport mode and the surrounding environment, which is considered necessary to know the influence area of these linear infrastructures in their environments.

Accordingly, a multilevel approach is proposed for the analysis of active accessibility in disused railway systems. Non-motorised transport modes are characterised by high flexibility and capacity but low speed and spatial reach. In this regard, they are considered as an appropriate transport mode in short distances or high-density spatial patterns. Walking, for example, is the main transport mode for distances of one kilometre or less (Millward et al., 2013; Scheiner, 2010).

Regarding the multilevel approach, three different scales or approaches have been chosen in order to comprehend the whole system. The linear infrastructure is firstly analysed in a regional approach, measuring the accessibility level of the cities and towns connected by the disused rail line. Afterwards, the areas near the line are studied in an interurban approach. Finally, the urban or rural cores (settlements exceeding 50 inhabitants) around the line and its nodes (old railway stations) are analysed in an urban approach. Locations of these infrastructure nodes are considered as the origin points of the accessibility analyses.

On the one hand, the total limit of the study has been established in one hour taking into account that according to the Marchetti´s Principe (Marchetti, 1994), people do not want to travel more than one hour per day or 30 minutes period was inferred as the average journey-to-work time across such a wide range of cities by Kenworthy and Laube (1999). This limit has been divided according to the different study levels. In the urban field, 10 minutes accessibility limit is applied, on the basis that several studies limited accessibility in urban cores to 10 minutes from a railway station (Bertolini & Spit, 1998), 500 metres walk from a railway station (de Munck Mortier, 1996) or 10 minutes from a trail or greenway (Lindsey et al., 2001). In the interurban approach, 400-800 m (walking-cycling) from a greenway, which is equivalent to 5 minutes, is considered as an

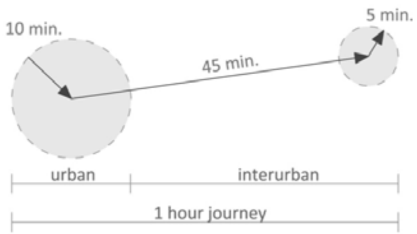


Figure 5.1 Distribution of travel times for the different accessibility areas in non round-trips. In round-trips these times are halved

opportunity area (Coutts, 2008) and therefore, an accessibility limit of 45 minutes (60 min – 10 min – 5 min = 45 min) is established for travels through the disused railway infrastructure (fig. 5.1). In the regional approach, all urban and rural cores that are part of the line or its environment have been analysed.

On the other hand, different speeds are established depending on the transport mode (walking / cycling) and analysis level (urban / interurban). In urban areas 6 km/h walking speed is used, in relation to the 10 minutes and 1 kilometre trips and based on previous studies, such as 5.47 km/h walking speed in Krizek et al., (2012) or Foth et al., (2013). A cycling speed of 12 km/h is determined, taking into account the mean bicycle speed (11.2 km/h) summarized in Millward et al. (2013) or the cycling speed (14 km/h) used in the Mobility and Public Space Plan of Vitoria-Gasteiz (City Council of Vitoria-Gasteiz, 2008), which is the main city of the case study analysed after. In the interurban level, these velocities are increased (6.67 km/h walking and 20 km/h cycling) due to the stops that are produced in urban areas because of existence of crosswalks or traffic lights and taking into account the specific favouring conditions of these infrastructures for non-motorised transports (flat, almost straight and with few crossings). In addition, daily walking and cycling to work was tested by Oja et al., (1998), resulting in 5.8 km/h-6.2 km/h speed for walking and 17.6 km/h-20 km/h speed for cycling, taking in both cases about 30 minutes.

Accessibility analysis in different levels and with different limits and non-motorised transport modes permits studying the different parts of a disused line through a varied territory, measuring accessibility in urban and rural areas and obtaining results for each section of the line and each core that the line crosses. In this regard, this multilevel approach permits to analyse a territory with different land uses or spatial patterns around the linear infrastructure. Accordingly, different accessibility measures are necessary to assess the different levels.

5.1.1. Accessibility Level 1 (AL1): Regional approach

Accessibility of cities and towns that are part of the entire line or its environment is analysed in this approach. Potential accessibility measures are used, expressing the capacity to access from a point of origin to all destinations in a certain territory, in this case, from a town or city to all other town or cities that are part of the disused infrastructure. The accessibility of each city or town is measured taking into account two different perspectives: accessibility in relation to their geographical location (Accessibility Index) and accessibility in relation to destinations and their population (Potential Accessibility).

Total and relative values related to minimum distances and locational distances are measured in the first one. The minimum distance refers to the minimum network distance, while the locational stands for the Euclidean distance. Then, a relative index (eq. 5.1) is obtained, which expresses the relation between the relative minimum network distance and the relative Euclidian distance, indicating the accessibility level of each core according to its geographical location.

$$AI_i = \frac{\frac{\sum_{j=1}^{n} ND_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} ND_{ij}}}{\frac{\sum_{j=1}^{n} ED_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} ED_{ij}}} \quad (5.1)$$

where $\mathrm{AI_i}$ represents accessibility index for each origin i to j destinations, $\mathrm{ND_{ij}}$ is the Network distance between each origin–

destination pair and ED_{ij} is the Euclidean distance between each origin–destination pair. When the Accessibility Index (AI) > 1, the city or town presents a lower level of accessibility through this infrastructure than the one corresponded geographically. When AI < 1, the town or city has been favoured by the infrastructure (Serrano, 1999). PgRouting in QGIS (kdijkstra) is used to create the necessary distance matrix. It should be pointed out that since a disused railway system is a linear infrastructure, half way is considered as the most accessible point in a general approach, so the analysis to all destinations is only useful to obtain the Accessibility Indexes.

In this regard, and in order to overcome this shortcoming, different total network distances are established (400 km in all, 200 km in all, 100 km in all, 50 km in all and 15 km per journey) for the potential accessibility measure, limiting the travel impedance and obtaining the population at the destinations that are within these limits. In this way, the reduction of the effect of the end of the line occurs, and the identification of the most accessible cores is possible. Accordingly, the formulation is based on the Potential Accessibility (eq. 5.2) formulated by Hansen (1959).

$$PA_i = \sum_{j=1}^{n} \frac{P_j}{I_{ij}} \quad (5.2)$$

where PA_i represents accessibility for each origin i to j destinations, P_j is the population at the destination j and I_{ij} is travel impedance (in this case, travel distance) between each origin–destination pair. However, with the limitation of the travel distance, population (P) assessment has resulted in the following formulation (eq. 5.3).

$$P = P_i + \sum_{j=1}^{n} P_j \text{ when } \sum_{j=1}^{n} I_{ij} \leq x \quad (5.3)$$

where P_i is the population at the origin i, P_j is the population at the destination j and I_{ij} is travel distance between each origin–destination pair. In addition to the population, the number of towns or cities is also measured by means of the same formulation (eq. 5.4) in the established distances.

$$C = C_i + \sum_{j=1}^{n} C_j \text{ when } \sum_{j=1}^{n} I_{ij} \leq x \quad (5.4)$$

where C_i represents an origin core i, C_j represents a destination core j and I_{ij} is travel distance between each origin–destination pair.

Finally, the 15 km per journey limit is, in turn, the distance defined as threshold for the use of an infrastructure beyond the exclusive use of greenway, allowing an active transport related to the surrounding cores and hosting more uses than leisure and tourism. In this latter case, contour measures have been used in order to obtain the population and number of cores, since the distance refers to the destinations that are reached in a single journey. Accordingly, the population and number of cores that are in 15 km (network distance) from the origin are taken into consideration.

As a result, on the one hand, the regional approach permits to compare the accessibility level of cities or towns in order to define territorial areas with similar characteristics, in addition to identify possible strategic zones. On the other hand, it shows the potential of the disused line as non-motorised axis of active transport.

5.1.2. Accessibility Level 2 (AL2): Interurban approach

Non-motorised accessibility level for each section of the infrastructure is analysed in the interurban level. This analysis permits the study of the areas near the line, mainly the ones out of cities or towns. For this purpose, the number of cities or towns, through where is possible to access to each section of the infrastructure in a specific time, is measured depending on the type of journey. In this regard, two different analyses are developed taking into account the population of the cities or towns. On the one hand, an analysis with the main cities or towns is made, in order to obtain results related to non-motorised active transports and daily purposes (work, shopping, services, sports, leisure, etc.). On the other hand, all urban or rural cores (> 50 inhab.) are taken into account, being its results more related to leisure and tourism uses. PgRouting in QGIS (drivingDistance) is proposed to assess simple network distance measures.

Walking and cycling transport modes are measured in the mentioned limit of 45 minutes. In addition, both round-trip (short stay: services, shopping, working, studying, sports, etc.) and non round-trip journeys (long stay: leisure and tourism) are studied, in order to cover different type of stays or activities by reason of the trip. Accordingly, depending on time limit, type of transport and chosen speeds, four distances are determined: 2.5 km (walking round-trip), 5 km (walking non round-trip or running round-trip), 7.5 km (cycling round-trip) and 15 km (cycling non round-trip). Furthermore, the combination of contour measures and different limits should create a graduation in results that makes not necessary the use of potential measures.

Consequently, the interurban approach shows the potential of the disused line as non-motorised axis related to different type of journeys on the one hand. On the other hand, it permits to compare the accessibility level of each section of the analysed linear infrastructure and its environment in order to identify possible strategic opportunity areas, which could act as future possible nodes in this non-motorised infrastructure.

5.1.3. Accessibility Level 3 (AL3): Urban approach

Accessibility level of the disused railway infrastructure and its nodes (old railway stations) are analysed in urban areas. Distance accessibility measures (isochrones) are used taking into account all transport infrastructures and urban networks in addition to the disused railway infrastructure, thus defining the land-use activities that are reached from each point of the line or a specific node (old railway station locations), in a certain time (10 minutes) and with non-motorised transport systems. Network analyses are developed using PgRouting in QGIS (alphashape).

As in the interurban level, walking and cycling transport modes are measured and different distances are determined depending on the time limit, type of transport and the chosen speeds: 0.5 km (walking round-trip), 1 km (walking non round-trip, running round-trip or cycling round-trip) and 2 km (cycling non round-trip). In the urban approach, the combination of contour measures and different limits should also create a graduation in results that makes not necessary the use of potential measures.

As a result, on the one hand, the urban approach permits to define the service or accessibility areas of the infrastructure and each of its nodes. In addition, it permits to identify different types of relations between the accessibility areas and the existing urban areas in order to compare them. In this regard, the use and the preservation state of the nodes of these areas should be also checked. On the other hand, different land use activities or areas that are included in these accessibility areas are analysed, representing the urban or local potential of these lines. These activities can be the origins of the interurban trips (1 hour) as represented in fig. 5.1 or can operate as destinations in the local trips (10 min). The first one is related to residential areas while the second one to economic, service or leisure activities or areas.

The three presented approaches at different levels enable analysing non-motorised accessibility in a disused railway infrastructure and its environment, thus comprehending the potentiality of this infrastructure as a non-motorised axis and the connection with its urban or rural environment. Each approach provides results of a different scale but, in turn, the three approaches provide results of the whole line areas. In this regard, it is possible to demonstrate the capability of non-motorised routes to organise the territory and attend several activities, giving rise to more sustainable transports. Furthermore, some extra information can be obtained, identifying future possible opportunity areas or zones. They are essential for the planning and future reconversion of the disused railway system.

Location based measures have been proposed for the development of the methodology, since they are broadly used in urban planning and geographical studies to analyse accessibility at locations. Contour measures are easy to interpret but do not satisfy most of the theoretical requirements. Meanwhile, potential accessibility measures satisfy more additional theoretical criteria, although the interpretation and communicability become more difficult. In this regard, a balance is got using one or other type of measure in order to fulfil the requirements of each approach or analysed area. In the interurban and urban approaches, simple contour measures are considered suitable, since the different non-motorised transport modes and the type of trips will define an adequate context to understand accessibility resulted of the disused railway network. However, in the regional approach potential accessibility measures must be adopted.

5.2. Development and results of non-motorised accessibility along the DRS

The proposed methodology has been applied in the Vasco-Navarro Railway. In this regard, accessibility analyses of a linear system have been developed using a multilevel approach that includes the regional, interurban and urban levels.

For the development of analyses, a data collection and fieldwork have been previously performed to create the necessary shapefiles that represent the disused railway system and its surrounding territory in GIS. The data related to road networks have been gathered from the spatial data infrastructures of each territory (Basque Country: geo.euskadi.net; Navarre: idena.navarra.es; both territories: euskalgeo.net), while demographic data (2014) have been obtained from the Basque Statistics Institute (Eustat) and the Statistical Institute of Navarre.

5.2.1. Regional approach: accessibility of cities and towns along the disused infrastructure

Following the methodology presented above, the Accessibility Indexes for each town or city have been obtained (table 5.1) by means of the accessibility analysis referred to all destinations (from a city or town to other cities or towns that are part of the disused infrastructure). The main city (Vitoria-Gasteiz) is the one presented as the most advantageous regarding the connection through this infrastructure (AI <1). Meanwhile, the northern municipalities are the most disadvantaged (AI >1), presumably due to the mountain pass that divides them from the rest.

Furthermore, the analysis of the number of cities or towns reached by the delimited total network distances (table 5.2) demonstrates that even so, the most accessible zone is the

ACCESSIBILITY ANALYSIS TO ALL DESTINATIONS

URBAN AND RURAL CORES	MINIMUN DISTANCE		LOCATIONAL DISTANCE		INDEX
	TOTAL	RELATIVE	TOTAL	RELATIVE	AI
Soraluze	**2301292.94**	**52.99**	**1272239.68**	**47.64**	1.11
Bergara	**2053070.46**	**47.27**	1088306.91	40.75	1.16
Oñati	**2108997.71**	**48.56**	883541.30	33.08	**1.47**
Arrasate	1813533.85	41.76	930233.21	34.83	**1.20**
Aretxabaleta	1709655.85	39.37	856023.16	32.05	**1.23**
Eskoriatza	1634852.34	37.64	820117.73	30.71	**1.23**
Leintz-Gatzaga	1322677.42	30.46	786154.94	29.44	1.03
Legutio	1294456.85	29.81	841866.67	31.52	0.95
Urbina	1142637.26	26.31	774796.62	29.01	0.91
Erretana	1081790.66	24.91	744526.05	27.88	0.89
Durana	1067031.40	24.57	739217.65	27.68	0.89
Vitoria-Gasteiz	1012974.46	23.32	764474.03	28.62	**0.81**
Otazu	974023.55	22.43	701835.79	26.28	**0.85**
Aberasturi	959297.24	22.09	661207.77	24.76	0.89
Andollu	**950768.71**	**21.89**	634228.83	23.75	0.92
Estibaliz	1044460.01	24.05	634133.20	23.74	1.01
Trokoniz	**950768.71**	**21.89**	624857.12	23.40	0.94
Erentxun	956580.64	22.03	614774.57	23.02	0.96
Gauna	990391.83	22.80	**608790.59**	**22.80**	1.00
Jauregi	1014492.18	23.36	618250.83	23.15	1.01
Zekuiano	1046737.89	24.10	663854.75	24.86	0.97
Maeztu	1062619.51	24.47	683496.35	25.59	0.96
Atauri	1085678.37	25.00	702799.74	26.32	0.95
Antoñana	1153366.87	26.56	772802.92	28.94	**0.92**
Kanpezu	1247132.54	28.72	829608.01	31.06	**0.92**
Zúñiga	1335010.64	30.74	831418.33	31.13	0.99
Acedo	1422417.04	32.75	931448.78	34.88	0.94
Antzin	1540260.87	35.47	1008637.49	37.77	0.94
Murieta	1605933.30	36.98	1060874.00	39.72	0.93
Zufía	1758385.25	40.49	1142265.67	42.77	0.95
Zubielqui	1844527.35	42.47	**1202358.09**	**45.02**	0.94
Lizarra	1943571.83	44.75	**1277384.99**	**47.83**	0.94

Table 5.1 Minimum and locational distances and the Accessibility Index (AI) of each city or town of the analysed line. Relative values are calculated as a percentage of 1000. Values in bold represent the highest and lowest values. Urban cores are listed according to their geographical location in the disused railway line (North-Southeast)

central area. This is mainly due to the existence of two sections (the mountain port of Arlaban and Laminoria) that separate this central area from the northern and southern territories. Furthermore, the study of the reached population (table 5.2) presents the main city and the cores around it as the most accessible ones, followed by the northern municipalities. Although delimited total network distances permit to obtain more practical results than the analysis referred to all destinations, the effect of the end of the line has not been totally removed.

In this regard, the analysis shows that all infrastructure sections are influenced by Vitoria-Gasteiz or Lizarra in the 400 km limit. The latter occurs between Kanpezu and Lizarra. In the 200 km and 100 km limit, however, there are sections located out of the influence of main urban areas, such as Zekuiano-Kanpezu (200 km) or Gauna-Acedo (100 km). Furthermore, the influence of Vitoria-Gasteiz reaches Leintz Gatzaga, but does not other urban areas in Gipuzkoa. In this regard, the division between Gipuzkoa and Araba/Álava is clearly evidenced by the 50 km limit. Meanwhile, the cores located between Erentxun and Antzin are not under the influence of any main city or town in this limit, and that is why Kanpezu and Maeztu are considered as the principal cores of this area.

As a result of the delimited analysis, on the one hand, table 5.2 shows different ranges of population (<5000 inhab./ 5000-25000 inhab./ 25000-100000 inhab./ >100000 inhab.), which have permitted to identify zones for depicting territorial and urban reality: The main northern towns (Bergara – Eskoriatza), the area influenced by Vitoria-Gasteiz (Legutio – Erentxun), the small towns (Gauna – Acedo) and the area influenced by Lizarra (Antzin – Lizarra) (fig. 5.2). In addition, although a single urban core is located in the mountain pass of Arlaban (Leintz-Gatzaga),

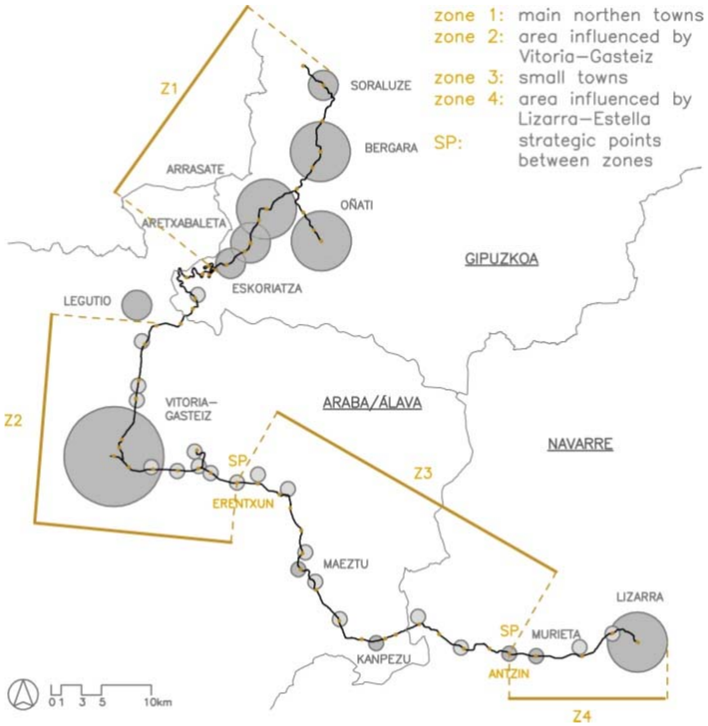


Figure 5.2 Zones identified in the regional or territorial field

this area can be considered as another zone. These zones coincide with the results of the analysis limited in 15km network distance. Furthermore, in the south side of the infrastructure, they also coincide with the geographical distribution of the main cities and towns. This means that the two points where the influences of main cities or towns extend (Erentxun–*Vitoria-Gasteiz*; Antzin–*Lizarra*) are the same points where the influences of smaller scale main cores spread (Erentxun–*Maeztu*–Kanpezu; Maeztu–*Kanpezu*–Antzin) (fig. 5.2). Hence, these points have been considered as strategic points or junctions between zones. Zone 1 (located in Gipuzkoa) cumulates more than 50 000 inhabitants, while the zone around Vitoria-Gasteiz (zone 2) comprises more than 200 000. Nevertheless, less than 3000 inhabitants are gathered in the

Table 5.2 Delimited network distance analysis referring to the number of cores and population from which each urban cores is reached

ACCESSBILITY ANALYSIS WITH LIMITED DISTANTES											
URBAN AND RURAL CORES	POPUL. 2014	TOTAL 400 KM		TOTAL 200 KM		TOTAL 100 KM		TOTAL 50 KM		UP TO 15 KM	
		Nº OF CORES	POPULATION	Nº OF CORES	POPULATION	Nº OF CORES	POPULATION	Nº OF CORES	POPULATION	Nº OF CORES	POPULATION
Soraluze	3941	12	301200	8	64702	6	63027	4	51948	2	18951
Bergara	15010	13	301355	9	65076	7	63282	5	58906	5	58906
Oñati	11075	12	301200	9	65076	6	63027	4	54965	5	59086
Arrasate	21922	14	301485	10	65372	7	63282	6	63027	6	63027
Aretxabaleta	6958	15	301559	10	65372	7	63282	5	59086	5	59086
Eskoriatza	4121	15	301559	10	65372	7	63282	5	59086	3	33001
Leintz-Gatzaga	255	17	298191	11	271459	7	242294	5	3151	5	3151
Legutio	1420	17	272342	11	242826	7	238173	5	3151	6	238173
Urbina	374	19	272734	13	243226	9	238532	6	238173	6	238173
Erretana	296	20	272791	14	239341	10	238705	7	238328	7	238458
Durana	806	20	272791	14	239341	10	238705	7	238203	9	238532
Vitoria-Gasteiz	235022	21	251927	15	239409	11	238850	7	236656	11	238850
Otazu	155	21	245073	15	239409	12	237666	7	235954	11	237292
Aberasturi	130	22	245205	16	239535	11	237292	8	236009	11	237292
Andollu	74	22	241575	17	239701	12	237360	9	236190	10	236996
Estibaliz	173	21	241084	15	238115	10	236996	7	987	9	236190
Trokoniz	194	22	241575	16	238281	12	237388	9	236190	10	236258
Erentxun	206	22	241575	16	238281	12	236639	8	1168	11	236582
Gauna	55	21	241084	16	238799	11	1617	7	1013	11	1617
Jauregi	181	21	241320	15	238799	10	1462	7	1102	11	1617
Zekuiano	68	21	240344	15	2911	10	2217	7	1057	9	2143
Maeztu	324	21	240287	15	2911	10	2247	7	1743	8	1949
Atauri	57	21	239454	14	2756	8	1847	5	1507	8	1847
Antoñana	166	21	239454	13	3314	9	1979	6	1611	7	1743
Kanpezu	892	19	20350	13	3500	9	2678	6	1675	8	2234
Zúñiga	104	19	20350	13	19518	9	2678	6	2229	7	2286
Acedo	132	18	20220	13	19518	8	2815	5	2063	7	2546
Antzin	491	17	20047	12	19337	9	18888	6	1757	8	18722
Murieta	444	16	19973	12	19337	9	18888	6	17726	7	17830
Zufía	317	15	19779	11	19269	8	18722	6	17726	6	17726
Zubielqui	269	15	19779	10	18945	8	18722	6	17726	5	17594
Lizarra	16073	14	19573	10	18945	7	17830	5	17594	5	17594

Number of cores	400 km 200 km 100 km 50 km 15 km		< 15 < 10 < 7 < 5 < 5		15 - 17 10 – 12 7 – 8 5 5 - 6		18 - 20 13 – 14 9 – 10 6 – 7 7 -9	> 21 > 15 > 11 > 8 > 10
Population	in all		< 5000		5000 - 25000		250001-100000	> 100000

small towns located out of the influence of Vitoria-Gasteiz (zone 3). Finally, population is measured in more than 15 000 inhabitants in the area of Lizarra (zone 4). However, this is far from the levels of Gipuzkoa, since Lizarra is the only main urban core of the area, which is in turn dependent on the main city of Navarre.

On the other hand, although the entire line can be used as a greenway, the 15km network distance analysis shows that this infrastructure also presents a high potential as non-motorised axis of active transport, more related to daily purposes. The only section that is out of this assessment is the mountain pass located between the two Basque provinces, i.e. none of the cores that are reached by Eskoriatza (3) or Leintz-Gatzaga (5) are the same (table 5.2).

5.2.2. Interurban approach: accessibility of the areas near the line

Following the methodology presented above, walking-cycling round-trip journeys and running round-trip or walking non round-trip journeys have been studied. Cycling non round-trip journeys were analysed in the previous level, regarding the potentiality of the line as a greenway and covering most of the infrastructure.

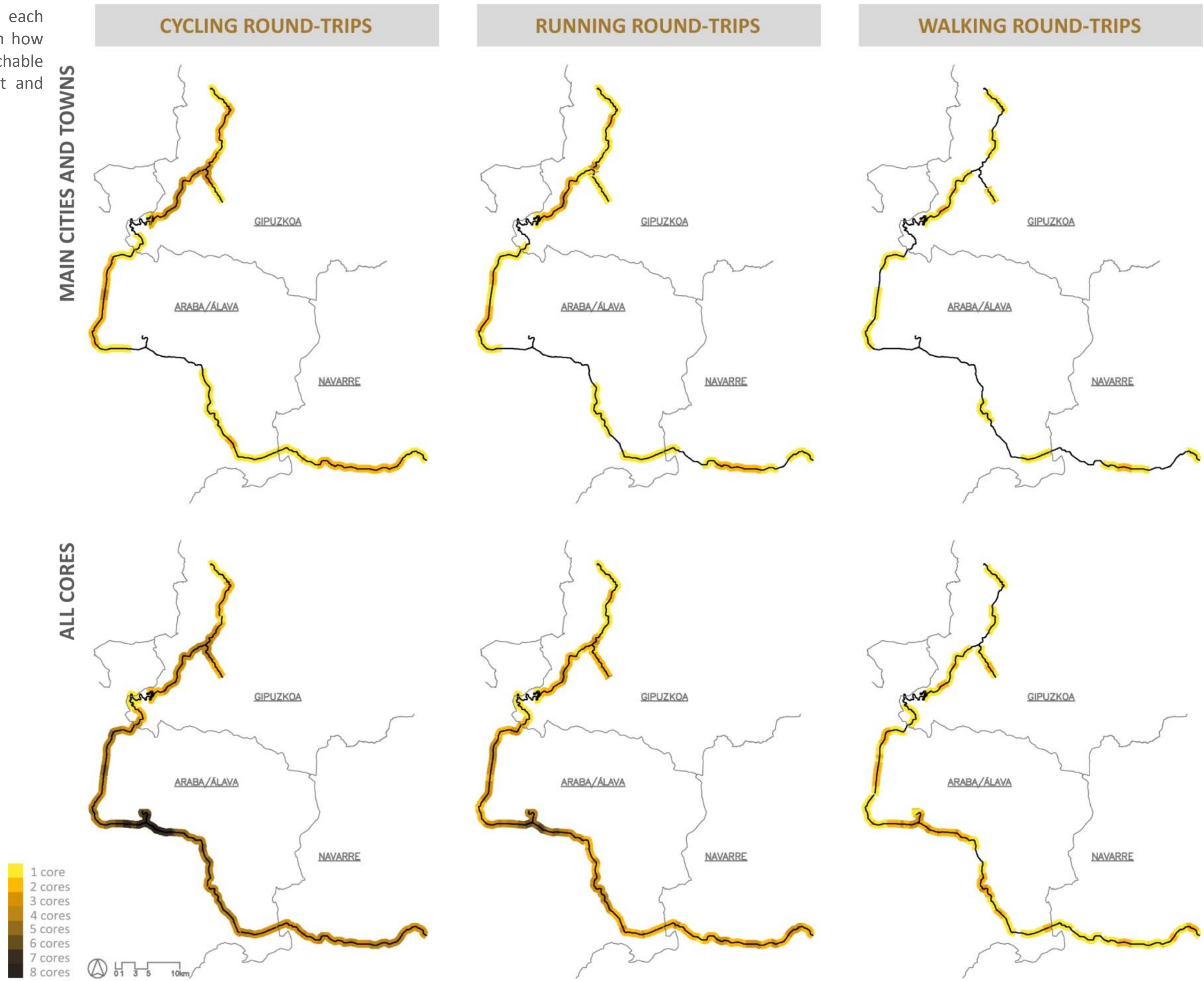
The analysis referred to the main cities and towns shows that the areas near the infrastructure in Gipuzkoa have the highest accessibility levels running and cycling (fig. 5.3 and annex 3.1.1). Furthermore, walking lowest levels are shown in Araba/Álava. In numbers, on the one hand, the 40% of the infrastructure can be reached cycling from at least two towns (table 5.3). Moreover, in Gipuzkoa the 25% of the analysed area can be reached from three towns. On the other hand, less than half of total

INFRASTRUCTURE DISTRIBUTION ACCORDING TO THE ACCESSIBILITY LEVEL

Nº OF CORES	PROVINCES	MAIN CORES			ALL CORES		
		WALKING	RUNNING	CYCLING	WALKING	RUNNING	CYCLING
1	**Gipuzkoa**	46.6	74.3	84.6	62.4	86.8	96.06
	Araba/Álava	40.0	62.4	75.2	92.7	100.0	100.00
	Navarre	38.6	75.4	100.0	97.1	100.0	100.00
	TOTAL	42.2	69.3	83.4	82.1	94.5	98.52
2	**Gipuzkoa**	4.2	23.8	54.1	6.8	38.3	68.88
	Araba/Álava	0.6	10.7	27.0	49.1	99.6	100.00
	Navarre	8.3	26.7	57.0	19.6	97.1	100.00
	TOTAL	3.4	18.6	42.9	27.7	75.7	88.31
3	**Gipuzkoa**	-	4.2	24.9	-	2.2	36.40
	Araba/Álava	-	-	2.6	8.4	63.4	100.00
	Navarre	-	-	0.4	-	33.0	100.00
	TOTAL		1.6	10.6	3.6	34.5	76.11
4	**Gipuzkoa**	-	-	0.4	-	-	12.25
	Araba/Álava	-	-	-	-	26.6	82.94
	Navarre	-	-	-	-	-	37.46
	TOTAL			0.2		11.5	47.81
5	**Gipuzkoa**	-	-	-	-	-	0.44
	Araba/Álava	-	-	-	-	11.4	36.19
	Navarre	-	-	-	-	-	0.41
	TOTAL					5.0	16.02
6	**Gipuzkoa**	-	-	-	-	-	-
	Araba/Álava	-	-	-	-	4.2	20.53
	Navarre	-	-	-	-	-	-
	TOTAL					1.8	8.95
7	**Gipuzkoa**	-	-	-	-	-	-
	Araba/Álava	-	-	-	-	-	14.36
	Navarre	-	-	-	-	-	-
	TOTAL						6.26
8	**Gipuzkoa**	-	-	-	-	-	-
	Araba/Álava	-	-	-	-	-	2.45
	Navarre	-	-	-	-	-	-
	TOTAL						1.07

Table 5.3 Percentage of the infrastructure that can be reached for a certain number of cores

Figure 5.3 Accessibility analysis of each section of the line, expressing from how many cores each section is reachable according to the type of transport and size of cores



kilometres are reachable walking from some core, in which the 3.4% is reachable from two cores. Finally, some integrated areas have also been identified in the analysis of the main cores. Accordingly, there are several areas with the influence of three cores in Gipuzkoa, while there is only one in Araba/Álava and Navarre, both of them located in small or rural areas and accessible by bicycle. One of those areas in Gipuzkoa permits connections between all its cores (Arrasate – Aretxabaleta - Eskoriatza), making an integrated functioning of these towns possible, even walking. This means that their minimum accessibility areas (related to walking trips) reach the next urban core (fig. 5.4). The same phenomenon is concluded in two towns of Navarre (Antzin-Murieta).

The different areas classified depending on the number of cores they are influenced by, have been listed below taking into consideration the main cities and towns:

- 0 cores: the section between Aberasturi and Uribarri-Jauregi; and the mountain port between Gipuzkoa and Araba/Álava.

- 1 core: both ends of the line; the sections between Vitoria-Gasteiz and Acedo, excluding two points; the areas from the previous mountain port to Legutio and outskirts of Eskoriatza; and the section between a neighbourhood in the outskirts of Bergara and the city centre.

- 2 cores: the section between Acedo and Zubielqui, where the area of Antzin-Murieta also shows pedestrian accessibility; Antoñana and the tunnel of Arquitas in the section between Vitoria-Gasteiz and Acedo; the section between Vitoria-Gasteiz and Legutio, where a zone with pedestrian accessibility is included; the section between Eskoriatza and its outskirts of the mountain area; and the districts of Mekoalde and Osintxu in Bergara.

- 3 cores: Zufia in Navarre; Erretana in Araba/Álava; several areas around the crossing of the branch of Oñati; and the section of Arrasate-Aretxabaleta-Eskoriatza.

- 4 cores: an area around the crossing of the branch of Oñati.

Main cities and towns have been defined as the cores that have more than 300 inhabitants in the case of the Vasco-Navarro Railway. Although it is a low value, some cores that are predominant in their area have this population level in Araba/Álava. Nevertheless, all the cores with more than 300 inhabitants in Gipuzkoa have more than 3000 inhabitants. Otherwise, smaller cores have been included in a second analysis. In the case of the Vasco-Navarro Railway, almost all cores (more than 50 inhabitants) have a railway station. However, the areas that only have a simple shelter or the railway stops located in industrial areas have not been considered.

The analysis referred to all cores shows that the highest accessibility level area is located in Araba/Álava, in a zone with small close cores (fig. 5.3 and annex 3.1.1), where reaching the area of Trokoniz from eight different cores is possible. From six cores, the 20% of the linear infrastructure of Araba/Álava is reachable cycling and some specific areas running (table 5.3). However, six cores are only reached in the mentioned highest accessibility zone. In the rest of the infrastructure of Araba/Álava, influences of 5 cores are highlighted close to Antoñana, Urbina or Erretana and around the Laminoria tunnel. In Gipuzkoa and Navarre, some areas are only possible to reach from five cores, such as Zufia or the area between Arrasate and San Prudencio. Nevertheless, all the areas in Araba/Álava and Navarre can be reached cycling from 3 towns and almost all areas running from 2 towns. On the other hand, more than a

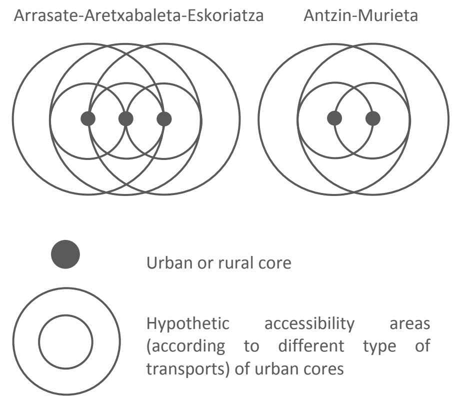


Figure 5.4 The phenomenon of the urban or rural cores that expand their accessibility areas into the next core.

quarter of the infrastructure is reachable from 2 cores walking, but these areas are mainly located in Araba/Álava.

In view of the above, in Gipuzkoa, the most strategic area is the connection point of the branch cycling (fig. 5.3 and annex 3.1.1) and the three towns as in the main cores analysis walking. In Araba/Álava, it is the mentioned highest accessibility level area, but it is out of the main city´s influence and surrounded by small cores. Accordingly, this is a strategic area to develop specific strategies that involve part of the disused infrastructure, but not the whole. In Navarre, all areas are reached from three or four cores cycling and from two or three cores walking. Some areas have better results than its surroundings and one of the points of the main cores analysis is presented as the most strategic one (Zufia), but large areas have not been highlighted.

Taking into consideration both analyses, there are no significant differences in Gipuzkoa, but there are in Araba/Álava due to the existence of the main city and many small rural towns. This means that this linear infrastructure could integrate different non-motorised transport purposes depending on its locations.

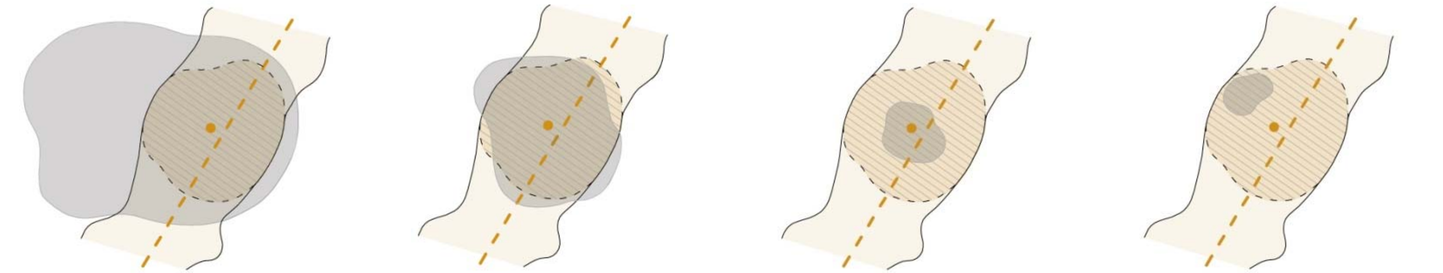
5.2.3. Urban approach: accessibility in urban areas

The analysis of the accessibility level of the disused railway line and its nodes has been made by isochrones, defining the accessibility areas created around them taking into account all transport and urban networks. The comparison of each analysed urban or rural core shows different relations between the nodes (old railway stations) and their accessibility areas, and the urban areas, which have permitted to classify them in four type of relations (table 5.4): (1) the urban core is larger than the accessibility area of the node; (2) the urban core is similar to the accessibility area of the node; (3) the urban core is smaller than the accessibility area of the node and is reachable from the walking round-trip influence area; and (4) the urban core is smaller than the accessibility area of the node and is not reachable from the walking round-trip influence area. Only the main city (Vitoria-Gasteiz) has been classified in the first group and seven towns have been classified in the second (the towns of Gipuzkoa and the main town of Navarre). Meanwhile, twelve have been sorted in the third type and other twelve in the fourth, most of them rural towns or areas of Araba/Álava and Navarre.

The use and state of preservation of the nodes have been also checked for these groups (table 5.4). One-third of the nodes of the third and fourth type have private uses. The other nodes of the third group have public uses (except Erentxun, which is disused), while the rest of the nodes of the fourth group have already disappeared or are in a poor state of preservation. Moreover, nodes located in Vitoria-Gasteiz have also disappeared. In the second type, where all the nodes are located in urban areas, some of the nodes have disappeared due to the urban development pressure, but others have been kept. Furthermore, some of them (Arrasate, Oñati, Aretxabaleta and Lizarra) are located in areas where a transition between land uses occurs, such as residential areas and industrial or civic land uses. Accordingly, they are considered strategic nodes located in urban areas that could be able to serve or support both land uses. Nowadays, existing nodes already have public owners. On the other hand, the existing node of Eskoriatza is sited in an industrial area, while current residential areas have substituted former railway stations in Soraluze and Bergara.

According to the land uses, on the one hand, the distance accessibility measures (isochrones) of the line reveal that all the analysed cores (except Legutio and a part of the main city) are

CORES ACCORDING TO THE RELATION BETWEEN URBAN AND ACCESSIBILITY AREAS							
TYPE 1: CITY		**TYPE 2: TOWN**		**TYPE 3: RURAL TOWN**		**TYPE 4: RURAL AREA**	
URBAN OR RURAL CORE	NODE STATUS	URBAN OR RURAL CORE	NODE STATUS	URBAN OR RURAL CORE	NODE STATUS	URBAN OR RURAL CORE	NODE STATUS
Vitoria-Gasteiz	**disappeared**	Soraluze-Plancencia de las Armas	disappeared	Urbina	private use	Leintz-Gatzaga	not building
				Durana	public use	Legutio	disused
				Otazu	public use	Erretana	private use
		Bergara	**disappeared**	Aberasturi	private use	Estibaliz	not building
		Oñati	public use	Andollu	public use	**Gauna**	**disappeared**
		Arrasate	public use	Trokoniz	public use	Jauregi	disused
		Aretxabaleta	disappeared	Erentxun	disused	Zekuiano	private use
		Eskoriatza	public use	**Maeztu**	**public use**	Atauri	disused
		Lizarra	public use	Acedo	private use	Antoñana	private use
				Antzin	public use	Kanpezu	private use
				Murieta	public use	Zúñiga	disused
				Zubielqui	private use	Zufía	disappeared



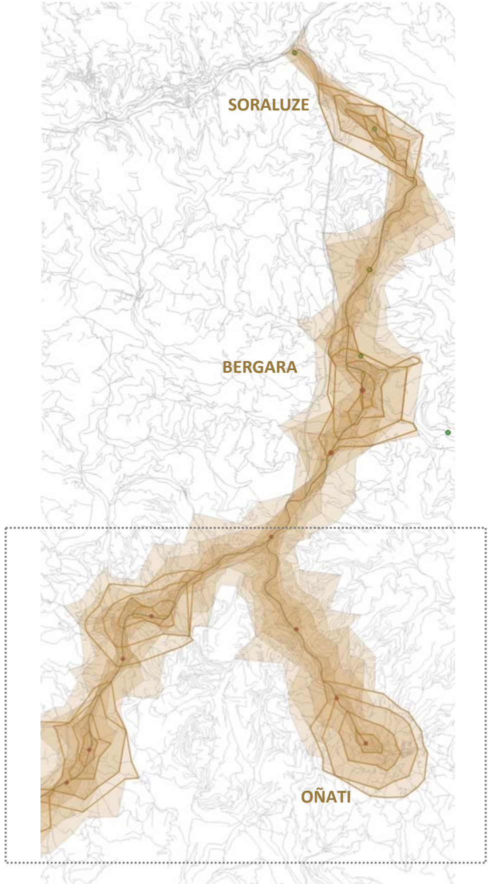
railway line	accessibility area of line	accessibility area of node	urban or rural core area
railway node			

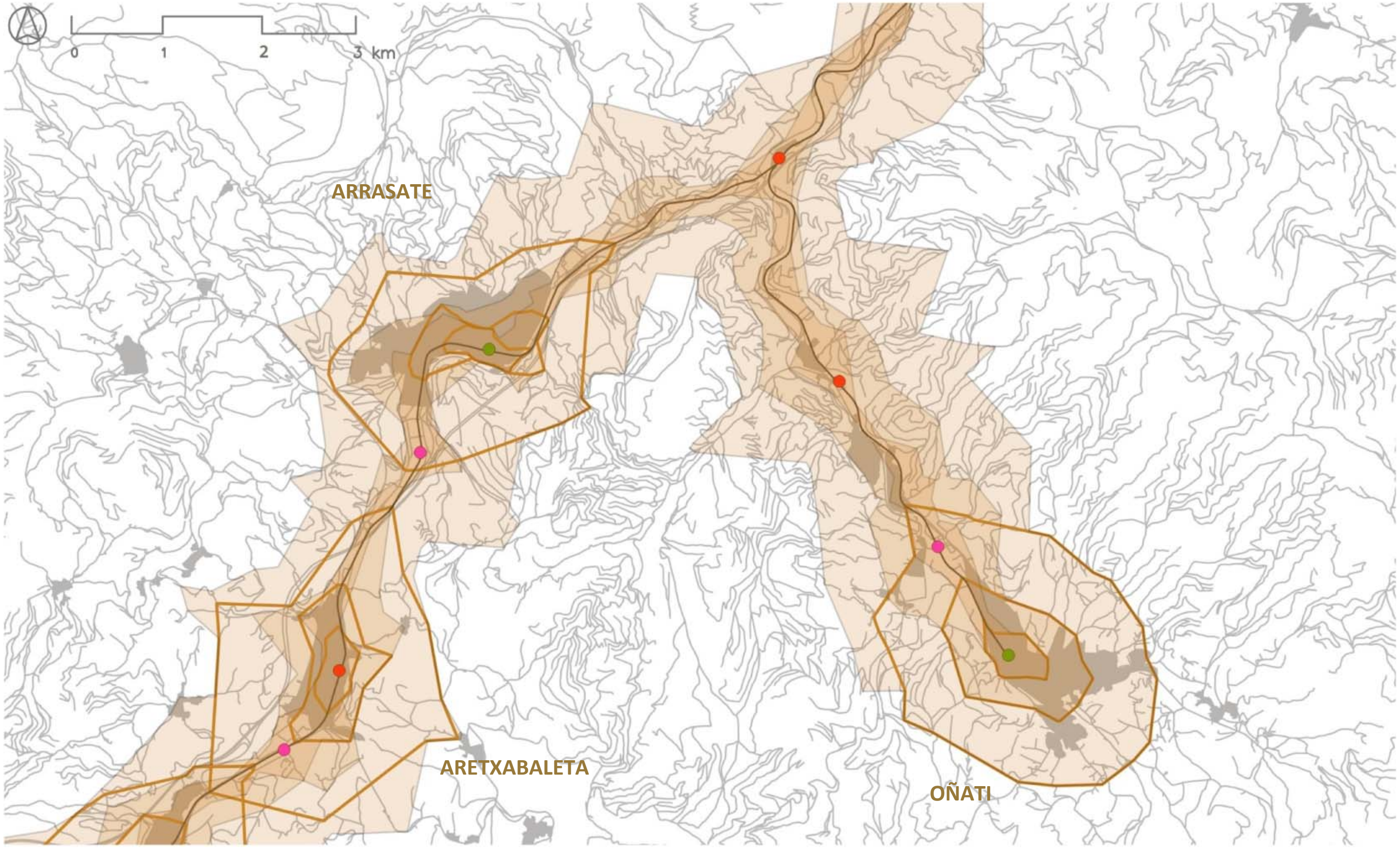
Table 5.4 Four groups of urban and rural cores and their characteristics depending on the relation of urban and accessibility areas. Relations of specific cores (in bold) are included at the bottom as examples

within the accessibility area (cycling), so they could operate as origins in the integral journeys (1 hour) in the analysed linear system (fig. 5.1).

In Gipuzkoa, where the line goes through a narrow valley, the cycling accessibility area practically covers all the built land use activities. What is more, the walking accessibility area also covers most of them (fig. 5.5). In the case of two municipalities, Soraluze and Bergara, there is an industrial area located out of the walking accessibility area. Meanwhile, some industrial and residential areas have been identified in Oñati, partly because it is the end of the line. However, all of them (except Olaberrieta) are accessible by cycling. The same happens in Arrasate, where there are one residential area and another industrial area that can only operate as origins of cycling routes, while the mental hospital located out of the city and its surrounding neighbourhoods are out of influence of the infrastructure. Finally, the disused line is highly accessible from the different areas of Aretxabaleta and Eskoriatza (even walking) due to their small size in comparison with the previous urban areas.

Figure 5.5 Accessibility areas in Gipuzkoa. Brown surfaces refer to the line accessibility areas and brown lines refer to node accessibility areas (10 minutes). Coloured points represent railway nodes (red: disappeared; green: public use; yellow: disused and in a bad state of conservation; pink: simple shelter, black: railway use)





The same effect has been observed in the small cores off Araba/Álava and Navarra, although the territory is wider and more rural. Vitoria-Gasteiz is the only urban area of Araba/Álava where the accessibility area of the disused infrastructure does not cover the whole city (fig. 5.6). The line goes north-south through the east side of the city. Accordingly, in addition to the old town of Vitoria-Gasteiz and the city centre, several housing or industrial areas and the university area can operate as origins in walking trips. Moreover, all the east-centre area is accessible by cycling, while some medium density residential areas and the industrial zone located in the west side of the city are out of this influence.

Finally, in Lizarra (Navarra), the disused railway line is accessible from all built areas in the north and west side of the city by cycling, while it is not by walking from the hospital area and some outskirt residential areas of the north. Similarly, in the east and south areas, industrial and outskirt residential areas are not part of the integral journal trips by walking, but they are cycling. The local camping area is the most significant element that is located out of the infrastructure's influence area.

Taking into consideration the integral journeys with numerous origins along the whole infrastructure and the different territorial nature of the provinces and their non-urban areas, the future use of the non-motorised infrastructure could be

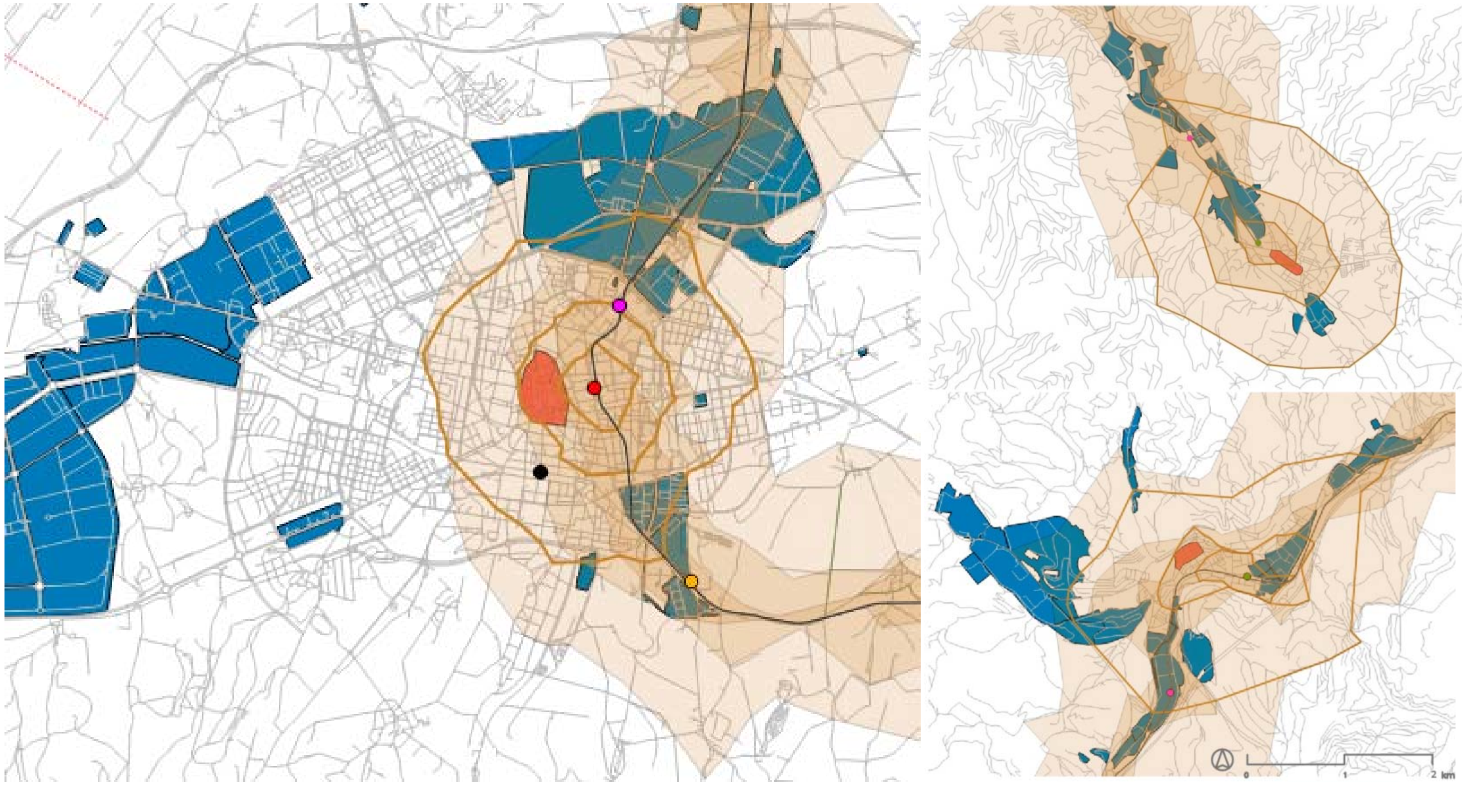


Figure 5.6 Accessibility areas in Vitoria-Gasteiz (left), Oñati (upper right) and Arrasate (bottom right). Brown surfaces refer to the line accessibility areas and brown lines refer to node accessibility areas (10 minutes). Red surface refers to the city centre while blue ones refer to industrial areas. Coloured points represent railway nodes (red: disappeared; green: public use; yellow: disused and in a bad state of conservation; pink: simple shelter, black: railway use)

generally linked to urban activities in the north section of the line and natural or rural activities in the rest.

On the other hand, the created accessibility areas (10 minutes) of the line and the nodes could also operate as destinations of local trips. That is why and as in the previous case the activities (economic, services or leisure) located in these urban or rural cores could be destinations. In this regard, almost all industrial areas (except one in the main city) are reachable by bicycle. Furthermore, all city centres and urban town centres are reached walking and round-trip cycling (fig. 5.6).

In Gipuzkoa, the disused railway infrastructure links most of the facilities and open areas of the analysed cores due to the narrowness of the valley, and the consequent linear organisation and size of urban settlements (fig. 5.6). This type of link is also obtained in the small cores of Araba/Álava and Navarre. Accordingly, several areas of Vitoria-Gasteiz are located out of the catchment area of the line or its nodes. Nevertheless, there are also interesting links, such as: the connection between the elements of the Green Belt of Vitoria-Gasteiz (Olarizu, Salburua and Gamarra parks and the areas around the Zadorra River) and the city centre; the link between the industrial areas of Gamarra-Betoño or Olarizu and the city centre; or the connection between the existing railway (The Railroad of the North) or the future railway (High Speed Railway) and the city centre. All of them are connections between the city centre and the northern or southern areas of the city. Furthermore, it should be noted the existence of a former node in the south area (Olarizu) or the strategic location of the disappeared station of the city centre (Vitoria Ciudad). Finally, in addition to the links of the main open areas or facilities, the connection between the disused railway line and the Way of St. James is happened in Lizarra, where the continuity to Iruñea becomes possible.

Taking all the above into consideration, the potential of the disused railway infrastructure as non-motorised transport axis has been defined by means of the multilevel comprehensive analysis. The entire infrastructure could operate as a greenway, indeed part of the line is already used in this way. Furthermore, almost all the line could support more specific active transport activities related to leisure and tourism, since future strategic areas have been identified in order to strengthen this uses. Nevertheless, the potential of the line could go beyond greenways, tourism and leisure activities in several sections. Some infrastructure sections could already operate as an active transport infrastructure comprising daily purpose journeys, while other sections could do it by means of future nodes located in the identified strategic areas. The analysis also reveals that almost all cores could operate entirely as origins of the whole system or destinations of the local network. On the other hand, the different territorial zones, and the relations between the node areas and cores have been identified in order to classify the different cores or their corresponding railway nodes. Accordingly, annex 3.2 includes useful information of the different analysis levels (AL1, AL2 and AL3) for the following study of nodes.

5.3. Conclusions

As part of the comprehensive analysis method, the relations between the disused linear infrastructure and its surrounding territory are studied in this chapter. The proposal is based on the use of different accessibility measures and scales to achieve a common goal. The presented methodology analyses accessibility around linear systems with a multilevel approach, making a distinction between municipalities or urban and rural cores, non-urban spaces around the line and spaces in urban or rural cores. Each approach provides results of different scales, but in turn provides results of the whole line areas. These results refer to the potential of linear infrastructures as non-motorised axes, showing that disused railway infrastructures could have different uses further than greenways. Furthermore, some extra information is obtained, which is essential for the planning and future reconversion of the disused railway system.

This multilevel approach is applicable to disused railway infrastructures (linear systems) located in areas where urban or rural cores appear minimally spaced and do not form a metropolitan area. Nevertheless, the method could be widespread referring to the type of transport (changes in distances) or system structure (linear or network, such as multi-centre or polinuclear network cities) in order to apply it in other territorial systems, as long as the existence of urban and rural communities and non-built natural areas happens.

The analysis method does not mix transport and land-use components. Therefore, the territory is only analysed as its configuration, studying the potential of the path. However, the strategic points and areas obtained from these analyses provide the possibility to study also the potential of the nodes (old railway existing nodes and new possible found nodes) (see chapter 6). This would allow finding the connections that could be created by the future non-motorised structuring element, in order to define the potential of the comprehensive system and design future reconversion strategies.

In this case, the application of the proposed methodology to the Vasco-Navarro railway has been developed, achieving specific results and evidencing the effectiveness of the proposal. The regional approach has identified five territorial zones while it has shown the potential of almost all the line as an active transport infrastructure related to daily purposes. Meanwhile, the interurban approach has specified the accessibility level of each infrastructure section (from 1 to 8 cores) according to the different types of journeys, in addition to identify the strategic areas that need to be taken into consideration in subsequent analyses. Finally, four types of relations between the accessibility areas of the railway nodes and their surrounding cores have been identified, and the operability of most of the surrounding core areas as origins of the interurban trips or destinations of local trips have been shown at urban level.

To that end, potential or contour accessibility measures have been used depending on the approach. Potential accessibility measures have permitted to employ the real geographical distribution of the destinations in the regional approach by means of the graduation in the distances. Meanwhile, the use of several different trip measures have created a sufficient distribution to use simple contour measures in the interurban approach, since the destinations are limited to the number of cores and not to specific activities. At the urban level, although different activities are part of the accessibility measure, contour measures have also provided a suitable approach in order to define the accessibility areas and the possibilities that the network could offer in the area by means of the different limits.

Contribution 5:

The relations between the disused railway line and its surrounding environment have been studied by means of a multilevel accessibility analyses and studying the former railway infrastructure as a non-motorised axis. This conception makes it possible the comprehension of linear infrastructure as a structuring element, not only of the surrounding territory but also of the disused railway system itself.

Contribution 6:

Accessibility along a linear infrastructure has been measured for varied territories, which include urban and rural communities and non-built natural areas. Hence, three different scales of analysis have been used for the comprehension of the potential of the axis in its surrounding environment: a regional approach, referred to the cities and towns which are connected by the disused railway line; an interurban approach related to the areas near the line; and an urban approach referred to the areas of urban or rural cores (settlements exceeding 50 inhabitants) around the line.

Contribution 7:

Existing potential measures have been adapted to linear infrastructures by limiting the travel impedance in order to reduce the effect of the end of the line that occurs in linear infrastructures.

Related Publications:

Eizaguirre-Iribar, A., Etxepare, L., Hernández-Minguillón, R.J., 2016. A multilevel approach of non-motorised accessibility in disused railway systems: The case-study of the Vasco-Navarro railway. *Journal of Transport Geography* 57, 35–43.

6. DISUSED RAILWAY NODES AS JOINTS IN ACTIVE TRANSPORT DEVELOPMENTS

VASCO-NAVARRO RAILWAY

As the final step of the comprehensive study of a DRS, the external relations referred to the node/territory are analysed in the following chapter. The analysis of each station area in relation to its surrounding territory should comprise both node and place approaches. For that purpose, the different transport systems and land uses that are involved in the influence area of each railway node are measured. This enables to understand each former railway node as a node in a network and as a place in the city and to propose them as future nodes in a non-motorised transport axis. Thus, on the one hand, a balance between transport and land uses can be managed, while, on the other hand, developments based on active transports can be supported. In consequence, sustainable urban development is advanced.

6.1. Definition of the models and proposed methodology

The proposed methodology is structured in several phases. First of all, former and new possible nodes are identified and their influence areas are delimited. Secondly, the different variables and indicators that are necessary to take into consideration are studied and defined. Having done this, the analysis of each node area can be developed based on different models. Multi-criteria Decision Analysis (MCDA) is proposed for this purpose. Finally, the results of the different nodes are compared and clustered in order to identify development typologies, for which PCA and k-means clustering are used.

6.1.1. Definition of the models

NODE/PLACE MODEL (N/P)

The node and place approaches of each defined node areas are measured, using the node-place model created by Bertolini (Bertolini, 1999) and operationalised by Zweedijk and Serlie (Serlie, 1998; Zweedijk, 1997) (see chapter 2.3.2). For that purpose, the different variables for each approach are defined and a two axes diagram is created (fig. 6.1). The y-axis of the diagram refers to the node-index (intensity and diversity of the transport supply) and represents the "potential for physical human interaction", while the x-axis corresponds to the place-index (intensity and diversity of activities) and shows the "degree of actual realisation of the potential for physical human interaction" (Bertolini, 1999). This model enables to determine the balance between transport and land uses, making future management and decision-making easier.

NODUS/CIVITAS/URBS MODEL (N/C/U)

The NCU model of Moreno (Moreno, 2013) is also used in order to study the transport and land use aspects of each node area (see chapter 2.3.2). In this approach, the morphological features that promote interaction in the area are separately included. Hence, a triaxial diagram is created, where the first axis refers to the node value, the second represents the urbs value and the third corresponds to the civitas value (fig. 6.1). As above, the balance between the different variables can be easily studied.

MULTIAXIAL MODEL

Although the previous two models are interesting because they

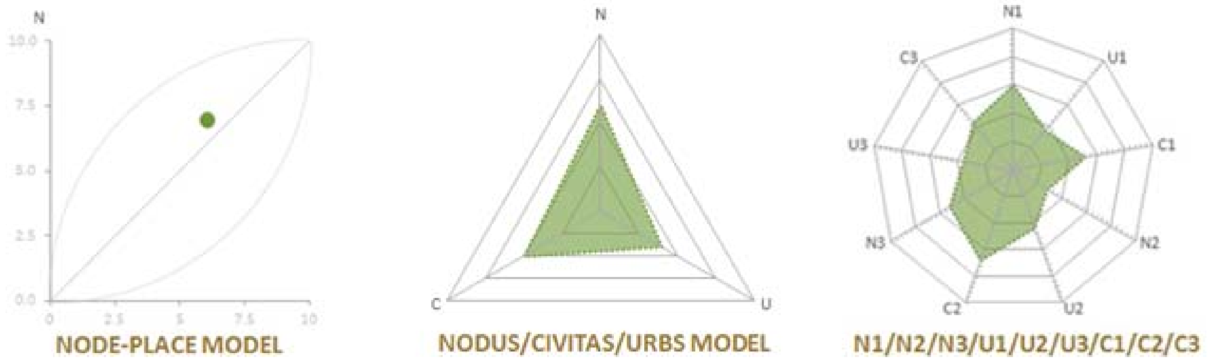


Figure 6.1 Node/place model (left), nodus/civitas/urbs model (middle) and multiaxial model (right)

are able to measure the balance between different variables, they are not able to represent the existing reality, especially in territories where the DRS runs through urban and rural areas.

For that purpose, a multiaxial model is proposed, which represents several criteria that are related to few variables. In this regard, the previous three main variables (node, urbs and civitas) are used, but urban and rural criteria are distinguished. Criterion 1 refers to the urban approach of the node area, while criterion 3 corresponds to rural issues. Otherwise, criterion 2 includes the indicators that can be related to either urban or rural areas. Therefore, a nine axes diagram is created from the combination of the three main variables and the three criteria (fig. 6.1). Hence, the analysis of disused railway lines taking into consideration both urban and rural features is possible within the framework of their node and place approach assessment. Furthermore, the resulting polygons of the diagram are classified in different development typologies in a similar way to the Stedenbaan model (Atelier Zuidvleugel, 2007; Balz & Schrijnen, 2009) (see chapter 2.3.2).

This model enables the illustration of the features that must be changed to encourage a particular development, in addition to represent the potential of each defined node area taking into account their node and place value (Balz & Schrijnen, 2009).

It should be finally added that all the compiled data are scaled in order to obtain values between 0 and 10 in the three diagrams. The value “10” indicates a defined node area that has the highest score in all indicators, while the value “0” corresponds to the lowest score in all indicators.

6.1.2. Identification of future possible new nodes

Two different approaches are proposed for the identification of possible new nodes. On the one hand, transports and land uses around the DRS are taken into account at territorial level. On the other hand, the accessibility analysis of the areas around the line (AL2) is checked in order to identify the areas with better accessibility levels than their surrounding environments.

6.1.3. Definition of nodes and their catchment areas

The consideration of the former railway nodes and possible new territorial or accessibility nodes are proposed for the identification of the nodes themselves and the limitation of their influence or catchment areas in the surrounding territory. For that purpose, the creation of different catchment areas related to different transport modes are proposed at urban level. In this regard, the accessibility analysis referred to the urban approach (AL3) is used for their configuration.

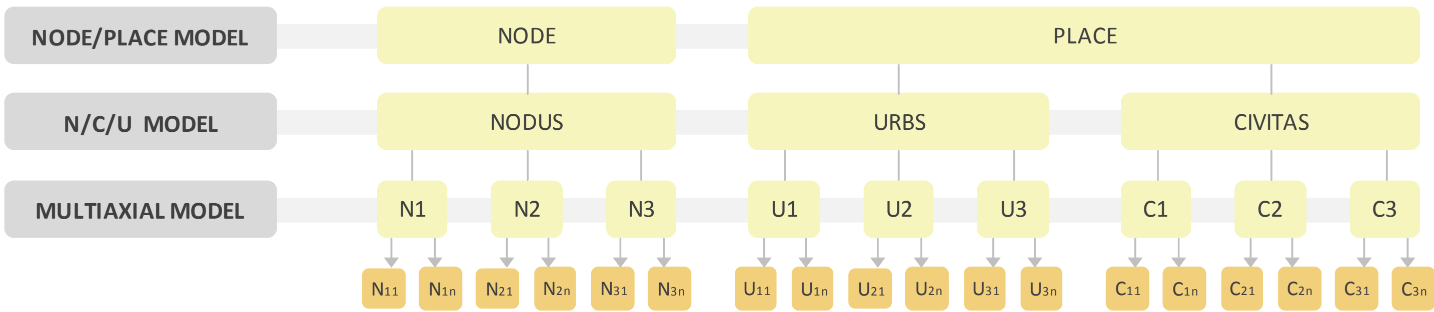


Figure 6.2 Structuration of the three models. Variables in yellow and indicators in orange

6.1.4. Definition of variables and indicators

The proposed variables correspond to the presented three models. Meanwhile, indicators are defined taking into account previous authors´ criteria (see annex 4.1) and both urban and rural approaches of the DRS (table 6.1). Hence, urban or rural activities and their mixture are measured in C1 and C3, while elements or areas of special interest are measured in C2. Urban and rural morphology is also measured based on the different land uses and their densities in U1 and U3, and population is measured in U2. Finally, rail, bus and tram accessibility are measured as public transports in N1, car accessibility in N2 and non-motorised transports in N3.

6.1.5. Analysis of nodes. Multi-criteria Decision Analysis

The complex problem is structured using the same variables and indicators in the three models (fig. 6.2). In this regard, Multi-criteria Decision Analysis (MCDA) is used in order to address the problem. Firstly, all the criteria are structured and weighted using the Analytic Hierarchy Process (AHP). Having done this, scores of each variable are measured for each model and first results are obtained. Finally, sensitivity analysis is used to determine the variability of the parameters and assess the suitability of previously established weights. If they are suitable, final results are obtained and the diagrams related to each model are created, if not, AHP is reviewed and edited.

ANALYTIC HIERARCHY PROCESS (AHP)

AHP, originally developed by Saaty (1980), is selected as the multi-criteria decision analysis method. Hence, the problem is decomposed and structured in several criteria and sub-criteria. To begin with, their relative importance is evaluated by means

VARIABLES AND INDICATORS OF THE MODELS

VARIABLES			INDICATORS	
NODE	NODUS	N1	N_{11}	Nº of rail stops
			N_{12}	Nº of rail directions serverd
			N_{13}	Nº of bus stops
			N_{14}	Nº of bus directions served
			N_{15}	Nº of tram stops
			N_{16}	Nº of tram directions served
		N2	N_{21}	Distance from the closest motorway access
			N_{22}	Distance from the closest secondary road
			N_{23}	Parking capacity
		N3	N_{31}	Cycling path lenth
			N_{32}	Pilgrimage routes in the area
			N_{33}	GR routes in the area
PLACE	URBS	U1	U_{11}	Distance to the town centre
			U_{12}	Housing density
			U_{13}	Urban land-uses
		U1	U_{21}	Nº of residents in the area
		U2	U_{31}	Forest cover
			U_{32}	Agricultural land-uses
	CIVITAS	C1	C_{11}	Nº of wokers in industry
			C_{12}	Nº of wokers in services
			C_{13}	Nº of student in education
			C_{14}	Open areas
			C_{15}	Degree of multifunctionality
		C2	C_{21}	Elements of interest
			C_{22}	Heritage elements
		C3	C_{31}	Protected natural areas
			C_{32}	Linking corridors
			C_{33}	Agricultural land
			C_{34}	Degree of multifunctionality

Table 6.1 Variables and indicators of the different models

of a pair wise comparison and priorities between them are established. Then, the comparison matrix is normalised and average weights are obtained. To conclude, a consistency analysis is used to check whether the initial rating is consistent. For that purpose, consistency measure, consistency index and consistency ratio are calculated.

MULTI-CRITERIA DECISION ANALYSIS (MCDA)

Values referred to each indicator of each defined node area are measured after having compiled the necessary data. Total values are rescaled in order to obtain scores between 0 and 1 (node areas with the highest values in each of the indicators are assigned with a 1 score, while the ones with lowest values with a 0). Furthermore, some of the indicators are previously log-transformed with the aim of reducing the disparity in their original values. Afterwards, previous weights are used to obtain the results for each variable and model. Hence, on the one hand, the three diagrams are created in order to show the potential of each defined node area and their level of balance between the different variables. On the other hand, a ranking of the different node areas is created according to their total node/place values or specific variable values.

SENSITIVITY ANALYSIS

To sum up, the variability of each weight should be determined and their suitability should be assessed, since a single decision-maker is used for the initial evaluation of the criteria. A sensitivity analysis is proposed for that target, where the influence of each weight on the output model is evaluated.

6.1.6. Comparison and classification of node areas

Different node areas are compared in a single diagram based on the node/place model. However, this stage does not contribute any further information in the NCU and multiaxial models, so the different node areas should be compared by zones. The zones concluded in the accessibility analysis of the cores (AL1) and the classification according to the relation between node areas and urban areas (AL3) are appropriate for this purpose. In this regard, the first two models provide suitable information for the general comprehension of the node areas. Meanwhile, the third model provides a suitable characterisation of each node and zone. However, the use of several variables makes difficult the comparison between them. Accordingly, PCA and k-means clustering are proposed to overcome this shortcoming and to compare and classify the different node areas.

PRINCIPAL COMPONENT ANALYSIS (PCA)

New components that combine different variables are created in this analysis and, hence, data are projected on them. The PCA is parameterised using Pearson correlation with a significance level at 95% applied at the initial matrix. Principal components, their coordinates and the contribution of each variable to them are obtained for each node area.

K-MEANS

Afterwards, defined node areas are grouped using k-means clustering, where each node area belongs to the group with the nearest mean. The k-mean classification is employed with 500 iterations and a convergence value of 0.00001. Data are tested with the coordinates of both initial variables and component axes obtained from the PCA.

6.2. Development and results of the nodes along the DRS

The proposed methodology has been applied to the Vasco-Navarro Railway. In this regard, the analysis of each station area in relation to its surrounding territory has been analysed taking into consideration transport and land uses.

6.2.1. Identification of future possible new nodes

The proposed two approaches have been taken into account for that purpose: transport and land uses and accessibility analysis.

CONSIDERATION OF TRANSPORTS AND LAND USES

A 2.5 kilometre buffer around the DRS has been defined and studied taking into account the different transport systems that perform at a territorial level and the natural or built areas that have the same scale (fig. 6.3).

The same zones that have been concluded in the accessibility

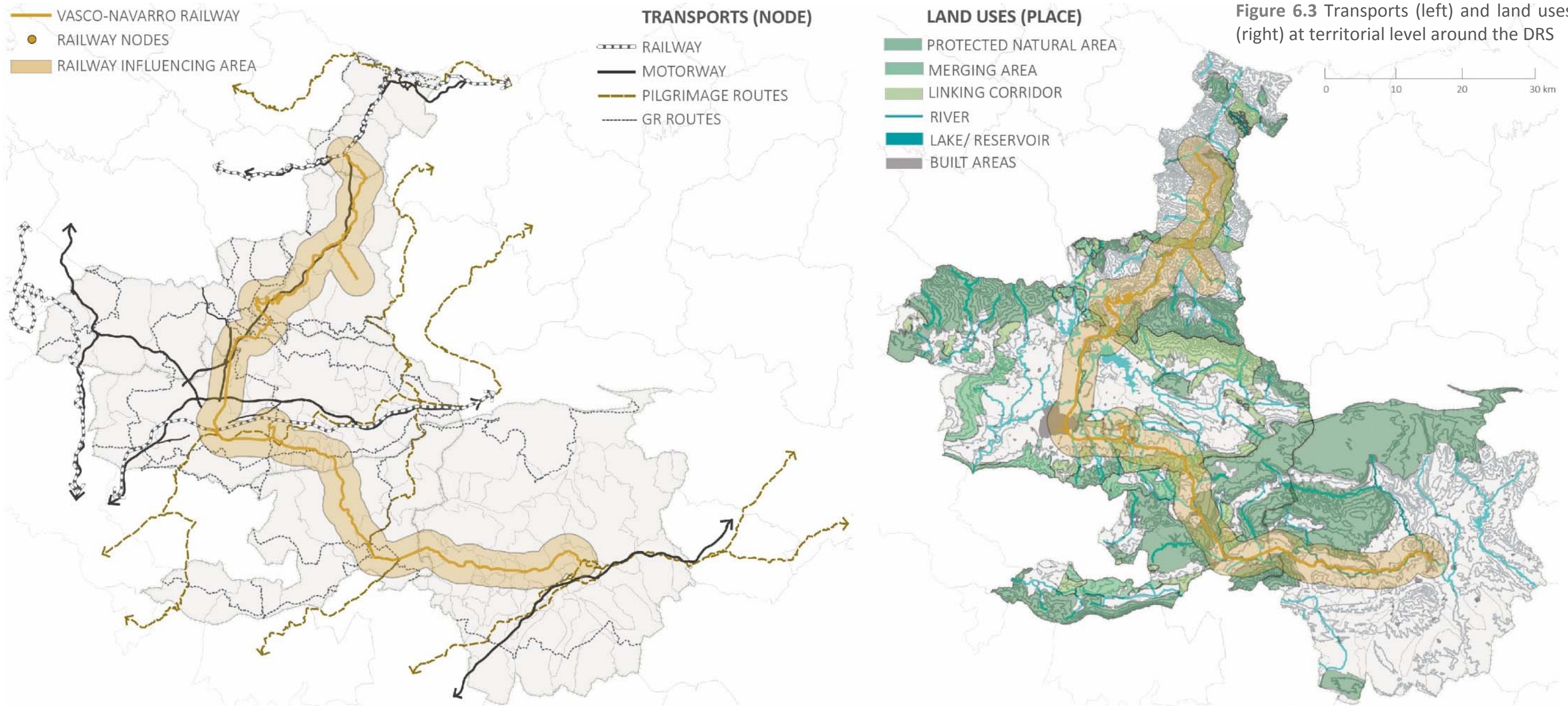


Figure 6.3 Transports (left) and land uses (right) at territorial level around the DRS

analysis (AL1) are used for the study of territorial elements and subsequent identification of possible new nodes: northern towns (zone 1: Maltzaga-Castañares), the mountain pass of Arlaban (zone 2: Mazmela-Landa), the area influenced by Vitoria-Gasteiz (zone 3: Legutio-Erentxun), small towns (zone 4: Gauna-Granada) and the area influenced by Lizarra (zone 5: Antzin-Lizarra).

In the northern section, the DRS goes mainly through a narrow valley, so the main road infrastructures has the same axis of the DRS. However, existing railways and main road infrastructures are generally located at the two ends of the line and the main city of Vitoria-Gasteiz. Otherwise, pilgrimage and long-distance footpaths (GR routes) are mainly located in the southern section, crossing it at several points as it goes.

Furthermore, although natural areas are spread all over the territory, they are mainly located in mountain areas, where main infrastructures do not exist; such as in zone 2 or zone 4.

All the elements identified in the different zones have been illustrated in fig. 6.4 and described below.

ZONE 1

All urban activities and infrastructures are concentrated in the bottom of the valley, where the DRS goes through. The river goes along the same axis as well, but protected natural areas are located in highlands and out of the influence area.

One of the main features of zone 1 is that all the territorial transport infrastructures are related to motorised transports. The motorway (AP1) runs parallel to the disused infrastructure and several motorway-accesses can be easily found along the axis. Moreover, the Bilbao-Donostia Railway and another motorway (AP8) have a connection in the northern end of the DRS, linking the whole axis with other important territorial axis that connects two provinces and their capital cities.

Another characteristic is related to the high degree of urbanisation of the area and the lack of protected natural areas along the axis. Nevertheless, a linking corridor (R9-R10) that connects the protected natural areas of Izarraitz, Aizkorri-Aratz and Urkiola is located in the influence buffer of the DRS. Furthermore, two merging areas that are part of the protected natural system are also identified (Udalaitz and Karakate-Irukurutzeta-Agerre Buru). All these natural elements have a regional character, except Aizkorri-Aratz. The latter has a supraregional character, since it is the most important natural park of the area.

ZONE 2

In zone 2, the DRS runs through the mountain pass between Gipuzkoa and Araba/Álava. That is why, although the motorway (AP1) follows the same axis, there are only two accesses to it. Otherwise, several GR routes are concentrated in the area: GR12, Euskal Herria Path; GR25, Araba/Álava Plain Tour; GR38, the Wine and Fish Route; GR121, Gipuzkoa Tour; and GR282, Sheep Drovers’ Road.

Accordingly, the protected natural area of Aizkorri-Aratz and a linking corridor (S1), which joins this area with the protected area of Gorbeia in a supraregional level, are sited close to the DRS. Moreover, there is another county linking corridor (C20) that connects the previous corridor with the wetlands of Salburua in Vitoria-Gasteiz, in addition to several merging areas (forest of Motxotegi, Albina and Albertia Mountain) that complete the protected natural system of the area.

Finally, in addition to the source of the Deba River, several reservoirs are located in the area: Urkulu reservoir in the north and Uribarri-Ganboa and Urrunaga reservoirs in the south.

ZONE 3

Zone 3 is focused in the main city Vitoria-Gasteiz and the small towns along the line that have its direct influence. Main road infrastructures converge in the city, such as two motorways (AP1 and A1), and the Railroad of the North has one of its main stations there. The latter connects Madrid with the border between Spain and France. While AP1 runs parallel to the DRS in the north of the city, A1 follows the existing railway axis to the east, moving away from the DRS.

Going east from the main city, pilgrimage and GR routes are identified rather than high-speed infrastructures. On the one hand, the Way of St. James overlaps with the DRS route at several sections or points and creates a connection with the existing railway and motorway axis. On the other hand, GR 25 route (Araba/Álava Plain Tour) runs through the south and coincides with the disused route between Uribarri-Jauregi and Gauna, while GR 38 (The Wine and Fish Route) crosses the area from north to south linking Gipuzkoa with Estibaliz and Andollu, then continuing south.

The protected area of Salburua (county level) is located in Vitoria-Gasteiz, within the area of the DRS. It is connected with the High Mountains of Araba/Álava, which has a supraregional character, by means of a county linking corridor (C1-C2) located also in the studied area. Furthermore, the protected area of Oak Groves of the Lowland and an extreme of the High Mountains of Araba/Álava are situated in the area, in addition to the linking corridor (C3-C13) that connects them. There are other two supraregional linking corridors that link the High Mountains with more distant protected areas, such as Valderejo in the west (S5) and Entzia in the east (S7).

ZONE 4

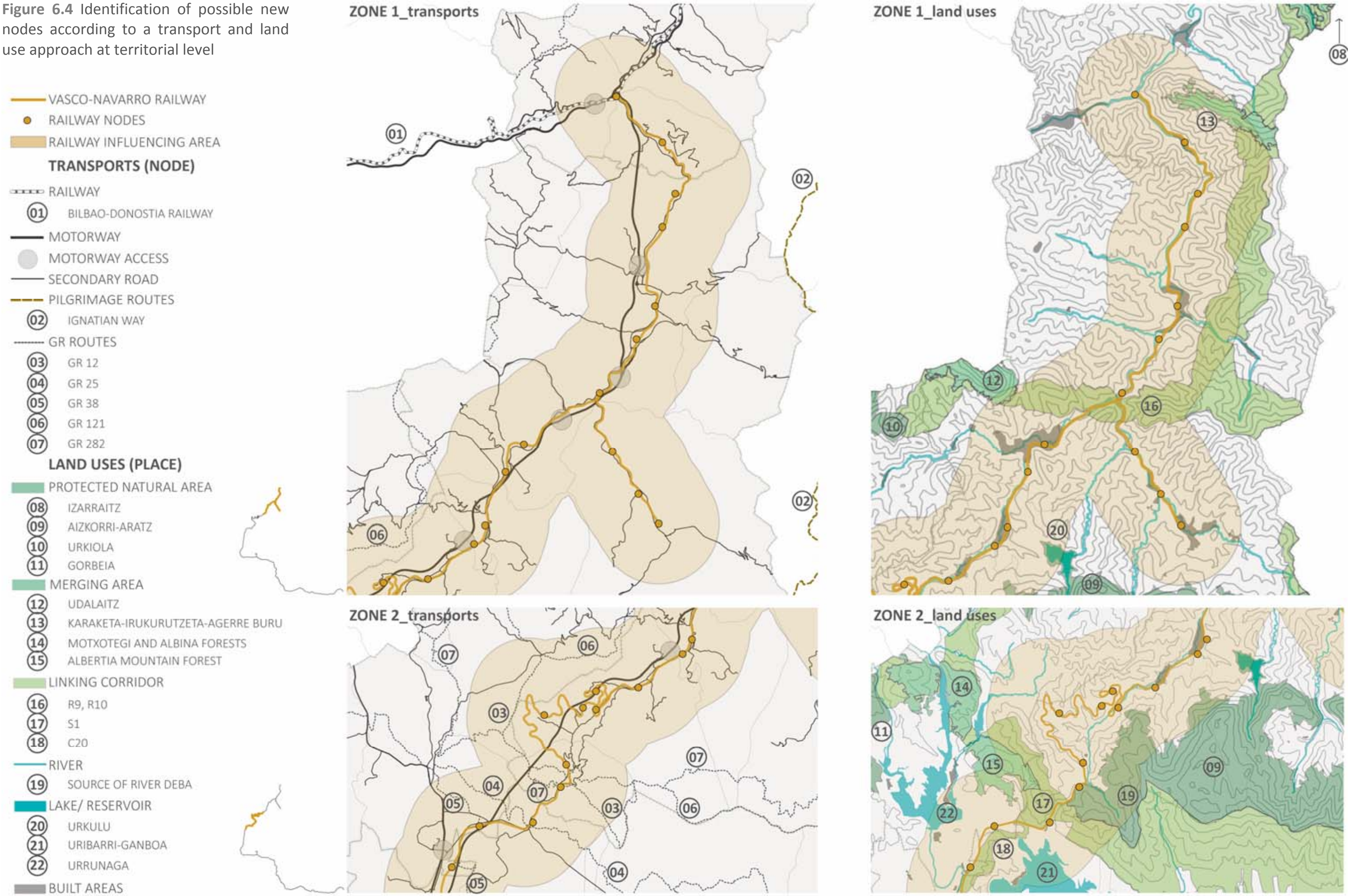
There is not any motorway in zone 4 and even any secondary road in some of its sections. Otherwise, there are walking routes that complete the transport approach of the area. The Ignatian Way crosses the area in Antoñana and Kanpezu from north to south, where two GR routes also have their meeting point. GR1 (the Historic Trail), which crosses the Peninsula from East to West, runs through the south of the area and deviates its direction in other to reach Kanpezu and Antoñana, while GR 282 (Sheep Drovers' Road) joins the previous routes in Antoñana. Finally, GR 25 (Araba/Álava Plain Tour) goes through the north of the area coinciding with the DRS route between Uribarri-Jauregi and Gauna.

Located in a mountain area, the DRS is surrounded by several supraregional protected areas, such as Entzia and Izki in the area of Maeztu and Antoñana, and the Mountain Range of Kodes and Lokiz between Gipuzkoa and Navarre. In addition, there are several merging areas (Eastern Mountains of Vitoria-Gasteiz, Hornillo Mountain and Kermes Oak Area of Arta) and linking corridors (S7, S8, S11 and S13) located in the influencing area that complete the dense natural network.

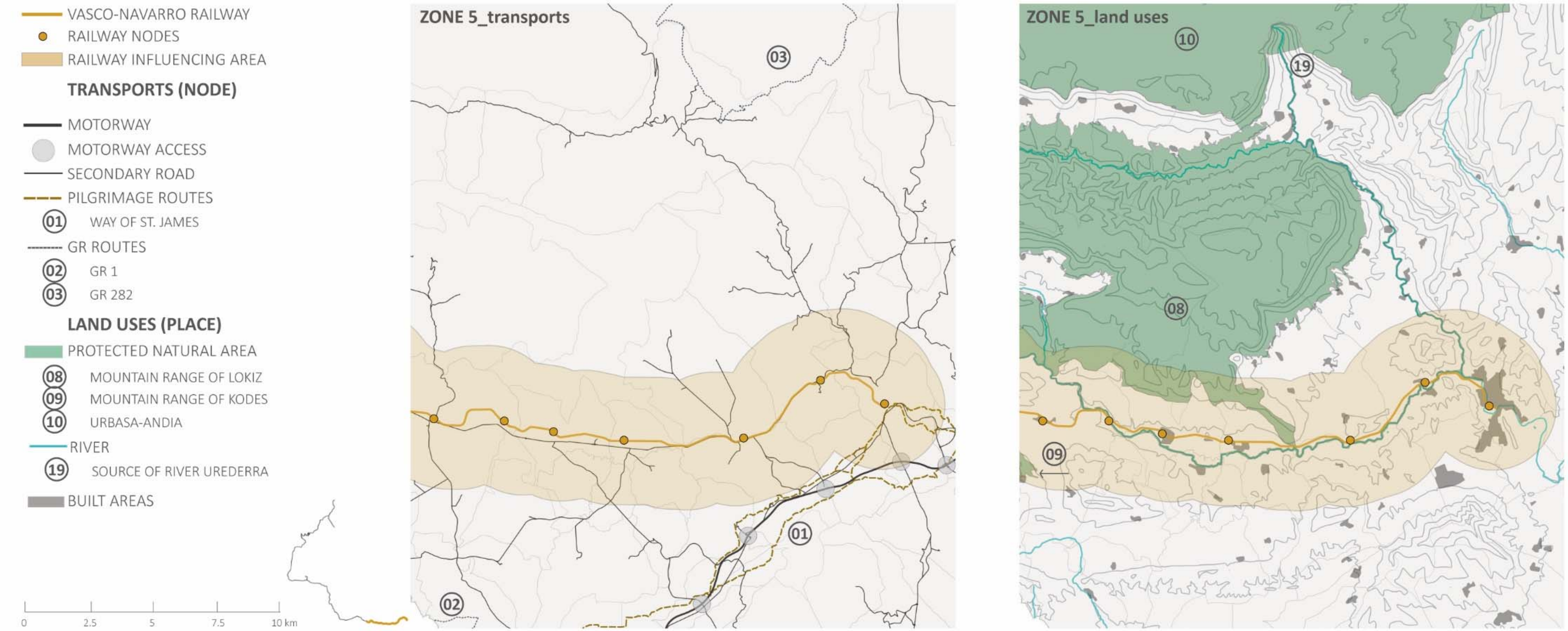
ZONE 5

Finally, zone 5 is entirely situated in Navarre and comprises the DRS area influenced by Lizarra. The DRS axis follows the Ega River and a secondary road, but main infrastructures, such as the motorway (A12) or the Way of St. James, indicate which the main axis of the area is, connecting Iruñea and Logroño through Lizarra. It is also close to Lizarra where the Urederra River, which has its source in the protected natural area of Urbasa, joins the Ega River. Although Urbasa is located quite far from

Figure 6.4 Identification of possible new nodes according to a transport and land use approach at territorial level




ZONE 3_transports
ZONE 3_land uses
ZONE 4_transports
ZONE 4_land uses
VASCO-NAVARRO RAILWAY
RAILWAY NODES
RAILWAY INFLUENCING AREA
TRANSPORTS (NODE)
RAILWAY
01 THE RAILROAD OF THE NORTH
MOTORWAY
MOTORWAY ACCESS
SECONDARY ROAD
PILGRIMAGE ROUTES
02 WAY OF ST. JAMES
03 IGNATIAN WAY
GR ROUTES
04 GR 25
05 GR 38
06 GR 1
07 GR 282
LAND USES (PLACE)
PROTECTED NATURAL AREA
08 SALBURUA
09 OAK GROVES OF THE LOWLAND
10 HIGH MOUNTAINS OF ARABA/ALAVA
11 ENTZIA
12 IZKI
13 MOUNTAIN RANGE OF KODES
14 MOUNTAIN RANGE OF LOKIZ
MERGING AREA
15 WESTERN MOUNTAINS OF VITORIA-GASTEIZ
16 EASTERN MOUNTAINS OF VITORIA-GASTEIZ
17 HORNILLO MOUNTAIN
18 KERMES OAK AREA OF ARTA
LINKING CORRIDOR
19 C1, C2
20 S5
21 C3-C13
22 S7
23 S8
24 S11
25 S13
RIVER
LAKE/ RESERVOIR
BUILT AREAS



the influence area of the DRS, the Mountain Range of Lokiz is situated just north and even has a connecting point with the disused line.

After having defined the elements involved in the 2.5 km buffer of the DRS, the areas or points that are interesting to consider as nodes are identified. Some of them are already former railway nodes, but others may turn out to be future possible new nodes.

Taking into consideration the transport network, the DRS area has two connecting points (Maltzaga and Vitoria-Gasteiz) with the existing railways, while one of them runs through the influence area in Estibaliz. All these areas have some former railway node, so new nodes are not identified. The same happens for the main roads, since they go parallel to the DRS in the northern section and there is a lack of them in the south (except Lizarra).

Walking routes are also considered in order to find new nodes taking into account transport infrastructures. On the one hand, pilgrimage routes coincide with the DRS in several sections, such as the Ignatian Way between Antoñana and Kanpezu or the Way of St. James in several parts between Trokoniz and Vitoria-

Gasteiz. The latter also has a connection in Lizarra. All sections or connecting points coincide with the location of several railway nodes. On the other hand, there is a concentration of GR routes between Arlaban and Urbina (5) or Antoñana (2). Antoñana is moreover connected with Kanpezu by means of a walking route of this type. Likewise, Estibaliz and Andollu are connected with a GR route and between Uribarri-Jauregi and Gauna, the route overlaps with the disused track. As in previous cases, new nodes are not detected, since there are several former railway nodes in the described areas.

Referring to the land uses, territorial natural elements are considered as the most interesting items. In the northern areas, linking corridors are the most common elements of the natural network located close to the DRS. There are linking corridors crossing the former railway line between Uribarri-Jauregi and Laminoria Tunel, Otazu and Trokoniz, Landa and Urbina and in San Prudencio. Moreover, next to the corridor between Landa and Urbina, a protected natural area reaches the disused line. Nevertheless, there are old railway nodes in (or close to) the crossing areas of all these natural elements. In the south, several protected natural areas are located in the influence area of the DRS and even really close to the line itself: two protected areas between Zekuiano and Antoñana, and other two in Arquijas. One of the latter has a connection with the disused line between Murieta and Zufia. This connecting point is the only one that does not have a railway node, although there are two nearby, in Murieta and Zufia.

Furthermore, several water surfaces have been identified in addition to rivers. On the one hand, some reservoirs are located in the DRS area, e.g. close to Aretxabaleta and the section between Landa and Urbina. All of them have former railway nodes. On the other hand, two river sources are related to the studied area. One of them is located in the mountain pass of Arlaban, so there is already a railway node in the area. In the other case, the confluence of the rivers Ega and Urederra can be an interesting point due to the significance of the Urederra source, although this tourist attraction is located far from the disused line.

In view of all the above, and although several areas have been highlighted at a territorial level, they all have former railway nodes within the area or close to it. That is why future possible new nodes are not identified for their incorporation into the subsequent analysis.

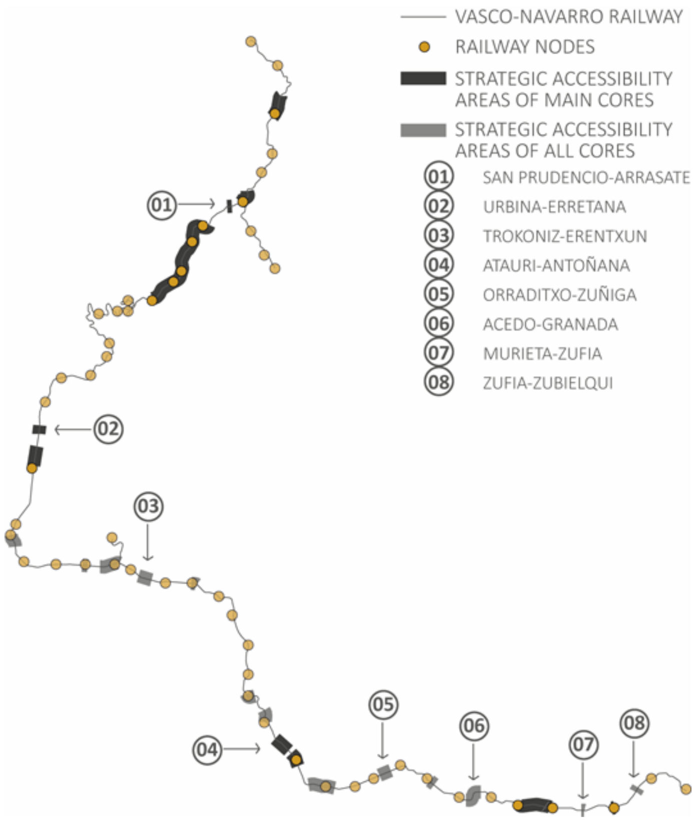
CONSIDERATION OF THE ACCESSIBILITY ANALYSIS

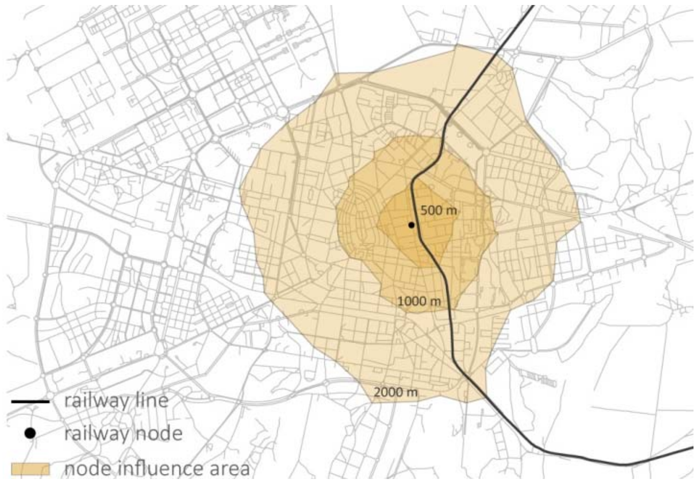
The second proposed approach for the identification of possible new nodes is based on the accessibility analysis of the areas around the disused railway infrastructure (AL2). In this regard, some of the sections can have higher accessibility levels than its surrounding segments, so these areas may contain future possible nodes that are necessary to consider. Both the analysis referred to all cores and the analysis regarding the main cities and towns are used in order to find strategic sections related to their accessibility level.

In the case of the Vasco-Navarro Railway, most of the identified segments already comprise some former railway node. Nonetheless, some sections do not have any of them (fig. 6.5): the section located between San Prudencio- Arrasate, Urbina-Erretana, Trokoniz-Erentxun, Atauri-Antoñana, Orraditxo-Zuñiga, Acedo-Granada, Murieta-Zufia and Zufia-Zubielqui. The first two have been identified in both analyses, while the others are only identified in the study referred to all cores. However, even all these segments are sited relatively close to certain

Figure 6.5 Identification of possible new nodes according to accessibility issues of the DRS (left)

Figure 6.6 Influence or catchment areas of former railway stations according to the defined non-motorised transport systems (right)





railway node, so the assumption of new possible nodes is unnecessary.

6.2.2. Definition of nodes and their catchment areas

The total number of nodes that are necessary to study is defined taking into consideration former railway nodes and future possible new nodes. Nevertheless, as discussed in the previous section, old railway nodes are only studied, since the identified possible nodes are located close to the old node areas or include some of them.

Hence, studied nodes correspond to any point or area of the DRS where a railway building was erected, even if it does not exist nowadays. That is to say, they correspond to the nodes studied in chapter 4 (55 nodes) and represent the main railway heritage elements of the DRS. The current chapter focuses on the analysis of their surrounding territory.

Furthermore, the influence area of each node has been already defined in the accessibility analysis referred to the urban approach (10 minutes travel) (AL3). Three different areas created by means of isochrones and related to different transport modes are distinguished in each node (fig. 6.6): 500 m, walking round-trips; 1000 m, walking non-round-trips, running round-trips or cycling round-trips; and 2000 m, cycling non-round-trips. Thus, they make it possible to study the different transport and land uses that are located in each influence area, or which is the same, that are reached from each node using certain means of transport.

6.2.3. Definition of indicators

Necessary data have been collected from different sources in order to define the previously proposed indicators (table 6.2). Different spatial data infrastructures, statistical institutes and governments have been mainly used for data collection. However, fieldwork and information from different private websites have resulted essential for the completion of the research.

Available data have been transformed in several cases in order to obtain the necessary data and make the information from different sources comparable. The latter have occurred because two different autonomous communities and four provinces are included in the analysed areas and most of the data are related to one of the autonomous communities.

In the node approach, three variables are distinguished according to the type of transport: motorised public transports (N1), motorised private transports (N2) and non-motorised transports (N3). The first one, measures the accessibility of different public transports taking into consideration their number of stops and directions served. The second is related to private car accessibility, which is calculated by the distance to the closest main road access and the number of parking lots of the main parking areas located in the defined node area. The

Table 6.2 Necessary data for each defined indicator and the available data, including its source

DEFINITION OF INDICATORS

VARIABLES				INDICATORS	NECESSARY DATA	AVAILABLE DATA	SOURCE
NODE	NODUS	N1	N11	Nº of rail stops	nº of rail stops	rail stops	geoeuskadi / IDENA
			N12	Nº of rail directions serverd	nº of rail directions	rail lines	geoeuskadi / IDENA
			N13	Nº of bus stops	nº of bus stops	bus stops	geoeuskadi / google maps
			N14	Nº of bus directions served	nº of bus directions	bus lines	geoeuskadi / google maps
			N15	Nº of tram stops	nº of tram stops	tram stops	geoeuskadi
			N16	Nº of tram directions served	nº of tram directions	tram lines	geoeuskadi
		N2	N21	Distance from the closest motorway access	distance to the motorway access through the road network	motorways and other road networks	geoeuskadi / IDENA / euskalgeo / IGN
			N22	Distance from the closest secondary road	distance to national and main local roads (red and orange) through the road network	national and main local roads (red and orange) and other roads	geoeuskadi / IDENA / euskalgeo / IGN
			N23	Parking capacity	number of parking lots with a minimun depending on the population: < 1000 → 8; 1000-10000 → 20; 10000-100000 → 25; > 100000 → 40	parkings areas	google earth
		N3	N31	Cycling path lenth	cycling path lenth	cycling lanes and greenways	geovitoria-gasteiz / bizikletaz/ vias verdes
			N32	Pilgrimage routes in the area	nº of pilgrimage routes (Way of St. James and Ignatian Way)	routes of the Way of St. James / Ignatian Way route	www.caminoignaciano.org/ www.rayyrosa.com
			N33	GR routes in the area	nº of GR routes	different GR routes	www.senderosgr.es/

VARIABLES				INDICATORS	NECESSARY DATA	AVAILABLE DATA	SOURCE
PLACE	URBS	U1	U_{11}	Distance to the town centre	distance to the town centre through the road network	road network	geoeuskadi / IDENA / euskalgeo / IGN
			U_{12}	Housing density	nº of dwellings per hectares	nº of dwellings (2011)	eustat / INE
			U_{13}	Urban land-uses	% of non-undeveloped area	undeveloped land areas	geoeuskadi / land registry (N)
		U1	U_{21}	Nº of residents in the area	nº of residents	population (2011)	eustat / IEN / INE
		U2	U_{31}	Forest cover	% of forest area	forest areas	geoeuskadi / IDENA
			U_{32}	Agricultural land-uses	% of agricultural land in non-forest areas	agricultural land areas	geoeuskadi / IDENA
	CIVITAS	C1	C_{11}	Nº of wokers in industry	nº of workers in the secondary sector companies located in the area	nº of companies depending on the nº of workers (2015/2016)	eustat / IEN
			C_{12}	Nº of wokers in services	nº of workers in the tertiary sector companies located in the area	nº of companies depending on the nº of workers (2015/2016)	eustat / IEN
			C_{13}	Nº of student in education	nº of students in the educational centres located in the area	nº of students per munipality (2016) / nº of students per centre (2016)	Dept. of Education (BC) (N)
			C_{14}	Open areas	surface (ha) of open and green areas	open and green areas	geoeuskadi / IDENA / master plans (N)
			C_{15}	Degree of multifunctionality	C_{11}, C_{12}, C_{13} and U_{23}	Herfindahl-Hirschman Index	literature review
		C2	C_{21}	Elements of interest	nº of elements of interest (recreational and sport areas, natural elements of interest and built elements of interest)	elements of interest	fieldwork / google maps
			C_{22}	Heritage elements	nº of heritage elements (regional protection: listed and inventoried elements)	heritage elements	Dept. of Education (BC) / IDENA
		C3	C_{31}	Protected natural areas	nº of protected natural area	protected natural areas	geoeuskadi / IDENA
			C_{32}	Linking corridors	nº of linking corridors (including protected rivers)	natural areas	geoeuskadi / IDENA
			C_{33}	Agricultural land	% of agricultural land	agricultural land areas	geoeuskadi / IDENA
			C_{34}	Degree of multifunctionality	C_{31}, C_{32} and C_{33}	-	-

geoeuskadi:	Spatial Data Infrastructure of the Basque Country (www.geo.euskadi.eus/s69-15375/eu)
euskalgeo:	Spatial Data Infrastructure of the Basque Country and Navarre (www.euskalgeo.net/eu)
IDENA:	Spatial Data Infrastructure of the Navarre (www.idena.navarra.es/Portal/Inicio)
Dept. of Education (N):	Navarre Department of Education
Dept of Education (BC):	Department of Education, Language Policy and Culture of the Basque Government
master plans (N):	master plans of the municipalities of Navarre
geovitoria-gasteiz:	mapping application of Vitoria-Gasteiz (www.vitoria-gasteiz.org/buscaturuta)
bizikletaz:	Department of Mobility and Road Infrastructure of the Regional council of Gipuzkoa (www.gipuzkoabizikletaz.eus/eu)
vias verdes:	Spanish greenway programme of the Association of Spanish Railways (FFE) (www.viasverdes.com/)
IGN:	National Geographic Institute (Spain)
Eustat:	Basque Statistics Institute
IEN:	Statistical Institute of Navarre
INE:	National Statistical Institute (Spain)
land registry (N):	land registry of Navarre
google earth:	(http://earth.google.es/)
google maps:	(www.google.es/maps)
www.caminoignaciano.org:	
www.rayyrosa.com:	
www.senderosgr.es:	

inverse of the distances are used in order to assign higher values to closest elements. Finally, non-motorised transport infrastructures are studied in the third variable, measuring the length of cycling lanes and greenways, and the number of territorial walking routes located in the area, such as pilgrimage and GR routes.

Meanwhile, the place approach is comprised by indicators related to the morphology features of the area (Urbs) and indicators referred to the activity that can take place there (Civitas). The urbs approach takes into consideration the percentage of a specific type of land use in the area and the density of the main elements located in it. Accordingly, agricultural land uses and forest density are considered for the rural variable (U3), while urban land uses and housing density are measured for the urban variable (U1). The latter also includes the inverse value of the distance from the node to the town centre. Conversely, the number of residents of the defined node area is considered for the general approach of morphology issues (U2).

Lastly, different activities located in the area and their mixture are considered both in urban and rural areas. The number of workers or students of the companies or education centres of the area and the surface of the open areas that can support different activities are considered in the urban variable (C1). Meanwhile, the areas that can support tourism, leisure or agricultural activities are considered in the rural variable (C3). Furthermore, the degree of multifunctionality of those two approaches has been assessed, but using different ways. In urban areas, the Herfindahl-Hirschman Index (HHI) has been used (eq. 6.1).

$$\mathrm{HHI} = \sum_{j=1}^{n} \mathrm{P}_j^2 \qquad \textbf{(6.1)}$$

where $\mathrm{P_j}$ is the percentage of each land use type j in the area and n is the number of land use types j. If there is only one type of land use, HHI equals 1, while if all types are uniformly presented, HHI equals 1/n. Hence, the higher values of HHI are related to less multifunctionality or land use mixture. Unlike the formula presented in the node/place model (see chapter 2.3.3), this integral estimation measure does not result in invalid parameter values when one of the activities is missed. On the contrary, a simple classification has been created in rural areas: if none or only one of the three parameters exists, the degree of multifunctionality is considered 0; if two of them exist, 0.5; and if all of them exist, 1. In the case of the agricultural land surfaces, values > 20 % are considered for the existence of this parameter. Finally, the general approach of civitas (C2) comprises the number of heritage constructions with regional protection and other elements of interest sited in the defined node area.

6.2.4. Analysis of nodes. Multi-criteria Decision Analysis

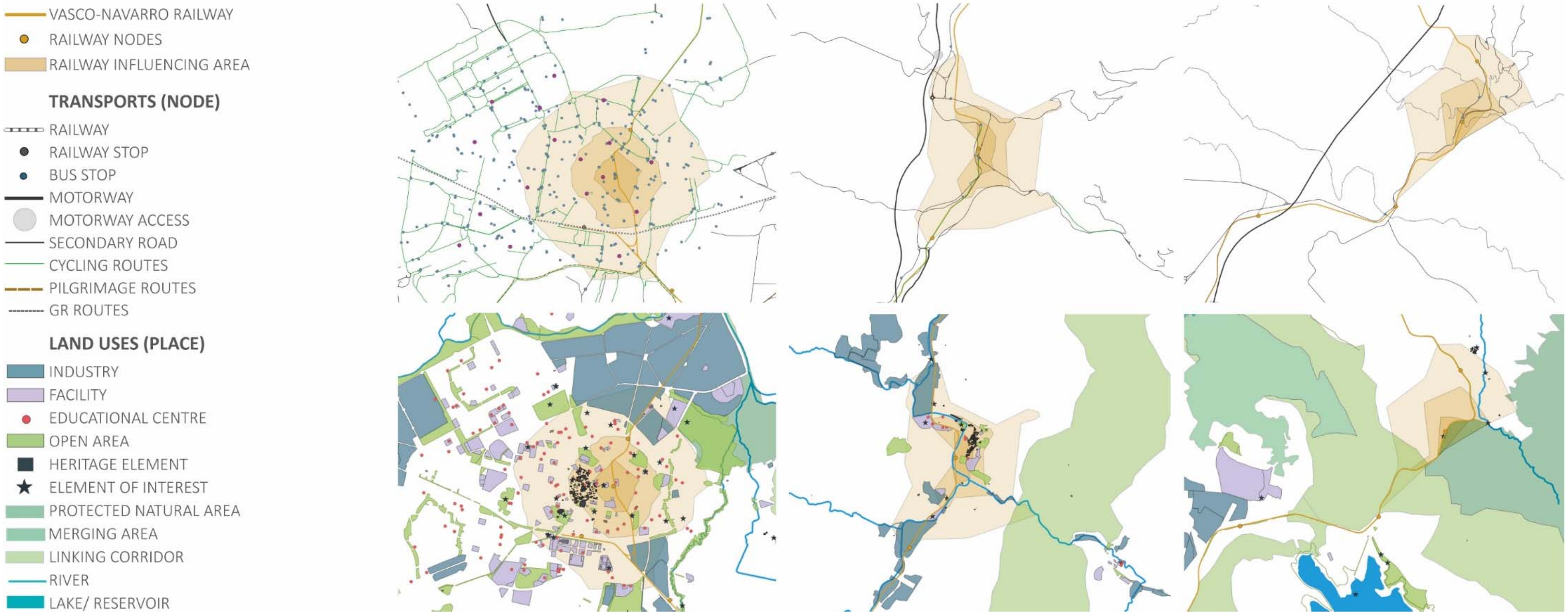
Before the MCDA, data related to each indicator have been compiled and values of each defined node area have been obtained. For that purpose, parameters related to both transport and land uses are analysed. Fig. 6.7 shows graphically three different defined node areas and some of the indicators that have been measured in order to comprehend the condition of each presented node area.

The images on the left refer to the main city (Vitoria-Gasteiz), where more infrastructures and activities are located, though they mainly correspond to urban indicators. This node area differs from the others in that it includes urban transports (city buses and trams) and an extensive network of bicycle lanes. Moreover, the Way of St. James also runs through the south of the city. Although it includes the highest service and industry rates regarding the land uses, it also includes natural and protected areas at a lower scale. Meanwhile, the central images correspond to one of the northern towns (Bergara), where the motorway and motorised transports are closely related to the area, lowland areas are highly urbanised and protected natural areas are not located close to the node areas (although there is a linking corridor). Finally, a node (Arlaban) located in a mountain port is represented on the right. It is only related to a secondary road, but in turn, several walking routes are placed in the area. Likewise, there are not almost any urban activities in the area, but there are protected natural elements of certain importance.

At first glance, results can vary considerably from one node area to another, since the former railway nodes are located in diverse territories. At a second glance, however, urban and rural approaches can complement each other, obtaining similar results in some of the cases. Hence, the use of the three different models in the analysis enables to measure the balance between different factors (node/place and nodus/urbs/civitas), but to define the urban or rural character of the area.

Using the collected data, and as a next step, total values regarding the defined node areas have been measured for each indicator (annex 4.2.1). Although most of the values correspond to real data, some of them are percentages of real data or are

Figure 6.7 Transport and land use approach of three defined node areas: Vitoria-Gasteiz (left), Bergara (middle) and Arlaban (right)



grouped in order to obtain comparable results. For example in Navarre, population, housing, industry and service values are measured as percentages of municipal values in some of the cases, since different urban or rural cores are part of the same municipality. Similarly, in the case of the data related to the number of workers and students, companies and centres have been grouped according to the range of workers or students.

Then those total values have been rescaled between 0 and 1 (table 6.3 and annex 4.2.1), where log-transformation has been used to reduce the disparity of some of them. The number of parking lots, inhabitants, workers and students have been log-transformed in the Vasco-Navarro Railway case.

Once that the rescaled values of each node area have been obtained, MCDA has been developed following the previously proposed three steps: definition of weights, multi-criteria analysis and sensitivity analysis.

ANALYTIC HIERARCHY PROCESS (AHP)

AHP has been used in order to decompose the problem and define the different weights for each criterion. A pair wise comparison matrix has been created for each of the nine variables and priorities between the different indicators have been determined (table 6.4 and annex 4.2.2). Afterwards, matrices have been normalised, obtaining the average weights that are necessary for the MCDA. In this regard, a consistency analysis has been used to verify the consistency of the initial rating (table 6.4 and annex 4.2.2). To that end, the Consistency Index (CI) has been calculated using the equation (eq. 6.2) proposed by Saaty (1980).

$$CI = \frac{\lambda max - n}{n-1} \quad (6.2)$$

where λmax is the largest eigenvalue and n is the order of

Table 6.3 Rescaled indicator values of 2000 m node areas, which refer to cycling non-round-trips

			N1						N2			N3		
			Rail		Bus		Tram		Car			Cycle	Walk (interurban)	
ZONE	URB. AREA	NODE	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}
	-	MALTZAGA	1.00	0.67	0.01	0.12	0.00	0.00	0.72	0.10	0.59	0.08	0.00	0.00
	2	SORALUZE	0.00	0.00	0.04	0.12	0.00	0.00	0.21	0.01	0.65	0.06	0.00	0.00
	-	LOS MARTIRES	0.00	0.00	0.03	0.12	0.00	0.00	0.23	0.08	0.60	0.18	0.00	0.00
	-	MEKOALDE	0.00	0.00	0.04	0.12	0.00	0.00	0.36	0.07	0.63	0.11	0.00	0.00
	2	BERGARA	0.00	0.00	0.04	0.16	0.00	0.00	0.58	0.05	0.83	0.11	0.00	0.00
	-	ALTOS HORNOS	0.00	0.00	0.03	0.14	0.00	0.00	1.00	0.04	0.72	0.14	0.00	0.00
	-	SAN PRUDENCIO	0.00	0.00	0.04	0.21	0.00	0.00	0.58	0.04	0.48	0.24	0.00	0.00
	-	ZUBILLAGA	0.00	0.00	0.06	0.12	0.00	0.00	0.21	0.00	0.67	0.16	0.00	0.00
1	-	SAN PEDRO	0.00	0.00	0.05	0.14	0.00	0.00	0.14	0.00	0.72	0.19	0.00	0.00
	2	OÑATI	0.00	0.00	0.05	0.14	0.00	0.00	0.12	0.00	0.76	0.18	0.00	0.00
	2	ARRASATE	0.00	0.00	0.34	0.07	0.00	0.00	0.37	0.02	0.83	0.24	0.00	0.00
	-	ULGOR	0.00	0.00	0.21	0.26	0.00	0.00	0.23	0.02	0.77	0.23	0.00	0.00
	2	ARETXABALETA	0.00	0.00	0.05	0.16	0.00	0.00	0.33	0.05	0.78	0.19	0.00	0.00
	-	LANDETA-MAR.	0.00	0.00	0.07	0.16	0.00	0.00	0.54	1.00	0.80	0.19	0.00	0.00
	2	ESKORIATZA	0.00	0.00	0.04	0.16	0.00	0.00	0.42	0.03	0.69	0.15	0.00	0.00
	-	CASTAÑARES	0.00	0.00	0.02	0.05	0.00	0.00	0.21	0.00	0.46	0.04	0.00	0.00

	U1			U2	U3		C1					C2		C3			
	Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
NODE	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
MALTZAGA	0.05	0.01	0.16	0.60	0.56	0.00	0.71	0.71	0.58	0.03	0.97	0.02	0.00	0.00	0.00	0.00	0.00
SORALUZE	1.00	0.05	0.16	0.70	0.46	0.00	0.75	0.58	0.61	0.01	0.99	0.01	0.38	0.00	0.00	0.00	0.00
LOS MARTIRES	0.01	0.00	0.06	0.52	0.71	0.00	0.62	0.35	0.00	0.00	1.00	0.00	0.12	0.00	0.00	0.00	0.00
MEKOALDE	0.02	0.00	0.11	0.46	0.54	0.04	0.72	0.41	0.00	0.00	1.00	0.00	0.12	0.00	0.00	0.02	0.00
BERGARA	1.00	0.10	0.37	0.80	0.30	0.01	0.87	0.74	0.78	0.14	0.86	0.91	0.19	0.00	1.00	0.01	0.00
ALTOS HORNOS	0.03	0.03	0.31	0.70	0.39	0.01	0.80	0.54	0.67	0.01	0.99	0.03	0.08	0.00	0.00	0.01	0.00
SAN PRUDENCIO	0.01	0.00	0.10	0.34	0.64	0.00	0.71	0.36	0.00	0.00	1.00	0.00	0.08	0.00	1.00	0.00	0.00
ZUBILLAGA	0.00	0.00	0.14	0.48	0.44	0.01	0.86	0.47	0.00	0.00	1.00	0.00	0.04	0.00	1.00	0.01	0.00
SAN PEDRO	0.05	0.02	0.20	0.69	0.28	0.01	0.92	0.67	0.64	0.09	0.91	0.73	0.19	0.00	0.00	0.01	0.00
OÑATI	1.00	0.06	0.29	0.78	0.19	0.00	0.89	0.71	0.75	0.26	0.74	0.83	0.27	0.00	0.00	0.00	0.00
ARRASATE	1.00	0.16	0.51	0.84	0.35	0.02	0.90	0.82	0.81	0.28	0.72	0.26	0.23	0.00	0.00	0.02	0.00
ULGOR	0.13	0.14	0.45	0.81	0.40	0.00	0.86	0.81	0.77	0.14	0.86	0.27	0.19	0.00	0.00	0.00	0.00
ARETXABALETA	1.00	0.04	0.26	0.74	0.37	0.00	0.89	0.67	0.70	0.16	0.84	0.02	0.23	0.00	0.00	0.00	0.00
LANDETA-MAR.	0.22	0.09	0.37	0.77	0.25	0.01	0.89	0.69	0.76	0.16	0.84	0.24	0.38	0.00	0.00	0.01	0.00
ESKORIATZA	0.22	0.03	0.19	0.69	0.48	0.03	0.73	0.58	0.64	0.02	0.98	0.23	0.19	0.00	0.00	0.02	0.00
CASTAÑARES	0.01	0.00	0.13	0.42	0.62	0.01	0.43	0.31	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00

ZONE	URB. AREA	NODE	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
2	-	**MAZMELA**	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.46	0.04	0.00	0.00	0.02	0.00	0.16	0.40	0.55	0.01	0.43	0.18	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00
	-	**ZARIMUZ**	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.08	0.35	0.68	0.00	0.00	0.21	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00
	-	**MARIN**	0.00	0.00	0.01	0.05	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.06	0.34	0.76	0.03	0.13	0.07	0.00	0.01	0.10	0.00	0.00	0.00	0.00	0.01	0.00
	4	**LEINTZ-GATZAGA**	0.00	0.00	0.04	0.07	0.00	0.00	0.12	0.01	0.54	0.02	0.00	1.00	0.07	0.00	0.03	0.46	0.65	0.00	0.27	0.29	0.00	0.06	0.20	0.15	0.15	0.50	0.00	0.00	0.00
	-	**ARLABAN**	0.00	0.00	0.04	0.07	0.00	0.00	0.10	0.33	0.52	0.09	0.00	1.00	0.02	0.00	0.03	0.37	0.74	0.00	0.13	0.22	0.00	0.07	0.22	0.01	0.12	0.50	1.00	0.00	0.50
	-	**LANDA**	0.00	0.00	0.01	0.05	0.00	0.00	0.13	0.10	0.62	0.16	0.00	0.33	0.00	0.00	0.11	0.33	0.49	0.02	0.21	0.21	0.00	0.19	0.34	0.00	0.12	0.50	1.00	0.01	0.50
3	4	**LEGUTIO**	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.17	0.00	0.33	0.00	0.00	0.29	0.22	0.30	0.07	0.49	0.07	0.00	0.04	0.29	0.00	0.08	0.00	1.00	0.05	0.00
	3	**URBINA**	0.00	0.00	0.04	0.05	0.00	0.00	0.45	0.01	0.41	0.17	0.00	0.33	0.23	0.00	0.37	0.44	0.22	0.33	0.72	0.36	0.00	0.06	0.46	0.02	0.00	0.00	1.00	0.27	0.50
	4	**ERRETANA**	0.00	0.00	0.02	0.05	0.00	0.00	0.32	0.04	0.00	0.18	0.00	0.33	0.15	0.00	0.30	0.42	0.05	0.79	0.69	0.49	0.00	0.05	0.60	0.00	0.00	0.00	1.00	0.78	0.50
	3	**DURANA**	0.00	0.00	0.03	0.09	0.00	0.00	0.41	0.02	0.50	0.16	0.00	0.00	0.18	0.00	0.26	0.51	0.06	0.74	0.38	0.53	0.70	0.08	0.54	0.00	0.00	0.00	1.00	0.73	0.50
	1	**VITORIA APEAD.**	0.00	0.00	0.77	1.00	0.67	1.00	0.33	0.01	0.97	0.85	0.00	0.00	1.00	0.52	1.00	0.98	0.00	0.00	1.00	0.98	0.96	0.79	0.51	0.99	0.92	0.50	0.00	0.00	0.00
	1	**VITORIA-CIUDAD**	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.01	1.00	1.00	1.00	0.00	1.00	0.65	1.00	1.00	0.00	0.00	0.95	1.00	1.00	0.67	0.51	1.00	1.00	0.50	0.00	0.00	0.00
	-	**OLARIZU**	1.00	1.00	0.25	0.70	0.17	0.67	0.15	0.00	0.85	0.41	1.00	0.33	0.12	0.20	0.65	0.87	0.02	0.44	0.84	0.82	0.83	1.00	0.46	0.00	0.27	0.00	0.00	0.45	0.00
	3	**OTAZU**	0.00	0.00	0.01	0.07	0.00	0.00	0.09	0.00	0.50	0.16	1.00	0.00	0.51	0.00	0.12	0.44	0.08	0.85	0.08	0.31	0.00	0.04	0.24	0.02	0.15	0.00	1.00	0.82	0.50
	3	**ABERASTURI**	0.00	0.00	0.01	0.07	0.00	0.00	0.11	0.01	0.00	0.17	1.00	0.33	0.66	0.00	0.06	0.42	0.11	0.94	0.00	0.07	0.00	0.05	0.01	0.00	0.04	0.50	1.00	0.87	1.00
	3	**ANDOLLU**	0.00	0.00	0.04	0.07	0.00	0.00	0.13	0.20	0.25	0.29	1.00	0.33	0.37	0.00	0.08	0.46	0.26	0.88	0.28	0.39	0.00	0.07	0.36	0.01	0.00	0.50	1.00	0.69	1.00
	4	**ESTIBALIZ**	1.00	1.00	0.02	0.07	0.00	0.00	0.19	0.00	0.62	0.10	1.00	0.33	0.23	0.00	0.17	0.47	0.09	0.82	0.23	0.38	0.00	0.05	0.32	0.01	0.04	0.50	1.00	0.78	1.00
	3	**TROKONIZ**	0.00	0.00	0.03	0.07	0.00	0.00	0.12	0.01	0.25	0.20	1.00	0.33	1.00	0.00	0.05	0.43	0.16	0.93	0.23	0.37	0.41	0.02	0.58	0.00	0.04	0.50	1.00	0.82	1.00
	3	**ERENTXUN**	0.00	0.00	0.01	0.07	0.00	0.00	0.12	0.00	0.00	0.17	0.00	0.33	1.00	0.00	0.05	0.45	0.07	0.96	0.23	0.17	0.00	0.02	0.10	0.00	0.08	0.00	1.00	0.94	0.50
4	4	**GAUNA**	0.00	0.00	0.01	0.05	0.00	0.00	0.13	0.00	0.00	0.18	0.00	0.33	0.10	0.00	0.03	0.36	0.15	0.95	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1.00	0.85	0.50
	4	**URIBARRI-JAUR.**	0.00	0.00	0.01	0.05	0.00	0.00	0.12	0.00	0.00	0.18	0.00	0.33	0.06	0.00	0.03	0.38	0.55	0.89	0.08	0.00	0.00	0.02	0.02	0.00	0.08	0.00	1.00	0.44	0.50
	-	**BRIGADA TUNEL**	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.09	0.00	0.33	0.03	0.00	0.04	0.00	0.77	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.03	0.00
	-	**LAMINORIA**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.02	0.00	0.03	0.00	0.52	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.05	0.00
	4	**ZEKUIANO**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.39	0.16	0.00	0.00	0.14	0.01	0.07	0.50	0.35	0.61	0.19	0.36	0.43	0.01	0.41	0.00	0.12	0.50	1.00	0.43	1.00
	3	**MAEZTU**	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.09	0.52	0.21	0.00	0.00	1.00	0.00	0.09	0.49	0.44	0.73	0.39	0.36	0.43	0.05	0.48	0.00	0.15	1.00	1.00	0.45	1.00
	4	**ATAURI**	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.11	0.27	0.22	0.00	0.00	0.12	0.00	0.05	0.30	0.67	0.68	0.08	0.10	0.00	0.01	0.15	0.00	0.12	1.00	1.00	0.26	0.50
	4	**ANTOÑANA**	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.11	0.33	0.15	1.00	0.67	0.45	0.00	0.09	0.41	0.49	0.79	0.08	0.15	0.00	0.05	0.07	0.00	0.12	1.00	1.00	0.44	1.00
	-	**FRESNEDO**	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.14	0.44	0.18	1.00	0.33	0.05	0.01	0.17	0.51	0.17	0.89	0.49	0.40	0.00	0.06	0.39	0.00	0.08	0.00	1.00	0.77	0.50
	4	**KANPEZU**	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.20	0.46	0.16	1.00	0.33	0.16	0.01	0.12	0.57	0.10	0.90	0.41	0.50	0.51	0.04	0.50	0.00	0.12	0.50	1.00	0.85	1.00
	-	**ORRADICHO**	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.20	0.00	0.14	1.00	0.33	0.04	0.00	0.04	0.43	0.12	1.00	0.16	0.44	0.51	0.04	0.65	0.00	0.15	0.50	1.00	0.93	1.00
	4	**ZUÑIGA**	0.00	0.00	0.02	0.09	0.00	0.00	0.00	0.20	0.22	0.18	0.00	0.00	0.10	0.00	0.13	0.40	0.35	0.97	0.13	0.07	0.00	0.01	0.05	0.00	0.12	0.50	1.00	0.67	1.00
	-	**ARQUITAS**	0.00	0.00	0.01	0.09	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.02	0.00	0.10	0.00	0.96	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.50	1.00	0.05	0.50
	3	**ACEDO**	0.00	0.00	0.01	0.09	0.00	0.00	0.00	0.17	0.42	0.19	0.00	0.00	0.35	0.00	0.08	0.43	0.42	0.91	0.19	0.34	0.00	0.00	0.32	0.00	0.19	0.00	1.00	0.57	0.50
	-	**GRANADA**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.03	0.00	0.09	0.18	0.54	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	1.00	0.48	0.50
5	3	**ANCIN**	0.00	0.00	0.02	0.09	0.00	0.00	0.09	0.03	0.51	0.16	0.00	0.00	1.00	0.00	0.15	0.50	0.27	0.86	0.41	0.18	0.33	0.02	0.26	0.00	0.19	0.00	1.00	0.67	0.50
	3	**MURIETA**	0.00	0.00	0.02	0.09	0.00	0.00	0.10	0.04	0.48	0.17	0.00	0.00	1.00	0.00	0.14	0.50	0.03	0.88	0.74	0.32	0.00	0.01	0.51	0.00	0.15	0.00	1.00	0.90	0.50
	4	**ZUFIA**	0.00	0.00	0.02	0.09	0.00	0.00	0.21	0.10	0.00	0.00	0.00	0.00	0.06	0.00	0.27	0.40	0.39	0.87	0.16	0.10	0.00	0.00	0.08	0.00	0.04	0.00	1.00	0.57	0.50
	3	**ZUBIELQUI**	0.00	0.00	0.01	0.09	0.00	0.00	0.16	0.12	0.00	0.09	0.00	0.00	0.49	0.00	0.10	0.47	0.24	0.54	0.39	0.42	0.00	0.01	0.45	0.00	0.15	0.00	1.00	0.43	0.50
	2	**LIZARRA**	0.00	0.00	0.13	0.28	0.00	0.00	0.37	0.01	0.84	0.06	1.00	0.00	1.00	0.08	0.49	0.80	0.17	0.19	0.90	0.74	0.79	0.21	0.58	0.04	0.31	0.00	1.00	0.17	0.00

log-transformed parameters

PAIR WISE COMPARISON						
	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}
N_{11}	1.0	1.0	0.3	0.3	1.0	1.0
N_{12}	1.0	1.0	0.3	0.3	1.0	1.0
N_{13}	3.0	3.0	1.0	1.0	3.0	3.0
N_{14}	3.0	3.0	1.0	1.0	3.0	3.0
N_{15}	1.0	1.0	0.3	0.3	1.0	1.0
N_{16}	1.0	1.0	0.3	0.3	1.0	1.0
TOT	**10.0**	**10.0**	**3.3**	**3.3**	**10.0**	**10.0**

NORMALISED MATRIX								CONSISTENCY ANALYSIS	
	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	TOTAL	AVERAGE	CONSISTENCY M.
N_{11}	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	6.0
N_{12}	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	6.0
N_{13}	0.3	0.3	0.3	0.3	0.3	0.3	1.5	0.3	6.0
N_{14}	0.3	0.3	0.3	0.3	0.3	0.3	1.5	0.3	6.0
N_{15}	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	6.0
N_{16}	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	6.0
TOT	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**5.0**	**1.0**	
								CI =	0.000
								RI =	1.24
								C.RATIO =	**0.00** **<0.1**

Table 6.4 Analytic Hierarchy Process of N1 variable

matrix. The Consistency Ratio (CR) is measured by dividing the Consistency Index by the Random Index (RI), which Saaty has calculated using large samples of random matrices of increasing order. He suggested that if CR exceeds 0.1, the initial judgment might be too inconsistent. Otherwise, if CR equals 0, the initial rating is perfectly consistent.

To sum up, indicators have been weighted in order to represent their relative importance, so final weights (scaled between 0 and 10) are measured and included in table 6.5. Nevertheless, variables have not been weighted, since their alteration should change also the weights of the indicators in the different models and this would make them non-comparable with each other.

WEIGHTS													
NODUS	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	
	1	1	3	3	1	1	4	2	4	3	4	3	
URBS	U_{11}	U_{12}	U_{13}				U_{21}			U_{31}	U_{32}		
	4	4	2				10			5	5		
CIVITAS	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}		C_{21}	C_{22}		C_{31}	C_{32}	C_{33}	C_{34}
	1.8	1.8	1.8	1.8	3		5	5		3	2	2	3

Table 6.5 Weights of all chosen indicators (left)

MULTI-CRITERIA DECISION ANALYSIS (MCDA)

The rescaled values of the defined node areas for each indicator are weighted using the values proposed in table 6.5 and total results (between 0 and 10) are obtained for each of the presented models. Table 6.6 includes the results for the 2000 m node areas, while the results related to all areas are included in annex 4.2.3. The values of the three different areas have been scaled all together in order to compare them, which means that in the case of 500 and 1000 m areas, the highest indicator values do not correspond to 1 scores.

The results show that Vitoria-Ciudad node area has the highest node and place values. Meanwhile, lowest node values are located in the mountain port between Gipuzkoa and Araba/Álava and the main tunnels of Arquijas and Laminoria. The latter also includes the lowest place values. On the other hand, regarding the multivariable model (9 variables), Vitoria-Ciudad includes the maximum score (10) in three of the variables (N1, U2 and C2), but the small town areas of Maeztu or Antoñana also show high scores (8.9) in one of the variables (C3). However, it is more common to find node areas with null values in more than one of their variables, such as Mazmela,

Table 6.6 Values resulted from MCDA and related to cycling non-round-trip areas (2000 m)

VALUES RESULTED FROM MCA

			NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
1	-	MALTZAGA	2.58	2.50	2.58	3.13	1.87	2.04	0.56	5.50	5.47	6.05	0.12	0.23	2.79	0.00	2.81	3.77	0.92	2.54	2.53
	2	SORALUZE	1.37	3.44	1.37	4.60	2.28	0.47	4.49	4.87	3.49	6.97	1.97	0.17	2.34	0.00	3.21	4.00	0.76	2.41	2.75
	-	LOS MARTIRES	1.50	2.12	1.50	2.99	1.25	0.44	0.20	3.17	3.50	5.19	0.58	0.55	3.59	0.00	1.32	2.98	1.27	1.81	1.91
	-	MEKOALDE	1.63	2.00	1.63	2.61	1.40	0.47	0.31	3.58	4.10	4.64	0.58	0.33	2.88	0.04	1.51	3.03	0.99	1.82	1.88
	2	BERGARA	2.23	4.71	2.23	4.89	4.53	0.61	5.12	6.08	5.74	8.00	5.51	0.34	1.54	2.02	3.88	6.34	1.29	3.47	3.88
	-	ALTOS HORNOS	2.63	2.60	2.63	3.29	1.91	0.51	0.89	5.16	6.95	6.97	0.55	0.43	2.00	0.01	2.25	4.72	0.76	2.61	2.61
	-	SAN PRUDENCIO	1.93	2.00	1.93	2.28	1.73	0.75	0.24	2.80	4.31	3.36	0.38	0.73	3.22	2.00	1.31	2.65	1.92	1.97	1.98
	-	ZUBILLAGA	1.50	2.17	1.50	2.46	1.89	0.53	0.31	3.43	3.51	4.84	0.22	0.47	2.22	2.01	1.48	2.75	1.54	1.84	1.95
	-	SAN PEDRO	1.53	3.30	1.53	3.02	3.57	0.57	0.70	6.08	3.44	6.93	4.62	0.58	1.44	0.02	2.54	4.90	0.64	2.41	2.71
	2	OÑATI	1.53	4.22	1.53	4.52	3.92	0.57	4.82	6.27	3.49	7.76	5.48	0.53	0.97	0.00	3.84	5.47	0.48	2.87	3.32
	2	ARRASATE	2.28	4.17	2.28	5.30	3.04	1.24	5.67	6.61	4.86	8.38	2.47	0.73	1.84	0.03	4.45	5.08	0.82	3.22	3.54
	-	ULGOR	2.05	3.43	2.05	4.03	2.84	1.39	1.99	6.21	4.06	8.10	2.30	0.70	2.01	0.01	3.25	4.66	0.85	2.74	2.97
	2	ARETXABALETA	1.93	3.53	1.93	4.65	2.42	0.64	4.69	6.00	4.57	7.41	1.25	0.58	1.85	0.00	3.73	4.26	0.76	2.73	3.00
	-	LANDETA-MAR.	2.89	3.37	2.89	3.67	3.08	0.69	1.97	6.10	7.40	7.71	3.12	0.58	1.31	0.01	2.97	6.00	0.60	3.13	3.21
	2	ESKORIATZA	1.86	3.00	1.86	3.63	2.36	0.61	1.40	4.94	4.52	6.90	2.11	0.45	2.59	0.04	2.36	4.39	0.95	2.43	2.62
	-	CASTAÑARES	1.00	1.74	1.00	2.56	0.91	0.20	0.32	2.73	2.67	4.19	0.00	0.12	3.16	0.01	1.12	2.19	0.99	1.37	1.49
2	-	MAZMELA	0.94	1.59	0.94	2.39	0.80	0.00	0.39	2.40	2.69	3.96	0.00	0.12	2.81	0.01	0.95	2.13	0.89	1.27	1.38
	-	ZARIMUZ	0.19	1.35	0.19	2.37	0.33	0.00	0.24	0.98	0.56	3.45	0.00	0.00	3.40	0.00	0.42	1.23	1.02	0.77	0.96
	-	MARIN	0.21	1.36	0.21	2.49	0.22	0.17	0.16	0.66	0.47	3.36	0.00	0.00	3.94	0.02	0.34	1.17	1.19	0.78	0.97
	4	LEINTZ-GATZAGA	2.02	2.16	2.02	2.74	1.57	0.33	0.35	1.69	2.65	4.64	1.53	3.07	3.23	1.50	0.81	2.86	2.57	2.09	2.11
	-	ARLABAN	2.26	2.43	2.26	2.51	2.34	0.33	0.16	1.38	3.17	3.68	0.65	3.27	3.69	5.00	0.65	2.44	4.00	2.34	2.37
	-	LANDA	1.63	2.30	1.63	2.04	2.56	0.17	0.22	2.09	3.23	3.32	0.58	1.49	2.59	5.03	0.86	2.33	3.06	1.97	2.08
3	4	LEGUTIO	0.83	1.50	0.83	1.52	1.47	0.00	0.58	1.91	1.00	2.16	0.38	1.50	1.83	2.10	0.84	1.13	1.81	1.16	1.28
	3	URBINA	1.73	2.71	1.73	2.92	2.51	0.26	1.66	3.39	3.43	4.38	0.10	1.50	2.71	4.04	1.77	2.55	2.75	2.22	2.39
	4	ERRETANA	1.03	3.10	1.03	3.18	3.01	0.20	1.19	3.96	1.34	4.17	0.02	1.54	4.18	5.06	1.81	1.73	3.57	2.06	2.41
	3	DURANA	1.51	3.32	1.51	3.46	3.18	0.37	1.27	4.56	3.69	5.12	0.02	0.48	4.00	4.97	2.10	2.84	3.11	2.42	2.72
	1	VITORIA APEAD.	4.92	6.16	4.92	5.96	6.37	6.99	8.09	8.06	5.22	9.78	9.54	2.55	0.00	1.50	7.69	8.10	1.42	5.54	5.75
	1	VITORIA-CIUDAD	7.34	6.33	7.34	6.20	6.45	10.00	8.59	7.86	5.03	10.00	10.00	7.00	0.01	1.50	8.83	8.26	2.98	6.83	6.67
	-	OLARIZU	5.30	3.90	5.30	4.55	3.26	5.66	2.57	7.50	4.02	8.74	1.37	6.22	2.34	0.91	5.38	4.51	3.20	4.60	4.37
	3	OTAZU	2.37	3.14	2.37	3.79	2.50	0.24	2.30	1.46	2.38	4.36	0.89	4.48	4.70	5.14	1.29	2.45	4.78	2.76	2.88
	3	ABERASTURI	2.06	3.47	2.06	4.05	2.89	0.24	2.76	0.24	0.44	4.16	0.19	5.51	5.23	8.25	0.99	1.47	6.38	2.77	3.00
	3	ANDOLLU	2.70	3.71	2.70	3.99	3.44	0.33	1.64	2.39	1.90	4.64	0.05	5.86	5.70	7.87	1.44	2.07	6.52	3.21	3.38
	4	ESTIBALIZ	3.61	3.48	3.61	3.50	3.47	2.27	1.27	2.09	3.25	4.67	0.26	5.30	4.56	8.06	1.91	2.63	6.04	3.55	3.53
	3	TROKONIZ	2.47	4.29	2.47	4.63	3.96	0.30	4.11	3.54	1.50	4.35	0.19	5.61	5.44	8.14	2.57	1.90	6.44	3.38	3.69
	3	ERENTXUN	0.75	3.42	0.75	4.59	2.26	0.24	4.11	1.01	0.49	4.51	0.38	1.52	5.14	5.38	1.67	1.66	3.96	2.08	2.53

ZONE	URB. AREA	NODE	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
	4	**GAUNA**	0.75	2.46	0.75	3.18	1.74	0.17	0.45	0.01	0.52	3.58	0.00	1.55	5.50	5.20	0.20	1.26	4.01	1.60	1.89
	4	**URIBARRI-JAUR.**	0.74	2.72	0.74	3.78	1.67	0.17	0.32	0.24	0.49	3.80	0.38	1.54	7.22	4.39	0.24	1.45	4.24	1.73	2.06
	-	**BRIGADA TUNEL**	0.57	1.11	0.57	1.52	0.69	0.00	0.19	0.00	0.44	0.00	0.00	1.26	4.37	2.06	0.06	0.16	2.47	0.84	0.93
	-	**LAMINORIA**	0.05	0.88	0.05	1.06	0.70	0.00	0.13	0.00	0.00	0.00	0.00	0.16	3.06	2.10	0.04	0.00	1.71	0.47	0.61
	4	**ZEKUIANO**	0.68	3.56	0.68	3.49	3.62	0.00	0.71	2.94	1.57	4.98	0.58	0.47	4.80	7.36	1.24	2.25	4.18	2.12	2.60
	3	**MAEZTU**	1.03	4.70	1.03	4.99	4.42	0.24	4.20	3.58	2.24	4.94	0.77	0.62	5.84	8.90	2.60	2.54	5.08	2.87	3.48
	4	**ATAURI**	0.73	3.12	0.73	3.44	2.80	0.24	0.59	0.80	1.29	2.97	0.58	0.66	6.74	7.02	0.54	1.54	4.71	1.92	2.32
4	4	**ANTOÑANA**	2.75	3.79	2.75	4.18	3.39	0.24	1.99	0.70	1.55	4.15	0.60	6.46	6.39	8.89	0.93	2.00	7.29	3.27	3.44
	-	**FRESNEDO**	2.60	3.22	2.60	3.67	2.76	0.24	0.59	2.84	2.04	5.14	0.41	5.53	5.29	5.05	1.25	2.40	5.29	2.91	3.01
	4	**KANPEZU**	2.65	4.08	2.65	3.88	4.29	0.24	0.92	4.06	2.23	5.71	0.60	5.49	5.01	8.20	1.78	2.70	6.29	3.37	3.61
	-	**ORRADICHO**	2.02	3.87	2.02	3.38	4.37	0.24	0.25	3.97	0.40	4.29	0.77	5.43	5.58	8.36	1.55	1.70	6.50	2.95	3.25
	4	**ZUÑIGA**	0.72	3.36	0.72	3.74	2.99	0.34	0.67	0.51	1.29	3.96	0.60	0.54	6.60	7.85	0.50	1.85	4.92	2.04	2.48
	-	**ARQUITAS**	0.30	2.15	0.30	2.55	1.76	0.31	0.27	0.00	0.01	0.00	0.19	0.57	7.37	5.09	0.19	0.07	4.20	1.23	1.54
	3	**ACEDO**	0.97	3.33	0.97	4.17	2.50	0.31	1.55	1.90	2.01	4.30	0.96	0.58	6.67	4.64	1.24	2.33	3.82	2.15	2.54
	-	**GRANADA**	0.18	2.39	0.18	3.16	1.61	0.00	0.31	0.00	0.01	1.75	0.38	0.55	7.42	4.46	0.09	0.66	3.98	1.29	1.65
	3	**ANCIN**	1.10	3.87	1.10	5.00	2.75	0.34	4.32	2.44	2.48	5.01	0.96	0.48	5.66	4.85	2.27	2.71	3.56	2.49	2.95
	3	**MURIETA**	1.08	3.89	1.08	4.62	3.16	0.34	4.30	3.41	2.40	5.02	0.77	0.50	4.54	5.30	2.60	2.62	3.39	2.48	2.95
5	4	**ZUFIA**	0.46	2.78	0.46	3.70	1.85	0.34	0.80	0.71	1.05	3.98	0.19	0.00	6.33	4.65	0.61	1.63	3.53	1.62	2.00
	3	**ZUBIELQUI**	0.49	3.12	0.49	3.60	2.64	0.31	2.16	2.80	0.88	4.71	0.77	0.27	3.92	4.37	1.74	1.99	2.80	1.80	2.24
	2	**LIZARRA**	3.43	4.25	3.43	5.04	3.47	1.22	5.31	6.35	4.89	7.96	1.73	4.19	1.83	2.34	4.24	4.70	2.83	3.84	3.98

Zarimuz, Marin, Brigada Tunel, Laminoria, Arquijas or Granada.

In this phase, it is already possible to create the three diagrams related to the three models and the ranking of the different node areas. Nevertheless, a sensitivity analysis has been developed first in order to confirm the suitability of the initial judgment that determines the weights for each indicator.

SENSITIVITY ANALYSIS

Sensitivity analyses of all indicators have been developed divided in the nine multiaxial variables. Using a total weight of 10 for each variable, indicators have been distributed using integer values (except in the case of C1, where four of the five indicators should have the same weight). For each possible combination, results for all defined node areas are obtained and their sum is compared with the sum of non-weighted results. Moreover, some extra conditions have been established in order not to give too much importance to some of the indicators and to follow some logical criteria, such as:

- The minimum value of each indicator´s weight will be 10 percent of the total variable value, i.e. 1.

- The maximum value of each indicator´s weight will be 60 percent of the total variable value, i.e. 6.

- The importance of an indicator will not be more than three times higher than other indicators in the same variable.

- Equilibrium between some of the indicators is necessary, creating other specific criteria: $N_{11} = N_{12}$; $N_{13} = N_{14}$; $N_{15} = N_{16}$; $N_{21} > N_{22}$; $N_{32} > N_{33}$; $C_{11} = C_{12} = C_{13} = C_{14}$; $C_{15} = C_{34}$; $C_{31} > C_{32}$.

Results of the different combinations for the first variable (N1) are included in table 6.7 and for all variables in annex 4.2.4. In the first case, two combinations that include all conditions show better total results, increasing them in 8.16 % or 16.68 %. The latter is related to the proposed combination of weights (1, 1, 3, 3, 1, 1), so it has been assumed as suitable. However, the combinations of weights initially presented for N2, N3 and U1 variables have been changed in order to obtain better results in

Table 6.7 Sensitivity analysis of N1 variable, including different combination of weights and their total and relative results

N1	COMBINATION OF WEIGHTS						
N_{11}	1.67	2.00	2.00	1.00	3.00	1.00	1.00
N_{12}	1.67	2.00	2.00	1.00	3.00	1.00	1.00
N_{13}	1.67	2.00	1.00	2.00	1.00	3.00	1.00
N_{14}	1.67	2.00	1.00	2.00	1.00	3.00	1.00
N_{15}	1.67	1.00	2.00	2.00	1.00	1.00	3.00
N_{16}	1.67	1.00	2.00	2.00	1.00	1.00	3.00
	2.99	3.59	3.46	1.92	5.13	2.04	1.79
	0.26	0.31	0.16	0.31	0.16	0.47	0.16
	0.24	0.29	0.15	0.29	0.15	0.44	0.15
	0.26	0.31	0.16	0.31	0.16	0.47	0.16
	0.34	0.40	0.20	0.40	0.20	0.61	0.20
	0.28	0.34	0.17	0.34	0.17	0.51	0.17
	0.42	0.50	0.25	0.50	0.25	0.75	0.25
	0.29	0.35	0.18	0.35	0.18	0.53	0.18
	0.31	0.38	0.19	0.38	0.19	0.57	0.19
	0.31	0.38	0.19	0.38	0.19	0.57	0.19
	0.69	0.83	0.41	0.83	0.41	1.24	0.41
	0.77	0.92	0.46	0.92	0.46	1.39	0.46
	0.35	0.42	0.21	0.42	0.21	0.64	0.21
	0.39	0.46	0.23	0.46	0.23	0.69	0.23
	0.34	0.40	0.20	0.40	0.20	0.61	0.20
	0.11	0.13	0.07	0.13	0.07	0.20	0.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.18	0.22	0.11	0.22	0.11	0.33	0.11
	0.18	0.22	0.11	0.22	0.11	0.33	0.11
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.14	0.17	0.09	0.17	0.09	0.26	0.09
	0.11	0.13	0.07	0.13	0.07	0.20	0.07
	0.20	0.24	0.12	0.24	0.12	0.37	0.12
	5.75	5.22	5.11	6.88	3.44	6.99	6.77
	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	6.31	6.72	6.61	5.55	7.78	5.66	5.44
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.18	0.22	0.11	0.22	0.11	0.33	0.11
	3.49	4.18	4.09	2.18	6.09	2.27	2.09
	0.17	0.20	0.10	0.20	0.10	0.30	0.10
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.17	0.21	0.10	0.21	0.10	0.31	0.10
	0.17	0.21	0.10	0.21	0.10	0.31	0.10
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.17	0.21	0.10	0.21	0.10	0.31	0.10
	0.68	0.81	0.41	0.81	0.41	1.22	0.41
TOTAL VALUE	38.59	41.74	35.29	38.58	38.45	45.03	32.12
INCREMENT	0.00	3.15	-3.30	-0.02	-0.14	6.44	-6.47
%	0.00	8.16	-8.56	-0.04	-0.36	16.68	-16.77

better results | including extra conditions

most of the defined node areas. The initial combination of N2 has been changed to the best combination (+ 23.5%), while in the case of N3 and U1, second best combinations have been used, since they are closer to the initial judgment and improvement is also obtained. They alter the values from 2.18 % to 6.21 % and from -0.64 % to 22.96 %. Finally, the weights of the rest of the indicators have not been altered. On the one hand, obtained improvements are quite irrelevant in U3 and C2, so the balance between the two indicators has been preserved. On the other hand, the initial combinations are the only or one of the few that fulfil all proposed criteria in C1 and C3, although their results are not the bests. Initial and reformulated weights for all indicators are included in table 6.8.

RESULTS AND RANKING

Using the reformulated weights, final results for each defined node area are obtained (table 6.9 and annex 4.2.3). Although total results have slightly increased in most of the node areas,

Table 6.8 Initial and reformulated weights for all indicators

REFORMULATED WEIGHTS

NODUS	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}
	1	1	3	3	1	1	4	2	4	3	4	3
	1	1	3	3	1	1	**3**	**2**	**5**	**3**	**5**	**2**

URBS	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}
	4	4	2	10	5	5
	5	**2**	**3**	10	5	5

CIVITAS	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
	1.8	1.8	1.8	1.8	3	5	5	3	2	2	3
	1.8	1.8	1.8	1.8	3	5	5	3	2	2	3

Table 6.9 Final values resulted from MCDA and related to cycling non-round-trip areas (2000 m)

VALUES RESULTED FROM MCA II

			NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
1	-	MALTZAGA	2.54	2.53	2.54	3.19	1.87	2.04	0.75	5.50	5.34	6.05	0.12	0.23	2.79	0.00	2.86	3.72	0.92	2.54	2.53
	2	SORALUZE	1.52	3.62	1.52	4.95	2.28	0.47	5.56	4.87	3.93	6.97	1.97	0.17	2.34	0.00	3.53	4.15	0.76	2.57	2.92
	-	LOS MARTIRES	1.62	2.13	1.62	3.01	1.25	0.44	0.26	3.17	3.87	5.19	0.58	0.55	3.59	0.00	1.34	3.11	1.27	1.88	1.96
	-	MEKOALDE	1.72	2.02	1.72	2.65	1.40	0.47	0.43	3.58	4.37	4.64	0.58	0.33	2.88	0.04	1.55	3.12	0.99	1.87	1.92
	2	BERGARA	2.31	4.91	2.31	5.28	4.53	0.61	6.29	6.08	5.99	8.00	5.51	0.34	1.54	2.02	4.23	6.42	1.29	3.61	4.04
	-	ALTOS HORNOS	2.54	2.64	2.54	3.38	1.91	0.51	1.17	5.16	6.68	6.97	0.55	0.43	2.00	0.01	2.33	4.62	0.76	2.59	2.61
	-	SAN PRUDENCIO	1.90	2.02	1.90	2.31	1.73	0.75	0.35	2.80	4.21	3.36	0.38	0.73	3.22	2.00	1.35	2.62	1.92	1.96	1.98
	-	ZUBILLAGA	1.65	2.19	1.65	2.50	1.89	0.53	0.45	3.43	3.96	4.84	0.22	0.47	2.22	2.01	1.52	2.91	1.54	1.92	2.01
	-	SAN PEDRO	1.72	3.33	1.72	3.09	3.57	0.57	0.91	6.08	4.02	6.93	4.62	0.58	1.44	0.02	2.60	5.10	0.64	2.53	2.80
	2	OÑATI	1.74	4.41	1.74	4.91	3.92	0.57	5.99	6.27	4.13	7.76	5.48	0.53	0.97	0.00	4.19	5.69	0.48	3.08	3.52
	2	ARRASATE	2.43	4.36	2.43	5.69	3.04	1.24	6.86	6.61	5.32	8.38	2.47	0.73	1.84	0.03	4.80	5.24	0.82	3.40	3.72
	-	ULGOR	2.23	3.48	2.23	4.13	2.84	1.39	2.29	6.21	4.60	8.10	2.30	0.70	2.01	0.01	3.34	4.85	0.85	2.86	3.07
	2	ARETXABALETA	2.08	3.73	2.08	5.04	2.42	0.64	5.87	6.00	5.02	7.41	1.25	0.58	1.85	0.00	4.08	4.42	0.76	2.90	3.18
	-	LANDETA-MAR.	2.98	3.44	2.98	3.80	3.08	0.69	2.38	6.10	7.66	7.71	3.12	0.58	1.31	0.01	3.09	6.09	0.60	3.21	3.28
	2	ESKORIATZA	1.95	3.05	1.95	3.75	2.36	0.61	1.75	4.94	4.79	6.90	2.11	0.45	2.59	0.04	2.46	4.49	0.95	2.50	2.69
	-	CASTAÑARES	1.08	1.76	1.08	2.60	0.91	0.20	0.45	2.73	2.92	4.19	0.00	0.12	3.16	0.01	1.16	2.28	0.99	1.42	1.53
	-	MAZMELA	1.02	1.62	1.02	2.44	0.80	0.00	0.55	2.40	2.93	3.96	0.00	0.12	2.81	0.01	1.00	2.21	0.89	1.32	1.42
	-	ZARIMUZ	0.14	1.36	0.14	2.40	0.33	0.00	0.34	0.98	0.42	3.45	0.00	0.00	3.40	0.00	0.45	1.18	1.02	0.75	0.96

ZONE	URB. AREA	NODE	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
2	-	**MARIN**	0.17	1.37	0.17	2.51	0.22	0.17	0.22	0.66	0.35	3.36	0.00	0.00	3.94	0.02	0.36	1.13	1.19	0.77	0.97
	4	**LEINTZ-GATZAGA**	1.82	2.17	1.82	2.77	1.57	0.33	0.44	1.69	3.07	4.64	1.53	2.07	3.23	1.50	0.84	3.00	2.22	2.00	2.06
	-	**ARLABAN**	2.06	2.44	2.06	2.53	2.34	0.33	0.21	1.38	3.59	3.68	0.65	2.27	3.69	5.00	0.66	2.59	3.65	2.25	2.31
	-	**LANDA**	1.68	2.32	1.68	2.08	2.56	0.17	0.33	2.09	3.71	3.32	0.58	1.16	2.59	5.03	0.89	2.50	2.94	2.00	2.11
3	4	**LEGUTIO**	0.65	1.54	0.65	1.62	1.47	0.00	0.87	1.91	0.79	2.16	0.38	1.17	1.83	2.10	0.93	1.06	1.69	1.10	1.25
	3	**URBINA**	1.61	2.81	1.61	3.11	2.51	0.26	2.25	3.39	3.40	4.38	0.10	1.17	2.71	4.04	1.95	2.54	2.64	2.21	2.41
	4	**ERRETANA**	0.81	3.17	0.81	3.33	3.01	0.20	1.64	3.96	1.02	4.17	0.02	1.21	4.18	5.06	1.95	1.62	3.45	1.99	2.38
	3	**DURANA**	1.54	3.40	1.54	3.61	3.18	0.37	1.70	4.56	3.78	5.12	0.02	0.48	4.00	4.97	2.23	2.87	3.11	2.47	2.78
	1	**VITORIA APEAD.**	5.13	6.32	5.13	6.28	6.37	6.99	9.05	8.06	5.86	9.78	9.54	2.55	0.00	1.50	7.98	8.33	1.42	5.73	5.93
	1	**VITORIA-CIUDAD**	7.93	6.44	7.93	6.43	6.45	10.00	9.30	7.86	5.78	10.00	10.00	8.00	0.01	1.50	9.04	8.52	3.33	7.18	6.94
	-	**OLARIZU**	5.75	3.97	5.75	4.68	3.26	5.66	2.95	7.50	4.71	8.74	1.37	6.89	2.34	0.91	5.49	4.75	3.43	4.86	4.56
	3	**OTAZU**	2.84	3.25	2.84	4.00	2.50	0.24	2.94	1.46	2.79	4.36	0.89	5.48	4.70	5.14	1.48	2.60	5.13	3.04	3.11
	3	**ABERASTURI**	2.25	3.59	2.25	4.29	2.89	0.24	3.47	0.24	0.33	4.16	0.19	6.18	5.23	8.25	1.21	1.43	6.62	2.92	3.14
	3	**ANDOLLU**	2.96	3.79	2.96	4.14	3.44	0.33	2.08	2.39	2.02	4.64	0.05	6.53	5.70	7.87	1.58	2.11	6.75	3.37	3.51
	4	**ESTIBALIZ**	3.97	3.55	3.97	3.63	3.47	2.27	1.67	2.09	3.68	4.67	0.26	5.97	4.56	8.06	2.02	2.78	6.28	3.76	3.69
	3	**TROKONIZ**	2.74	4.47	2.74	4.98	3.96	0.30	5.16	3.54	1.63	4.35	0.19	6.28	5.44	8.14	2.89	1.94	6.68	3.60	3.89
	3	**ERENTXUN**	0.60	3.60	0.60	4.94	2.26	0.24	5.16	1.01	0.37	4.51	0.38	1.18	5.14	5.38	1.99	1.62	3.84	2.10	2.60
4	4	**GAUNA**	0.59	2.48	0.59	3.22	1.74	0.17	0.58	0.01	0.39	3.58	0.00	1.22	5.50	5.20	0.24	1.21	3.90	1.54	1.85
	4	**URIBARRI-JAUR.**	0.58	2.74	0.58	3.81	1.67	0.17	0.41	0.24	0.37	3.80	0.38	1.21	7.22	4.39	0.27	1.41	4.12	1.66	2.02
	-	**BRIGADA TUNEL**	0.42	1.12	0.42	1.54	0.69	0.00	0.26	0.00	0.33	0.00	0.00	0.93	4.37	2.06	0.08	0.12	2.36	0.77	0.88
	-	**LAMINORIA**	0.05	0.89	0.05	1.08	0.70	0.00	0.18	0.00	0.00	0.00	0.00	0.16	3.06	2.10	0.05	0.00	1.71	0.47	0.61
	4	**ZEKUIANO**	0.81	3.59	0.81	3.56	3.62	0.00	0.90	2.94	1.96	4.98	0.58	0.47	4.80	7.36	1.30	2.38	4.18	2.20	2.66
	3	**MAEZTU**	1.21	4.88	1.21	5.35	4.42	0.24	5.28	3.58	2.76	4.94	0.77	0.62	5.84	8.90	2.92	2.72	5.08	3.04	3.66
	4	**ATAURI**	0.82	3.15	0.82	3.49	2.80	0.24	0.77	0.80	1.56	2.97	0.58	0.66	6.74	7.02	0.59	1.64	4.71	1.98	2.37
	4	**ANTOÑANA**	2.97	3.87	2.97	4.35	3.39	0.24	2.53	0.70	1.88	4.15	0.60	6.79	6.39	8.89	1.09	2.11	7.40	3.42	3.57
	-	**FRESNEDO**	2.97	3.25	2.97	3.74	2.76	0.24	0.80	2.84	2.48	5.14	0.41	6.20	5.29	5.05	1.32	2.55	5.52	3.11	3.16
	4	**KANPEZU**	3.03	4.13	3.03	3.97	4.29	0.24	1.19	4.06	2.69	5.71	0.60	6.16	5.01	8.20	1.86	2.86	6.53	3.58	3.76
	-	**ORRADICHO**	2.24	3.88	2.24	3.40	4.37	0.24	0.33	3.97	0.40	4.29	0.77	6.09	5.58	8.36	1.57	1.70	6.73	3.06	3.34
	4	**ZUÑIGA**	0.80	3.40	0.80	3.82	2.99	0.34	0.89	0.51	1.52	3.96	0.60	0.54	6.60	7.85	0.56	1.93	4.92	2.10	2.53
	-	**ARQUITAS**	0.30	2.17	0.30	2.59	1.76	0.31	0.38	0.00	0.01	0.00	0.19	0.57	7.37	5.09	0.22	0.07	4.20	1.24	1.55
	3	**ACEDO**	1.11	3.40	1.11	4.31	2.50	0.31	1.97	1.90	2.43	4.30	0.96	0.58	6.67	4.64	1.36	2.48	3.82	2.26	2.64
	-	**GRANADA**	0.18	2.41	0.18	3.20	1.61	0.00	0.43	0.00	0.01	1.75	0.38	0.55	7.42	4.46	0.13	0.66	3.98	1.30	1.67
5	3	**ANCIN**	1.24	4.06	1.24	5.38	2.75	0.34	5.47	2.44	2.89	5.01	0.96	0.48	5.66	4.85	2.61	2.85	3.56	2.65	3.12
	3	**MURIETA**	1.21	4.08	1.21	4.99	3.16	0.34	5.43	3.41	2.78	5.02	0.77	0.50	4.54	5.30	2.94	2.75	3.39	2.64	3.12
	4	**ZUFIA**	0.39	2.83	0.39	3.81	1.85	0.34	1.13	0.71	0.84	3.98	0.19	0.00	6.33	4.65	0.71	1.55	3.53	1.61	2.02
	3	**ZUBIELQUI**	0.43	3.22	0.43	3.79	2.64	0.31	2.75	2.80	0.72	4.71	0.77	0.27	3.92	4.37	1.91	1.94	2.80	1.83	2.29
	2	**LIZARRA**	3.92	4.48	3.92	5.48	3.47	1.22	6.64	6.35	5.36	7.96	1.73	5.19	1.83	2.34	4.64	4.87	3.18	4.20	4.29

highest, lowest or null values are related to previously mentioned areas. In this regard, each node area has been featured using the three presented models (annex 4.2.5). Additionally, an image of the area has also been included to comprehend visually the overall view of each node area.

Five different node areas are presented as examples (fig. 6.8), which represent the reality of the Basque-Navarre territory. They have been classified according to the relations between the defined node areas and their surrounding urban areas in the previous chapter: Vitoria-Gasteiz is located in zone 3 (area influenced by Vitoria-Gasteiz) and its urban core is larger than the node area (type 1); Bergara is located in zone 1 (main towns) and its urban core is similar to the node area (type 2); Murieta is located in zone 5 (area influenced by Lizarra) and its urban core is smaller than the node area and reachable by the walking round-trip influence area (type 3); Kanpezu is located in zone 4 (small towns) and its urban core is smaller than the node area but not reachable by the walking round-trip influence area (type 4); and Arlaban is located in zone 2 (mountain port) and does not have any urban core around.

According to the node/place model, the railway station areas of Arlaban and Kanpezu are the most balanced ones, although the first one is located in the dependent area defined by Bertolini (see chapter 2.3.2) and the second one close to it. Vitoria-Gasteiz is not also far from the balance between transport and land uses, but there are differences in the results of the three areas. Hence, place-index is higher than node-index in the 500 m and 1000 m areas, while the opposite occurs in the 2000 m area, where the stressed area is almost reached. This is due to the size of the city, which makes the main infrastructures be located on the fringes of the city and activities be more concentrated in the city centre. In the case of Bergara, the place-indexes are higher than the node ones, being necessary to include new transport infrastructures in order to get the desirable balance, since the reduction of the place-index would entail to get into the dependent area. Lastly, although certain place values are illustrated in the case of Murieta, node-indexes are very low, locating it in the limit of unsustained places. Hence, the connection with surrounding areas becomes strategic for the future of the area.

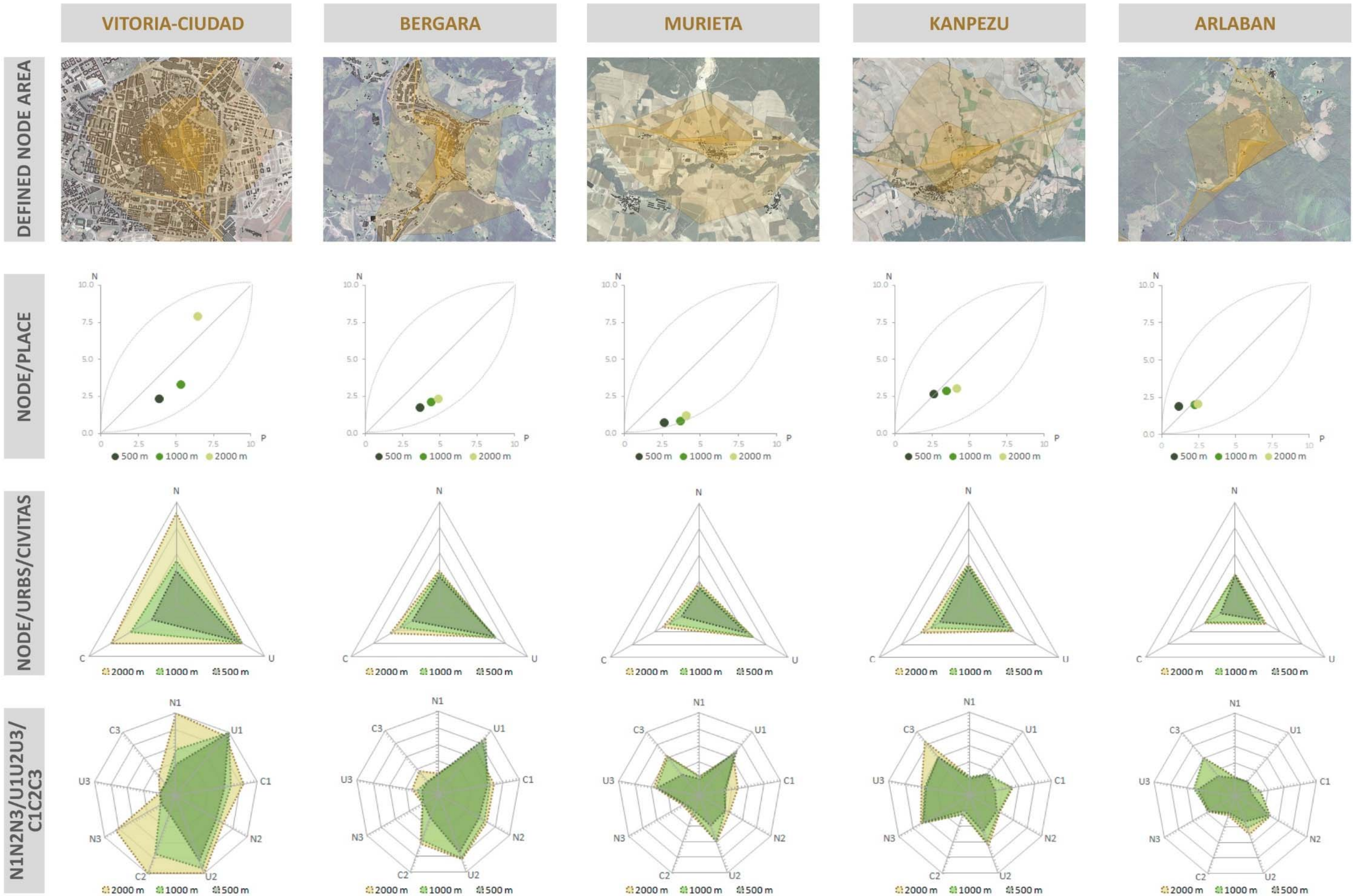
The same balance is illustrated referring to the NCU model in the cases of Arlaban and Kanpezu. Nevertheless, in the case of Vitoria-Gasteiz, nodus values have especially increased in the 2000 m area, while civitas values have uniformly increased and urbs values have remained constant (high) in the three areas. Although nodus values are lower, something similar occurs with civitas and urbs in Bergara and Murieta, creating an unbalance between the three criteria in the case of Murieta.

The presented two models determine the balance between transport and land uses. In this regard, and taking into consideration all defined node areas, although some of the node areas are balanced, many others show very low node values. They generally refer to quite isolated rural areas, even if they comprise certain urbanity or some activities.

On the other hand, the multiaxial model shows the urban or rural character of the analysed area in addition to its potential taking into account more specific criteria. Hence, the understanding of each area becomes easier. Moreover, the characteristics that can be enhanced to achieve the balance between transport and land uses or to encourage a particular development are illustrated.

In the case of Vitoria-Gasteiz, urban and general criteria and the variable related to non-motorised transports (N3) show high

Figure 6.8 Characterisation of five defined node areas according to the three models (right)


VITORIA-CIUDAD
BERGARA
MURIETA
KANPEZU
ARLABAN
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/
C1C2C3
N
P
10.0
7.5
5.0
2.5
0.0
0
2.5
5
7.5
10
500 m
1000 m
2000 m
C
U
N1
U1
C1
N2
U2
C2
N3
U3
C3

scores, although the variable related to private motorised transports (N2) show medium scores, since main road infrastructures are located out of the city. Meanwhile, criteria related to rural morphology and activities (U3 and C3) present lower scores. Similarly, the diagram of Bergara shows that urban and general features are the ones that take place in the area, while rural characteristics are not included at all. On the contrary, rural criterion and the population variable (U2) include significant values in Kanpezu. Although Murieta shows a similar diagram, non-motorised transport infrastructures (N3) are not relevant in this case and the urban morphology variable (U1) has higher scores, since the station area is located near the urban core. In the case of Murieta, all morphological approaches have significant values. Accordingly, this can be the main difference between the nodes classified in type 3 and 4. Finally, although all variables have generally low scores in Arlaban, rural criterion, the population variable (U2) and the private vehicle variable (N2) are highlighted.

Eventually, a raking of the different node areas has been developed taking into account total transport and land use values or specific variable values.

Taking into consideration the 2000 m area (table 6.10), the nodes located in Vitoria-Gasteiz are at the top of the ranking, followed by other main towns, such as Lizarra, Bergara, Arrasate or Oñati, but also by smaller scale towns, such as Antoñana o Kanpezu or the area of Andollu-Estibaliz-Trokoniz. Meanwhile, the node areas located in the mountain port between Gipuzkoa and Araba/Álava and the tunnels of Laminoria and Arquijas are at the bottom. Most of the defined node areas are not in a very different position in both node and place rankings, but Maeztu for example, number 36 ranking in the node approach, ranked fourth in the place approach. On the other hand, different classifications have been obtained in the multilevel and the urban/rural approach. Main cities and towns ranked high in urban and general criteria, but not in rural criterion. It should be

RANKING OF 2000 m NODE AREAS (cycling non-round-trips)

	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
MALTZAGA	14	38	14	38	39	5	37	12	11	19	48	52	41	55	19	19	50	29	35
SORALUZE	33	17	33	11	35	18	8	15	18	11	10	49	41	50	9	14	50	24	23
LOS MARTIRES	30	46	30	41	49	20	51	26	19	18	26	34	29	51	34	17	40	41	44
MEKOALDE	27	47	27	43	48	19	43	20	13	27	28	46	35	41	29	16	44	42	45
BERGARA	16	3	16	7	3	12	5	10	3	6	3	45	50	33	6	3	39	6	5
ALTOS HORNOS	13	37	13	34	37	17	29	13	2	12	31	44	45	45	19	11	52	23	29
SAN PRUDENCIO	23	48	23	51	43	9	47	29	14	47	35	24	32	35	33	26	34	39	43
ZUBILLAGA	29	43	29	48	38	16	41	23	17	24	39	41	43	34	30	19	37	40	42
SAN PEDRO	26	27	26	40	10	15	31	9	16	13	5	29	51	43	17	7	53	26	24
OÑATI	25	7	25	13	8	14	6	6	15	8	4	37	53	54	7	5	55	14	12
ARRASATE	15	8	15	3	19	7	3	4	8	4	7	25	47	42	4	6	49	10	8
ULGOR	19	22	19	19	23	6	20	7	12	5	8	26	44	49	10	9	48	20	22
ARETXABALETA	20	16	20	8	32	11	7	11	9	10	14	31	46	52	8	13	51	19	16
LANDETA-MAR.	7	23	7	25	18	10	19	8	1	9	6	30	52	46	11	4	54	12	15
ESKORIATZA	22	33	22	27	33	13	24	14	10	14	9	43	40	40	18	12	45	27	26
CASTAÑARES	38	49	38	44	50	44	40	31	27	36	49	51	33	47	38	34	43	47	49

Table 6.10 Raking of 2000 m node areas regarding total and specific values

	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
MAZMELA	39	59	39	49	51	52	39	33	26	41	50	52	36	48	40	35	47	48	50
ZARIMUZ	54	53	54	50	54	55	48	43	45	46	52	54	30	53	48	49	42	54	53
MARIN	53	52	53	47	55	48	53	47	50	48	53	55	26	44	40	50	41	52	52
LEINTZ-GATZAGA	24	45	24	42	46	28	42	39	25	28	12	15	31	38	43	18	33	36	39
ARLABAN	21	40	21	46	34	27	54	41	23	44	22	14	28	20	45	28	20	30	36
LANDA	28	42	28	52	28	45	50	35	21	49	29	22	39	19	42	31	29	35	38
LEGUTIO	44	51	44	53	47	51	34	37	43	51	36	21	49	31	41	51	36	51	51
URBINA	31	35	31	39	29	33	21	25	24	31	45	20	38	28	23	30	31	31	33
ERRETANA	41	31	41	35	20	43	27	19	41	37	48	18	24	17	24	43	23	37	34
DURANA	32	26	32	30	16	21	25	16	20	19	47	40	25	21	20	20	28	28	25
VITORIA APEAD.	3	2	3	2	2	2	2	1	4	2	2	13	55	37	2	2	38	2	2
VITORIA-CIUDAD	1	1	1	1	1	1	1	2	5	1	1	1	54	36	1	1	26	1	1
OLARIZU	2	12	2	14	15	3	15	3	11	3	13	2	42	39	3	10	24	3	3
OTAZU	11	29	11	20	31	41	16	40	29	32	17	11	20	15	31	27	9	17	21
ABERASTURI	17	20	17	17	22	38	14	49	52	38	41	7	16	4	37	46	5	18	18
ANDOLLU	10	15	10	18	13	26	22	34	35	29	46	4	10	8	27	36	2	11	13
ESTIBALIZ	4	21	4	29	12	4	26	36	22	26	38	10	21	7	21	23	7	5	9
TROKONIZ	12	6	12	10	7	32	13	22	38	33	40	5	14	6	14	38	4	7	6
ERENTXUN	45	18	45	12	36	42	12	42	49	30	33	19	17	12	22	44	18	34	30
GAUNA	46	39	46	36	42	46	38	51	47	45	51	16	13	14	51	48	17	46	46
URIBARRI-JAUR.	47	36	47	24	44	47	45	50	48	43	34	17	3	26	50	47	15	44	40
BRIGADA TUNEL	49	54	49	54	53	54	52	52	51	53	54	23	23	32	54	53	32	53	54
LAMINORIA	55	55	55	55	52	53	55	55	55	55	55	50	34	30	55	55	35	55	55
ZEKUIANO	42	19	42	31	9	49	32	27	36	22	27	42	19	10	36	33	14	32	27
MAEZTU	36	4	36	6	4	34	11	21	31	23	19	28	9	1	13	25	10	16	10
ATAURI	40	32	40	32	24	39	36	44	39	50	30	27	4	11	46	42	12	38	35
ANTOÑANA	9	14	9	15	14	37	18	46	37	39	24	3	7	2	39	37	1	9	11
FRESNEDO	8	28	8	28	25	40	35	28	33	18	32	6	15	18	35	29	8	13	17
KANPEZU	6	9	6	21	6	36	28	17	32	16	23	8	18	5	26	21	6	8	7
ORRADICHO	18	13	18	33	5	35	49	18	46	35	21	9	12	3	28	41	3	15	14
ZUÑIGA	43	25	43	22	21	23	33	48	40	42	25	36	6	9	47	40	11	33	32
ARQUITAS	51	44	51	45	41	31	46	54	53	54	43	33	2	16	52	54	13	50	48
ACEDO	37	24	37	16	30	30	23	38	34	34	16	32	5	24	32	32	19	29	28
GRANADA	52	41	52	41	45	50	44	53	54	52	37	35	1	25	53	52	16	49	47
ANCIN	34	11	34	5	26	24	9	32	28	21	15	39	11	22	16	22	21	21	19
MURIETA	35	10	35	9	17	22	10	24	30	20	18	38	22	13	12	24	25	22	20
ZUFIA	50	34	50	27	44	29	34	49	46	40	42	53	8	23	44	45	22	45	41
ZUBIELQUI	48	30	48	26	27	29	17	30	44	25	20	47	27	27	25	39	30	43	37
LIZARRA	5	5	5	4	11	8	4	5	6	7	11	12	48	29	5	8	27	4	4

0-13	14-27	28-41	42-55

added that nodes located in Vitoria-Gasteiz show higher results than northern towns in this criterion. This is because the existence of a large network of non-motorised transports (N3) and protected natural areas near the city (C3). The availability of flat lands makes it easier to combine urban activities and natural areas, which is difficult in Gipuzkoa due to the narrowness of the valley and its consequent high population and industrial densities. Moreover, Antoñana has the highest rural criterion scores, while Granada and Maeztu ranked first in rural activities (C3) and rural morphology (U3) respectively.

Results are quite different in the 1000 m and 500 m areas (annex 4.2.6), since the smaller the areas, the more similar they are. However, the differences in the ranking respond especially to the walking and running areas of Vitoria-Gasteiz, which are similar to the areas of other intermediate size towns. In this regard, in the 1000 m area, Lizarra is number two in total values, but it ranks first in the node approach of the classification. What is more, it ranks first in total values in the 500 m area. In this case, Trokoniz leads the place variable and the rural criterion. Moreover, number one in multiaxial variables is divided between several node areas: Vitoria-Ciudad (N1, U1 and U2), Lizarra (C1), Landeta-Marianistas (N2), Oñati (C2), Antoñana (N3), Zufia (U3) and Atauri (C3).

6.2.5. Comparison and classification of node areas

Results of the defined node areas have been compared in order to study their transport and land use balance on the one hand, and to distinguish several groups with common characteristics that are able to represent the existing development typologies on the other hand.

COMPARISON OF RESULTS

All railway station areas have been included in a single diagram in order to compare the results of the node/place model (fig. 6.9). A diagram has been created for each type of catchment areas (2000, 1000 and 500 m), where indicators have been separately rescaled from 0 to 1 for each diagram, i.e. the three influence areas have been separately studied and compared.

According to the resulting diagrams (annex 4.3.1), although most of the former railway station areas are located in the balanced area of the diagram, values are significantly low. Moreover, there is not any station located in the balanced stressed area or in the unsustained node area. In the 2000 m zone, Vitoria-Ciudad is the only that is close to the stressed area. In this regard, most of the stations are sited bellow the line that represents absolute equilibrium, where place-indexes are higher than node-indexes. As a result, mean values of node-indexes correspond to 1.87, 1.65 and 1.59 values for the three different areas, while place-indexes are 3.18, 2.93 and 2.45.

Therefore, some unsustained places have been identified, the number of which varies with the size of the analysed area (5 in the 2000 m area, 6 in 1000 m and 1 in 500 m). Erentxun is the only station area that remains as an unsustained place in the three diagrams, while Maeztu and Zubielqui maintain the cycling and intermediate influence zones but modify the walking zone (balanced area). Gauna, Aberasturi and Zekuiano in the 1000 m zone or Zufia and Granada in the 2000 m zone are the other railway station areas recognised as unsustained places.

Furthermore, many of the balanced station areas are located in the dependent area, where both node and place values are low. In this regard, 10, 17, and 24 stations have been respectively classified in the 2000 m, 1000 m and 500 m zones. Nine of them (Castañares, Uribarri-Jauregi, Arquijas, Marin, Legutio, Brigada Tunel, Mazmela, Zarimuz and Laminoria) are dependent areas in the three zones, while other eight (Maltzaga, Leintz-Gatzaga, Erretana, Acedo, Zuñiga, Zufia, Granada and Orradicho) in the 500 m and 1000 m zones.

Finally, 40 (2000 m), 32 (1000 m) and 30 (500 m) former railway station areas have been identified as balanced node and place areas. By and large, their place-indexes go from 2 to 5, while the node-indexes go from 1 to 4. Furthermore, there are only few railway station areas that have 3.5 or higher values in both node and place indexes. Vitoria-Ciudad, Vitoria-Apeadero and Lizarra achieve these values in the three diagrams, while Olarizu in the 1000 m and 2000 m zones and Estibaliz in the 2000 m zone. In addition, some of the node areas are located quite far from the line of equilibrium in the balanced area. Thus, node approach should be enhanced in order to obtain more balanced results, since the reduction of the place-index could become them into dependent areas. Some of the northern towns, such as Soraluze, Arrasate, Bergara, Oñati or Aretxabaleta, and other main towns of the Navarre zone (Antzin and Murieta) are in this situation in the 2000 m and 1000 m zones. In the 500 m zone, however, Arrasate and Aretxabaleta are located closer to the line, while Bergara has crossed to the other side of the line. Meanwhile, Antoñana, Andollu, Landeta-Marianistas, Fresnedo, Zubillaga, Los Martires, Landa, San Prudencio and Mekoalde are the ones located close to the line of balance, of which San Prudencio has the closest location and Antoñana the highest node and place indexes.

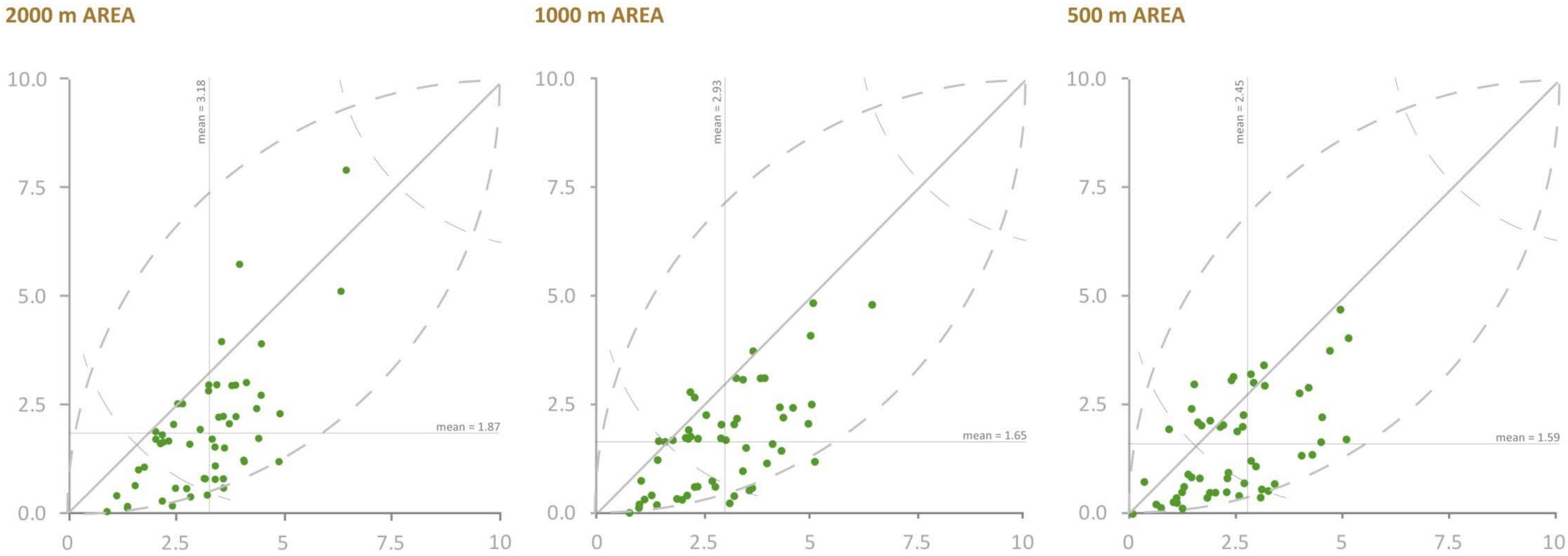


Figure 6.9 Node/place model of all defined node areas in the 2000 m, 1000 m and 500 m zones

The balance between transport and land use has been studied and compared for the defined node areas using a single diagram in the node/place model. Nevertheless, a single diagram cannot be created in the case of the NCU and multiaxial models. In this regard, defined node areas have been divided in groups and different diagrams have been created in these cases (annex 4.3.2). The two divisions obtained in the accessibility analysis of the line have been used for this purpose: zones concluded in the accessibility analysis of cities or towns, and type of relations between node and surrounding urban areas.

In the NCU model, in addition to the balance between the three variables, the distribution of land uses according to the activities and the morphology of the area can be distinguished. In zone 2, for example (fig. 6.10), some of the areas show a balance between nodus, civitas and urbs (Arlaban and Landa) but others show higher values in urbs. In the case of Zarimuz or Marin, place-indexes of the node/place model were related almost entirely to the urbs variable. In zone 1, a similar effect occurs: while several of the node areas are quite balanced, others represent higher urbs values. Meanwhile, in zone 5

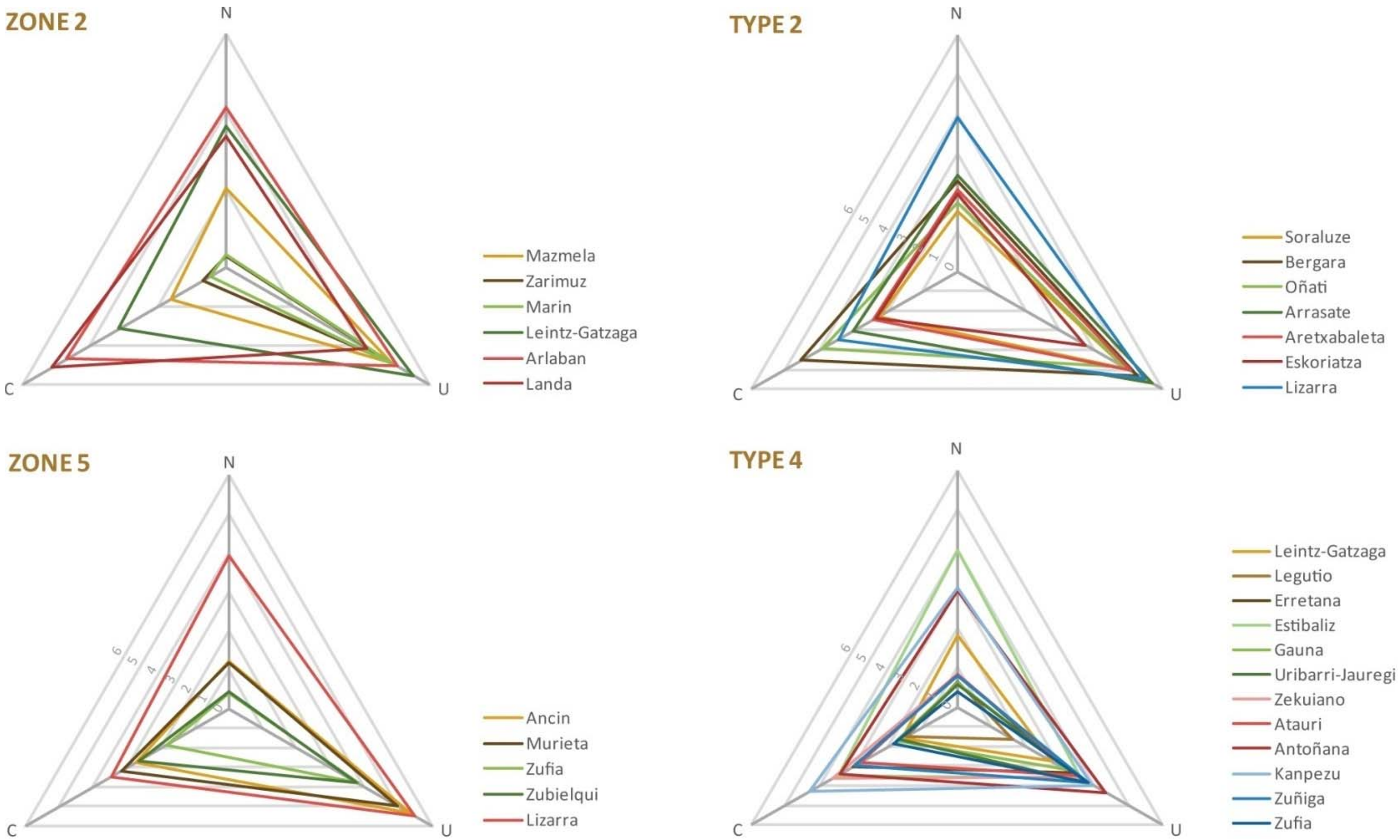


Figure 6.10 NCU model of some defined node areas in the 2000 m zones according to zones (left) and type of relations (right)

(fig. 6.10), the most balanced node area is Lizarra. It is the most different node area due to its high nodus value, followed by Antzin and Murieta, which show very similar results between them. Conversely, civitas and urbs values remain fairly balanced between them in zone 3, where results are considerably higher in the nodes located in Vitoria-Gasteiz. Finally, very different values have been obtained in the node areas of zone 4.

According to the type of relations between node and urban areas, more similarities in results have been found in the node areas of the same type. Although civitas values are different, general results are quite similar for all node areas in type 2

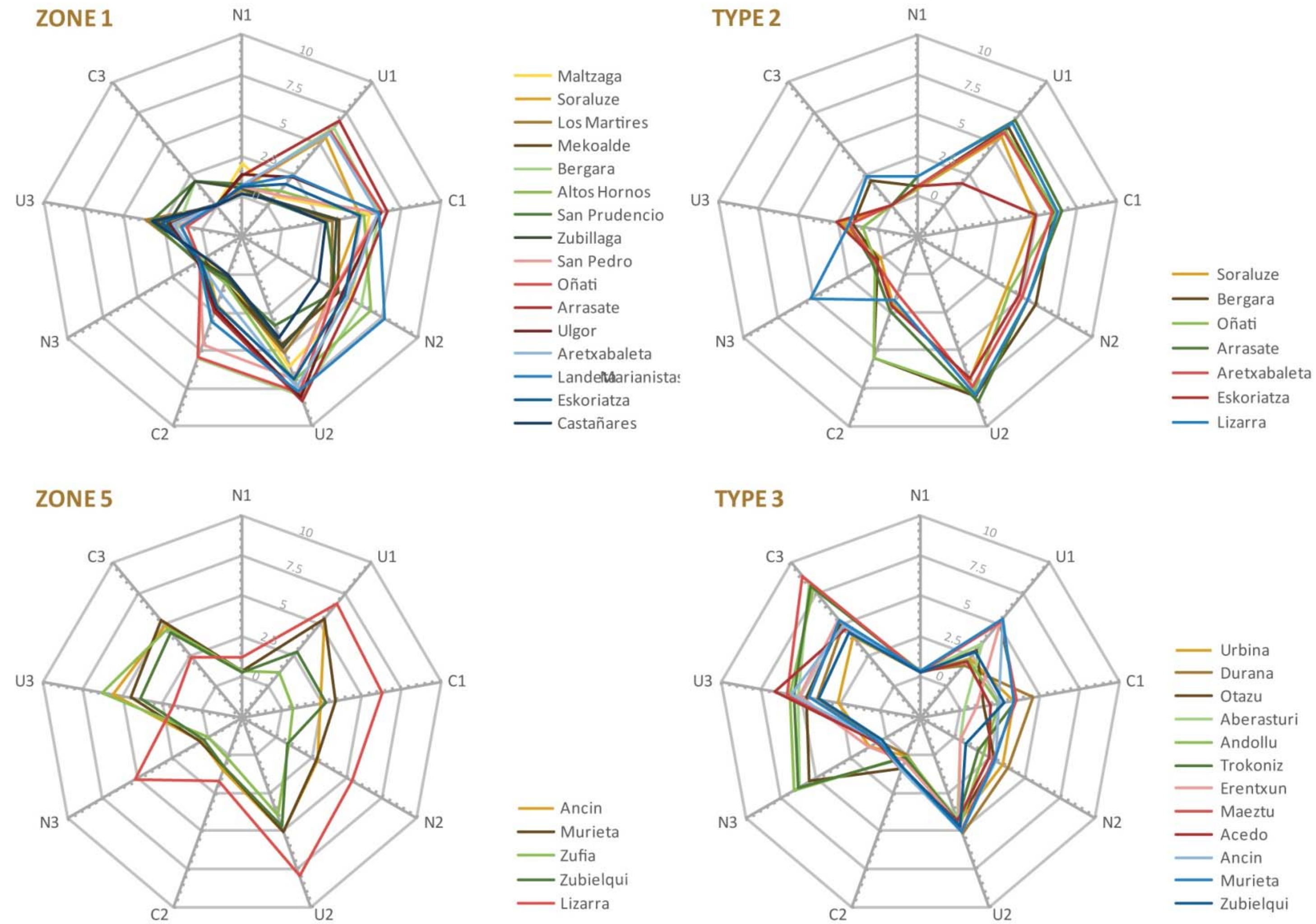


Figure 6.11 Multiaxial model of some defined node areas in the 2000 m zones according to zone (left) and type of relation (right)

(fig. 6.10), where Lizarra is the only different because of its mentioned high nodus value. Moreover, two groups can be distinguished in type 4, (fig. 6.10): the ones that represent quite balanced node areas (Antoñana, Fresnedo, Kanpezu and Orradicho) and the ones that do not due to their lower node values. On the other hand, node areas that are not located in a certain urban or rural core (type -) have been divided in two, taking into consideration whether industrial areas are located close to them (a) or not (b). Olarizu and Orradicho railway station areas are highly differentiated in these groups because of their high node and civitas values respectively.

In the multiaxial model, urban and rural approaches of each defined node areas are represented (annex 4.3.3), from which some conclusions have been easily drawn. Rural features are almost nil in zone 1 (fig. 6.11), but they are highly representative in zone 2 or 4. Meanwhile, zone 3 includes diverse node areas, comprising all variables in the zone. Similar conclusions have been drawn in the comparison made by the types resulted from the relations between node areas and urban cores. Type 2 and type –(a) have low rural values (expect Lizarra and Olarizu), while type 4 and type –(b) have high rural values and low urban and general values. Finally, type 1 is significantly different from others according to its high urban and general values.

Furthermore, the multiaxial model makes it easier to distinguish different groups that have similar features. On the one hand, most of the node areas of zone 5 (except Lizarra) have high values in rural activities (C3) and general and rural morphologies (U2 and U3), (fig. 6.11), but the same happens in the case of several of the nodes in zone 4 or zone 3. Moreover, a group with high rural values (N3, C3 and U3) has been also distinguished in zone 3 and 4. On the other hand, the different types of relations show more clearly a possible grouping. Type 2 for example, is comprised by quite similar node areas, where Eskoriatza is the most unfavourable node area due to the location of the station area in an industrial area, and Oñati and Lizarra present the highest values related to the elements of interest (C2) and non-motorised transports (N3) respectively (fig. 6.11). In addition, type 3 and 4 include two groups: one of them has high values in all rural variables, while the other only has significant values in two of them (C3 and U3). Moreover, some of the node areas located in type –(b) can correspond to the previous groups, such as Orradicho or Fresnedo.

To sum up, the use of several variables makes difficult the comparison between the areas. That is why a division into zones or types was necessary. In this regard, PCA has been used to check if components that are able to represent several variables can be created in order to overcome this shortcoming.

The PCA analysis has been applied in the 55 defined node areas of 2000 m. The correlation matrix shown in table 6.11 reveals that all urban and general criteria are intercorrelated among themselves, while they are negatively correlated with the variable referred to the rural morphology (U3). On the other hand, the rural activity variable (C3) is negatively correlated with some of the other variables (C1, N2, U2, C2, N3 and U3), while, the non-motorised transport variable (N3) is only correlated with the public transports variable (N1).

Accordingly, new components that represent the nine previous variables have been created with the aim of representing all data in few new components. The first three components account for the 84.14% of the total variance, with a variance of up to 7.17%, while eigenvalues fall less than unity after the first three components (table 6.12).

The first component (F1) has a variance of 56.7% and is positively determined by the urban and general criteria (N1, U1, C1, N2, U2 and C2), while negatively determined by the rural morphology variable (U3) (table 6.13), as expected in the correlation matrix. Meanwhile, component F2 (20.27%) is characterised by non-motorised transports (N3) and rural activities (C3), cumulating the 76.97% of the total variance. Finally, the third component F3 (7.17%) shows very low correlations with the different variables. That is why the two first components are able to easily represent all the variables. Hence, the first component represents the urbanity of the area while the second is related to rural activities and tourism. Nevertheless, two components result inadequate for the comprehension of the differences between nodes, especially when one of the components includes seven of the nine variables. A model based in F1 and F2 would correspond to a two axes diagram that would represent the urban and general approach of the node areas versus their rural approach.

Table 6.11 Correlation matrix of the PCA. Values in bold represent significant correlations (95%)

CORRELATION MATRIX (Pearson (n))

	N1	U1	C1	N2	U2	C2	N3	U3	C3
N1	**1**								
U1	**0.599**	**1**							
C1	**0.663**	**0.669**	**1**						
N2	**0.411**	**0.397**	**0.740**	**1**					
U2	**0.595**	**0.688**	**0.956**	**0.769**	**1**				
C2	**0.746**	**0.722**	**0.714**	**0.500**	**0.700**	**1**			
N3	**0.396**	0.224	0.176	-0.054	0.179	0.140	**1**		
U3	**-0.466**	**-0.408**	**-0.648**	**-0.730**	**-0.639**	**-0.603**	0.100	**1**	
C3	-0.211	-0.077	**-0.373**	**-0.526**	**-0.361**	**-0.321**	**0.470**	**0.735**	**1**

Table 6.12 Component characteristics of the PCA. Values in bold are meaningful

EIGENVALUES

	F1	F2	F3	F4	F5	F6	F7	F8	F9
Eigenvalue	**5.10**	**1.82**	0.64	0.58	0.29	0.22	0.19	0.11	0.03
Variability (%)	**56.70**	**20.27**	**7.17**	6.49	3.19	2.47	2.07	1.28	0.37
Cumulative %	56.70	76.97	**84.14**	90.63	93.82	96.28	98.35	99.63	100

Table 6.13 Correlations between variables and new components or factors

CORRELATIONS BETWEEN VARIABLES AND FACTORS

	F1	F2	F3	F4	F5	F6	F7	F8	F9
N1	0.76	0.37	-0.20	0.37	0.27	0.02	-0.19	-0.07	0.03
U1	0.74	0.36	-0.32	-0.33	-0.25	-0.06	-0.20	0.04	-0.01
C1	0.93	0.08	0.16	-0.16	0.15	-0.17	0.08	-0.09	-0.12
N2	0.80	-0.29	0.40	-0.11	0.05	0.28	-0.14	0.10	-0.02
U2	0.92	0.07	0.20	-0.24	0.07	-0.14	0.10	0.01	0.13
C2	0.85	0.17	-0.37	0.05	0.02	0.19	0.26	0.10	-0.01
N3	0.13	0.84	0.36	0.33	-0.18	-0.06	0.04	0.10	-0.01
U3	-0.80	0.40	-0.05	-0.24	0.30	-0.06	-0.04	0.20	-0.01
C3	-0.52	0.76	0.08	-0.27	0.03	0.22	0.04	-0.17	0.01

CLASSIFICATION OF DEFINED NODE AREAS

A clustering of the defined node areas for the 2000 m zone has been developed based on the multiaxial model and taking into consideration its nine variables. On the one hand, a visual grouping based on the multiaxial diagrams has been developed, defining the adequate number of groups or development typologies. On the other hand, a statistical clustering (k-means clustering) has been performed in order to compare them and to validate or enhance the first grouping.

The first grouping has been obtained from the resulting polygons of the multiaxial diagrams, for which the previous comparison by zones and types have been helpful. Accordingly, the 55 node areas have been classified in eight main typologies (fig. 6.12 and annex 4.3.4):

- Typology 1 refers to very high values of urban and general criteria, while rural criterion is not significant. The two nodes of the city centre of Vitoria-Gasteiz are the only ones included in this group, which in turn were the only nodes of type 1.

- Typology 2 corresponds to high values in urban and general morphology (U1 and U2), urban activities (C1) and private transports (N2), but not in rural criterion, public transports (N1) or elements of interest (C2). They are mainly urbanised and industrialised areas, so northern towns and Lizarra have been included in this group. In this regard, all the node areas except Lizarra are of zone 1, while all of them correspond to the same type of relations (type 2). Nevertheless, Lizarra and Oñati show higher values of non-motorised transport or elements of interest respectively. Therefore, the C2 value of the case of Oñati should be especially considered in zone 1.

- Typology 3 shows similar features than typology 2, but in this case, urban morphology (U1) values are low. Accordingly, this group includes the node areas located in the industrial areas that are close to the towns related to typology 2. The node of Eskoriatza has been included here and not in typology 2 because the former railway station is located on the fringe of the town. Furthermore, Olarizu has been incorporated into the group, although node values related to public transports (N1) and non-motorised transports (N3) are higher. As in the case of typology

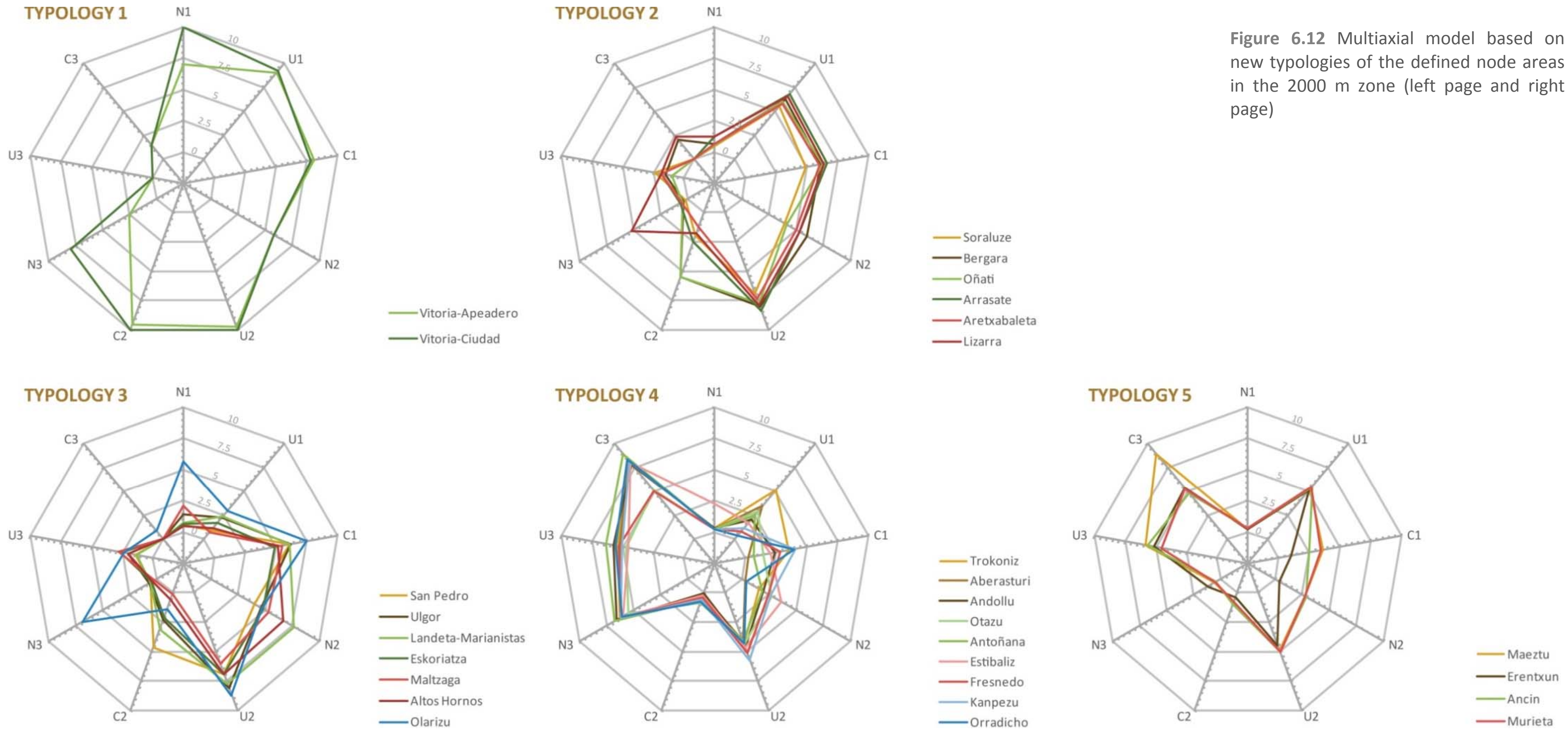
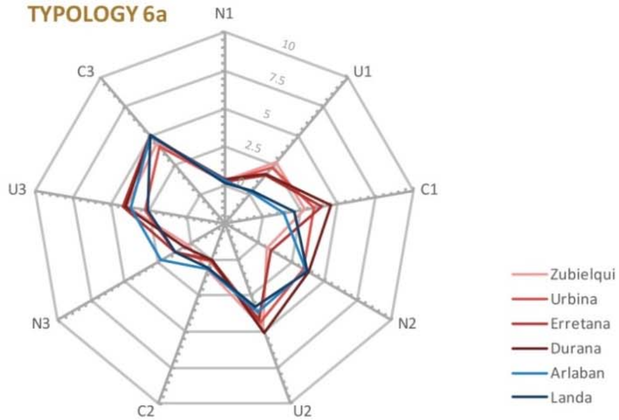


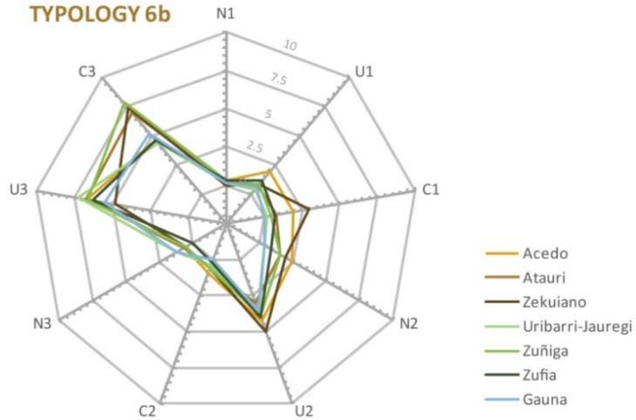
Figure 6.12 Multiaxial model based on new typologies of the defined node areas in the 2000 m zone (left page and right page)

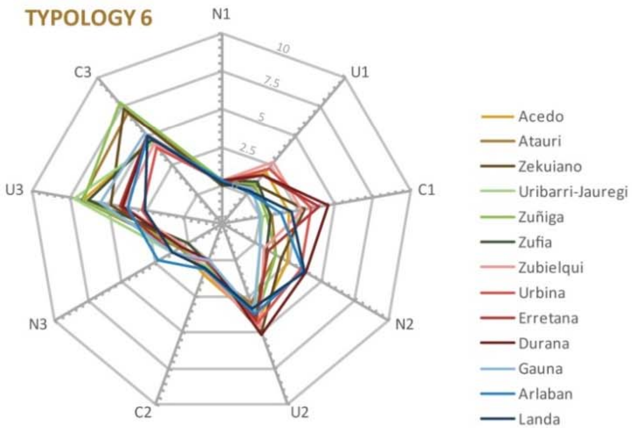
2, all the node areas included in the group are of zone 1 (except Olarizu), while most of them correspond to the same type of relations (type -(a)). Eskoriatza is the only that corresponds to type 2.

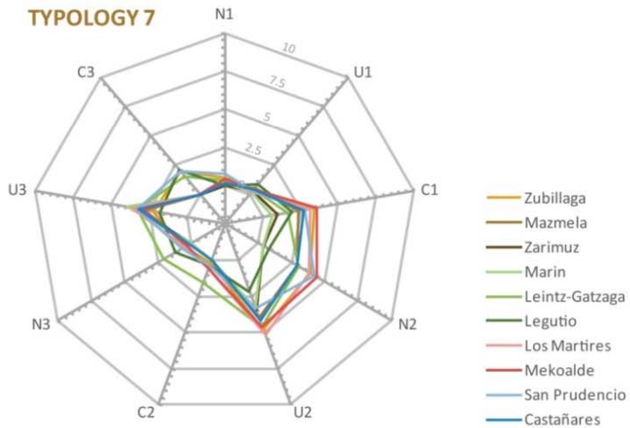
- Typology 4 includes all nodes with high values in the rural criterion (N3, U3 and C3). Nevertheless, they have medium scores in population (U2) and low scores in public transports (N1) or elements of interest (C2). Nodes located in the areas of Otazu-Trokoniz in zone 3 and Antoñana-Orradicho in zone 4 have been included in this group. The first area includes four rural towns (type 3) and the node located in the sanctuary of Estibaliz, while the second includes two areas around towns (type 4) and other two rural or natural areas (type -(b)).

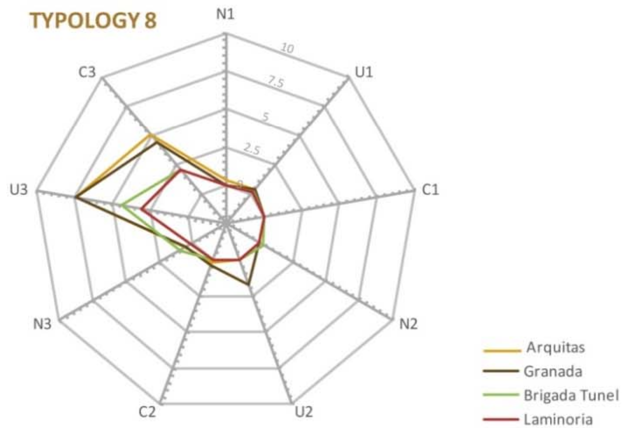
- Typology 5 refers to significant values of rural activities (C3) and all morphological variables (U1, U2 and U3). Four node areas are only included in the group, from which Maeztu is











distinguished because of its high C3 score. Although located in different zones, all of them correspond to rural towns (type 3). Furthermore, the two strategic points between zones that were identified in the accessibility analysis (Erentxun and Antzin) have been classified in this group.

- Typology 6 is based in typology 5, since rural activities (C3) and morphological approaches are highlighted. However, the variable referred to urban morphology (U1) is insignificant in this case. Several node areas from different zones and types have been included in this group. In this regard, the group has been divided in two (typology 6a and typology 6b) in order to obtain results that are more accurate. The node areas that have medium C3 and U3 values have been included in typology 6a, while the ones that have higher results in typology 6b. Thus, similarities within each group have been observed. In 6a, nodes from zones 2, 3 or 5 and types 3, 4 or -(b) can be identified. Meanwhile, all the nodes are of zone 4 (except Zufia) and type 4 (except Acedo) in 6b.

- Typology 7 shows worse results in comparison with the previous typologies. Accordingly, rural criterion has considerably diminished, but scores higher than 2.5 have been reached in some of the variables (C1, N2, U2 or U3). Several node areas from zones 1 and 2 have been included in addition to the node of Legutio (zone 3), which correspond to several types of relations (4, -(a) and -(b)). Therefore, node areas of zone 1 included in typology 7 have fewer attractiveness than the other ones, located in typology 2 or 3.

- Typology 8 includes the node areas that have almost nil values in six of the nine variables. The included four nodes areas are located in zone 4 and all of them correspond to type –(b). Most of them are areas located close to tunnels and in consequence, their influence is weaker.

This first graphical grouping can be a laborious process depending on the number of node areas that are necessary to analyse. Furthermore, the characterisation of the different groups can be quite subjective in some of the cases. In this regard, a statistical clustering has been made using k-means analysis. This second classification or grouping has been developed taking into account the initial nine variables, and different number of classes (8, 9 and 10) has been used in order to compare the resulting groups with the preciously obtained ones. In the three cases, the intra-class variance is lower than the inter-class variance.

Table 6.14 Characterisation of the 8 groups obtained by means of the k-means analysis. N is the number of node areas per group

CHARACTERISATION OF GROUPS (8)										
GR.	N	N1	U1	C1	N2	U2	C2	N3	U3	C3
1	2	8.50	8.34	7.89	5.12	9.89	9.77	4.77	0.00	1.50
2	3	0.58	3.55	5.56	4.22	7.57	5.20	0.48	1.32	0.68
3	10	1.45	2.95	5.61	5.02	7.52	1.70	1.43	2.09	0.34
4	9	0.48	1.76	3.28	1.74	4.61	0.44	5.52	5.32	7.55
5	4	0.29	4.23	3.59	1.90	4.87	0.72	0.78	5.29	6.10
6	6	0.27	1.11	3.41	2.62	4.23	0.36	1.43	3.51	4.74
7	9	0.21	0.63	2.76	0.92	3.26	0.43	0.72	6.52	5.63
8	12	0.24	0.28	2.74	2.16	3.32	0.31	0.69	3.14	0.99

Table 6.15 Node areas included in each group

GROUPING (8)							
GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
Vitoria-Ciudad	Maltzaga	Bergara	Otazu	Erentxun	Arlaban	Gauna	Los Martires
Vitoria-Apeadero	Soraluze	San Pedro	Aberasturi	Maeztu	Landa	Uribarri-Jauregi	Mekoalde
	Altos Hornos	Oñati	Andollu	Ancin	Urbina	Zekuiano	San Prudencio
	Arrasate		Estibaliz	Murieta	Erretana	Atauri	Zubillaga
	Ulgor		Trokoniz		Durana	Zuñiga	Castañares
	Aretxabaleta		Antoñana		Zubielqui	Acedo	Mazmela
	Landeta-Marianistas		Fresnedo			Granada	Zarimuz
	Eskoriatza		Kanpezu			Zufia	Marin
	Olarizu		Orradicho			Arquitas	Leintz-Gatzaga
	Lizarra						Legutio
							Brigada Tunel
							Laminoria

The features of each group obtained in the k-means clustering referred to 8 classes have been included in table 6.14, while the node areas that are located in each group are presented in table 6.15. In this case, great similarities between the k-means clustering and the first grouping have been easily identified, where most of the groups correspond exactly to the previously defined typologies. Nevertheless, two differences are observed. On the one hand, typology 8 does not exist, so the four node areas located there have been distributed in other groups (two in group 7 and two 8). Accordingly, Arquijas and Granada would be included in typology 6b, and Laminoria and Brigada Tunel in typology 7. On the other hand, the nodes located in typologies 2 and 3 have been differently distributed. In the case of the k-means clustering, Group 2 (Bergara, San Pedro and Oñati) has been limited by the C2 variable, while the U1 variable seems to be a high conditioning factor in order to divide groups 2 and 3.

Nevertheless, the clustering developed with ten classes (annex 4.3.5) shows another classification of the node areas related to typologies 2 and 3. In this case, the initial division is used to create groups 2 and 3, but another group (10) is also created with the node areas that have some peculiarities (Lizarra and Olarizu). However, these small differences are not considered significant enough to justify the inclusion of a new typology in the initial grouping.

Furthermore, typologies 1 and 7 have been maintained in the k-means clustering of ten classes, while the other typologies have experienced small changes. Otazu and Granada have been moved from typologies 4 and 8 to 6a and 6b respectively, as Zubielqui and Zekuiano from 6a and 6b to typology 5. Typology 5 was characterised by scores around 5 in the three morphological variables, but Zubielqui and Zekuaino do not meet this requirement in U1. That is why these changes have not been approved. Regarding the node area located in Otazu, its values correspond to the main feature of typology 4, i.e. high values in all rural variables, so it seems to be inappropriate to change it into another group. Finally, although Granada can be included in typology 6b, its population levels (U2) would be lower than any other node area of the group.

As a result, nine final groups that correspond to the initial classification have been created (A-I) (fig. 6.13). They refer to different development typologies and show the variety of results related to their multiaxial model features, as described below:

- Group A corresponds to the node areas of main city centres located along the line. The only main city along the Vasco-Navarro Railway is Vitoria-Gasteiz and hence, two node areas have been only included in this group. Urban and general criteria are very high in these areas.

- Group B comprises the nodes of intermediate cities or towns. Most of them are located in Gipuzkoa and they are characterised by high urbanity and activity levels, predominance of private motorised transports and lack of rural or natural areas in their immediate environment. In this regard, and taking into account that most of them are unsustained places according to the node/place model, strengthening of public transports and non-motorised transport would be a possible guideline to follow.

- Group C includes the nodes located in the industrial outskirts of urban areas. They are areas with significant level of activity and population, but they are located out of the city, where transport infrastructures have an important role in their operability. Nowadays, predominant transport infrastructures are related to motorised means of transportation. Nevertheless,

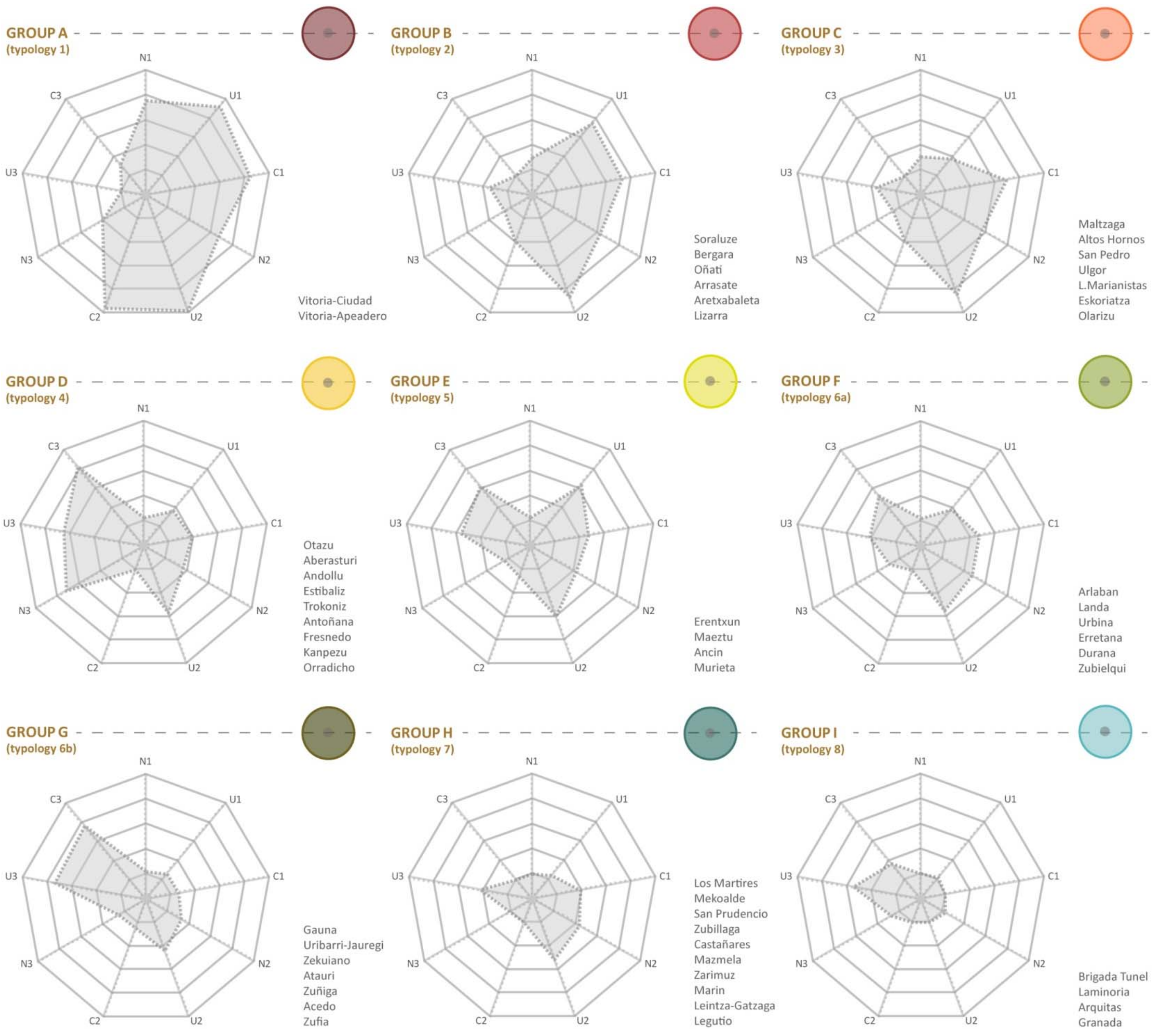


Figure 6.13 Final clustering of the defined node areas in the 2000 m zone

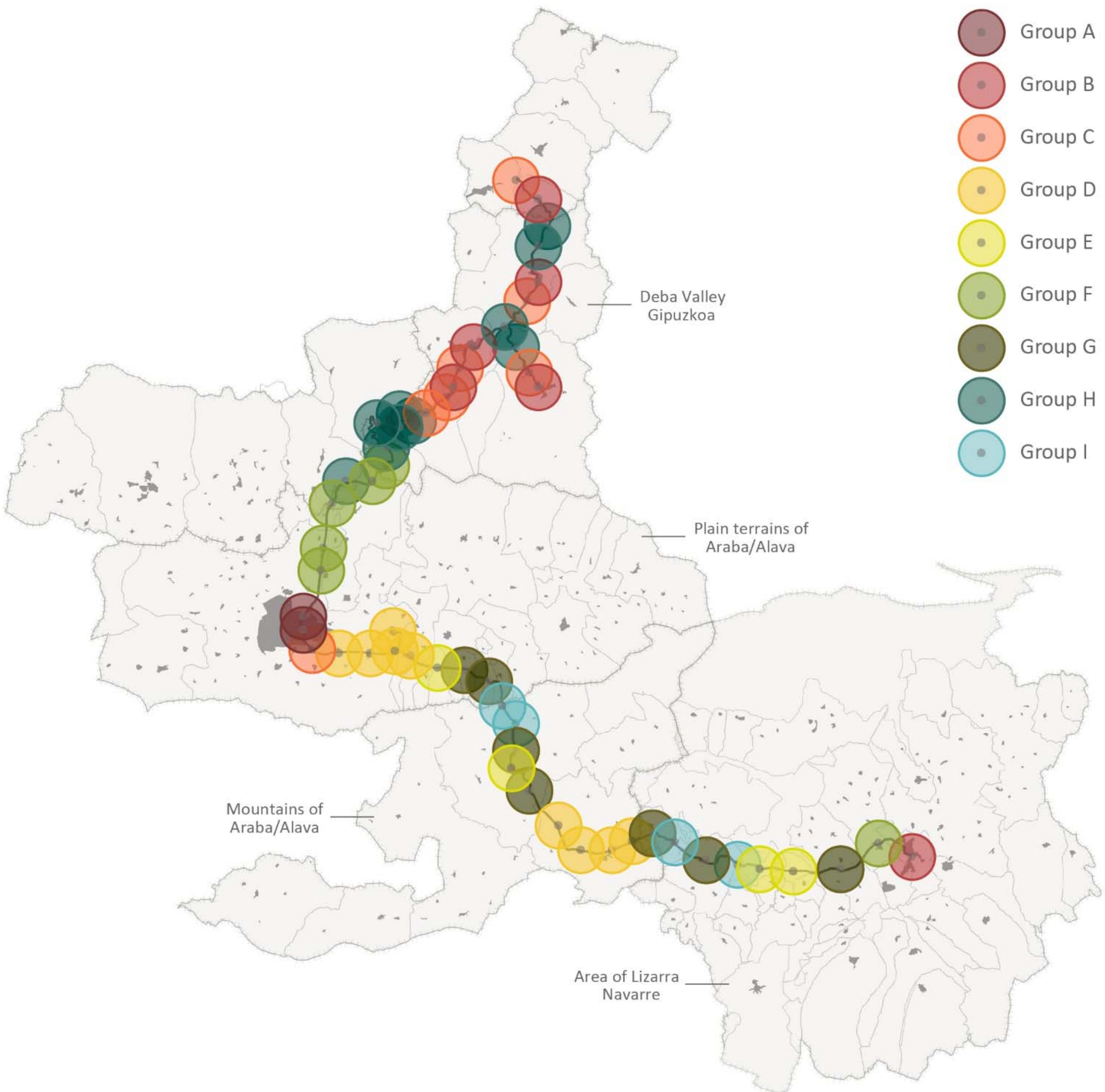


Figure 6.14 Final clustering of the node areas along the Vasco-Navarro Railway

differences in the node/place balances of the nodes included in the group makes it difficult to assess a single direction in their future development. In this regard, promotion of sustainable transports (public and non-motorised) and rural activities or elements of interest that are able to generate attraction should be taken into consideration in order to achieve a future balanced development strategy.

- Group D comprises the node areas of the rural towns that show a high level of rural criteria. They are mainly balanced areas that have low values of motorised transports infrastructures. This situation can be used to encourage public and non-motorised transports, in addition to include new activities or elements of interest. Hence, local development should be promoted.

- Group E refers to strategic node areas located in small towns. They are unsustained places based on high levels of morphological features and rural activities but low levels of transport infrastructures. Accordingly, the potential of the node areas located in this group is related to the future promotion of transport systems. Furthermore, two of the nodes located in the group correspond to the strategic points sited between the different territorial zones. In these cases, the preservation level of the railway elements positively enhances future interventions, i.e. the better the conservation of elements, the higher future development opportunities. As in group D, local development should be promoted.

- Group F corresponds to the node areas located in rural areas that have some urban or general features in addition to their rural character. Some of the former railway stations included in this group have balanced areas, but the ones that comprise some urban settlement correspond to unsustained places, where again, sustainable transports should be promoted.

- Group G is also associated with rural areas. Rural morphology and activity indicators are fairly significant, while population levels are medium. Meanwhile, other variables show low values, so they correspond to unsustained places. Leisure and tourism activities related to rural and natural environments can be encouraged in these areas, if suitable transport systems are included.

- Group H includes the node areas located in non-developed or monofunctional areas. They do not show any interesting rural or natural element, although they can comprise low population or activity densities.

- Group I refers to the nodes that have a small influence area due to the lack of suitable transport networks in their surroundings.

These identified groups that classify the different node areas are not regularly distributed along the line (fig. 6.14). Therefore, the northern section include node areas classified as group A, B, C, F and H, while in the southern section groups D, E, G and I can be identified. As an exception, two node areas of groups B and F respectively are located in the south end of the line. In this regard, groups that have strong urban features are located in the north, in addition to other node areas with less significant overall values. Meanwhile, groups with high rural and natural characteristic levels (except group I) are placed in the south. Furthermore, node areas appear one after the other in some groups (A, D, G and H), while they are fairly widespread along the line in others.

Furthermore, the different territorial zones also show a variety in the classification of their node areas. In zone 1, nodes from three different groups (B, C and H) are interspersed. Nodes from groups B and C are coupled working together as an urban area (Bergara and Oñati) or are grouped creating an area of different urban cores (Arrasate-Aretxabaleta-Eskoriatza). Meanwhile, two zones with nodes that correspond respectively to groups H and F have been identified in zone 2. Accordingly, each section or zone would be related to a specific future strategy, but both of them should be related to the non-motorised infrastructure (as a greenway) and its surrounding tourism activities. Similarly, there are several sections of nodes that are related to a single group in zone 3 (Urbina-Erretana-Durana (F), Vitoria-Gasteiz (A and D) and Otazu-Trokoniz (D)), so the same strategy can be applied in each whole section. Moreover, zone 4 includes several groups (D, E, G and I), of which nodes of group D are clustered, while the others are scattered. Hence, two different situations have been identified: on the one hand, nodes located between Antoñana and Orradicho are of group (D); on the other hand, a combination of a node of group E and two nodes of group G has been distinguished in two areas (Erentxun-Gauna-Uribarri and Zekuiano-Maeztu-Atauri). In this regard, two different strategies should be implemented regarding to the different situations. Finally, zone 5 includes five node areas of four different groups.

6.3. Conclusions

As part of the comprehensive analysis method, the relations between former railway stations and their surrounding territory are studied in this chapter. For this purpose, transport and land use balance is sought and developments based on active transports are suggested. Accordingly, the node/place and NCU models, proposed for TOD developments, have been adapted to nodes of non-motorised transport infrastructures in order to manage their balance between transport and land uses and to propose suitable future general approaches. Nevertheless, these models are not able to represent the reality in territories of varied nature (urban and rural). In this regard, a multiaxial model has been created for a comprehensive characterisation of node areas and the proposal of future specific guidelines. Hence, three models that complement one another are used, where the results refer to the potential of node areas in a non-motorised axis and the future possible directions that each node area could include.

In addition to the urban criteria proposed by previous authors, the creation of new variables and indicators has been necessary for the adaptation and construction of the models. Accordingly, criteria related to the character of disused railways in varied territories have been included, i.e. data related to rural features and activities have been assessed. Hence, the proposition of former railway stations as nodes in a non-motorised infrastructure is possible at territorial level, where not only urban cores are studied.

Furthermore, the combination of two methods is also used for the clustering of the different results of the node areas. The visual analysis of the diagrams is useful for the comprehension of the main features that each group comprise or the differences that can exist between them. Nevertheless, it can be laborious in the cases where the sample number is high, in addition to somewhat subjective. Conversely, k-means clustering on its own does not illustrate the differences that can appear in the nodes included in the same group. In this regard, the statistical method is used to validate or enhance the initial grouping.

As in the previous chapter, the proposed models are applicable to disused railway nodes (regardless of the system structure) located in diverse territories, but could be widespread referring to the type of transport (changes in distances) or even the system itself (any territorial system composed of several nodes).

In this case, the methodology has been applied to the Vasco-Navarro Railway and, hence, its node areas have been characterised by the three models. Low node-index values have been generally obtained and therefore several unsustained places or balanced dependent areas have been identified. Accordingly, most of the strategies or guidelines are related to transport improvements. Furthermore, the use of previously identified zones and types in the comparison has been very useful for the creation of groups according to the multiaxial model diagrams. Moreover, PCA has not entailed the creation of suitable components and consequently, initial nine variables have been used to develop the k-means clustering. As a result, different development typologies or groups from totally urbanised and industrialised areas to rural and natural areas have been distinguished.

Finally, some problems or shortcomings have been detected in the research process. On the one hand, data that correspond to different provinces and autonomous communities have been compiled, since the Vasco-Navarro Railway is not limited by administrative boundaries. Information of different sources is not comparable in several cases, so percentages of real data have been used for the analysis of some of the node areas (especially in Navarre). Meanwhile, the application called LurData of the Basque Statistics Institute has been used, which provides information of any area combining a GIS and statistical data, although there are not much data available yet. On the other hand, sensitivity analysis has been proposed for the validation of the initial non-objective weights. However, it has not been used to detect changes in the ranking of nodes, since small changes in weights produced variations in a ranking of 55 nodes. That is why sensitivity analysis has been applied to obtain the percentages of improvement in general results. Another way to overcome the shortcoming would be to include multiple decision makers in the initial judgment.

Contribution 8:

The relations between the disused railway nodes and their surrounding environments have been studied implementing TOD concepts on DRSs and studying former railway station areas as nodes of a non-motorised axis. This conception makes it possible the comprehension of railway heritage elements as territorial structuring elements.

Contribution 9:

Previous models have been adapted to DRSs and their surrounding territories, while a specific multiaxial model has been also created. Together, they are able to characterise each node area as well as to assess their transport and land use balance. Furthermore, several indicators that were not included in previous proposals and mainly represent rural features have been incorporated. Hence, general, urban and rural criteria are used for a comprehensive approach of the territories where the DRSs go through.

Contribution 10:

Two approaches for the identification of future new nodes along the non-motorised infrastructure have been proposed. One of them refers to the accessibility analysis of the areas around the infrastructure, while the other is based on transport and land use features. Although new future nodes others than railway elements have not been recognised in the Vasco-Navarro Railway, the proposals have been suitable to validate the identification process.

PART IV: METHODOLOGICAL PROPOSAL

7. COMPREHENSIVE ANALYSIS METHOD (CAM) FOR THE STUDY OF DISUSED RAILWAY LINES (DRL) AS COMPLEX SYSTEMS

The Comprehensive Analysis Method (CAM), resulted from the initial approach (Part II) and the development (Part III) of the method, and based on the three presented theoretical and methodological conceptions (Part I), is presented in the following chapter for the analysis of Disused Railway Systems (DRS). Accordinly, DRLs can be understood as territorial structuring systems, thus demonstrating their potential in the territory.

7.1. Comprehensive Analysis Method (CAM) for a DRS

Although the arrival of the railway was in the 19th century, several of them were closed in the 20th century. In the present 21th century, the future of these disused railways is questionable. In this regard, the proposed Comprehensive Analysis Method (CAM) responds to the current and future lack of comprehensive analyses and proposals. As previously presented, the objective of this research is to develop a methodology for the analysis of Disused Railway Systems (DRS).

For that purpose, railways should be understood as territorial systems, as several authors did previously and as suggested in the first sections of the theoretical and methodological frameworks (see chapters 1.1 and 2.1) (fig. 7.2). The railway was already presented as a complex system by Aguilar (2008) and, hence, she claimed that the railway heritage is composed by a wide range of elements. Afterwards, the considering of the railway heritage as a whole was proposed by Tarchini (2010) for the suitable reintegration of the railway areas at territorial and local level.

In this regard, and taking into consideration the definition of the concept of system, it is important to define both the components and the relations that can be created in this type of systems in order to develop a comprehensive analysis of disused railway lines. Thus, analysis areas based on the different elements and relations are proposed (fig. 7.2).

On the one hand, the elements or components that are part of the system are considered, i.e. the line and the nodes (developed in chapter 4). On the other hand, the relations between these elements and the surrounding territory are studied, the ones called “external relations”. There are also internal relations (relations between the elements itself, between the line and the nodes), but the external ones include them. Hence, the analysis of the relations between the line and the territory on the one hand, and the analysis of the nodes and the territory on the other hand, are proposed (developed in chapters 5 and 6). Consequently, these four are the main analysis areas of the CAM (fig. 7.1).

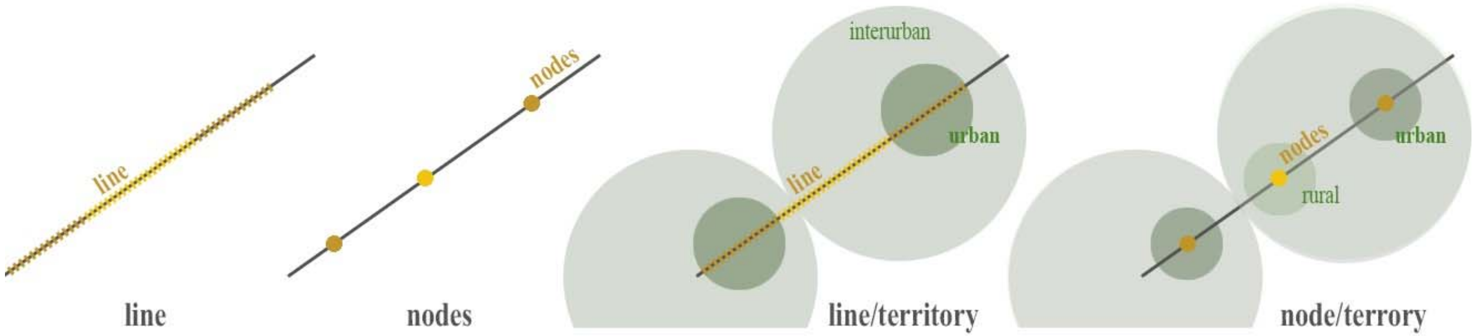


Figure 7.1 Analysis areas of the Comprehensive Analysis Method (CAM)

In this regard, there are previous researches that try to analyse the interrelations between the railway and its territory, in addition to railway heritage itself (Llano-Castresana, 2017). However, they are mainly focused in the heritage elements, especially in the railway nodes, and the territorial relations are set aside. This research is principally centred on the latter.

Besides the concept of system, other several issues have been studied and considered in the four proposed analysis areas. On the one hand, the opportunities that the disused infrastructure could offer as a non-motorised transport axis in the current society for a sustainable development. This approach has been considered in the second parts of the theoretical and methodological frameworks (see chapters 1.2 and 2.2) and it will take part in the accessibility relations between the infrastructure and the territory. On the other hand, the analysis of the relations between the railway nodes and the territory is proposed based on transit oriented development proposals and, hence, conditioned by the balance between transports and land uses, again looking for a more sustainable development. This approach has been presented in the third sections of the theoretical and methodological frameworks (see chapters 1.3 and 2.3).

As a consequence, the different sections of the theoretical and methodological frameworks have been structured according to the three previous approaches (system, non-motorised axis and interrelation between transports and land uses) and each of them will influence the whole or a part of the methodological proposal: the concept of system and the consequent analysis areas in the whole method; the structuring non-motorised axis in the relations between the line and the territory; and the interrelations between transports and land uses in the relations between the line and the territory and the nodes and the territory, especially in the last one.

Hence, those three theoretical and methodological concepts are the basis for the creation of the Comprehensive Analysis Method (CAM) for the analysis of Disused Railway Systems (DRS). By means of the CAM, and taking into consideration the the four analysis areas, the potential of the DRSs as territorial structuring elements is proposed to show (fig. 7.2).

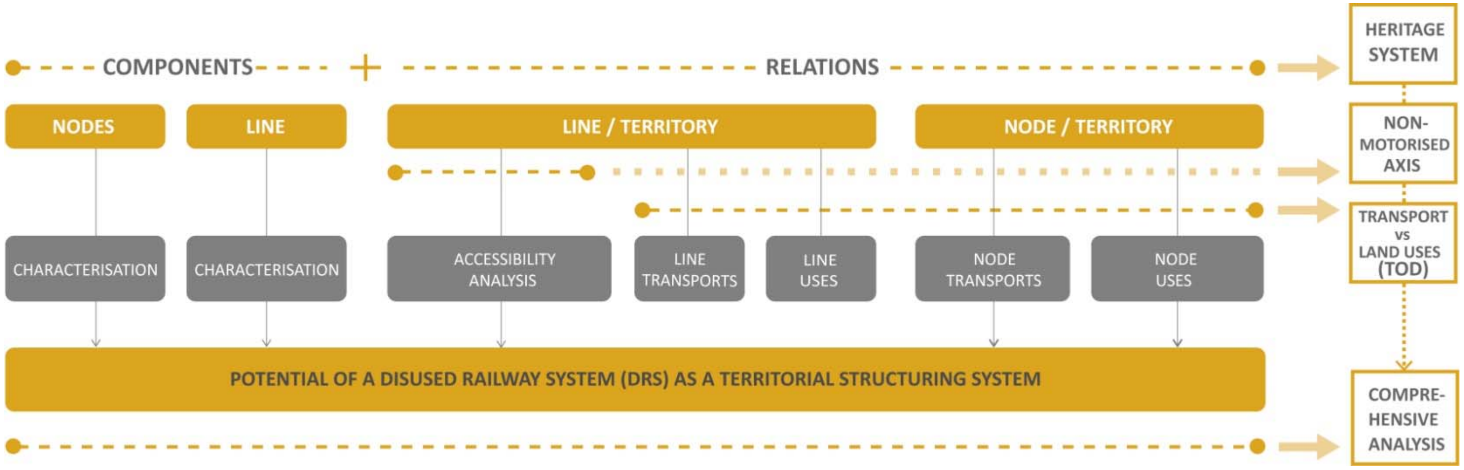


Figure 7.2 Theoretical and methodological foundations and analysis areas of the Comprehensive Analysis Method (CAM)

7.1.1. Analysis areas of the CAM in a DRS

A railway system is defined as a set formed not only by the line and the nodes, but the relations that are created between those and the territory in this research. Accordingly, the concluded issues compose the different analysis areas.

First of all, the comprehension of the elements is necessary from their beginning to the present. For that purpose, it is proposed to know the importance of the DRSs as heritage elements, identifying and analysing each of the pieces that compound each type of element. Afterwards, the study of the opportunities that the railway system could have in the territory for a sustainable development is proposed: on the one hand, the potential of the linear infrastructure in the territory as a non-motorised transport axis and on the other hand, the potential of each node in its surroundings. Likewise, the current state of the studied elements will also influence the potentials mentioned above in order to comprehend the structuration of the elements in the territory and create future comprehensive reconversion proposals.

Different methodologies based on the needs of the different elements have been proposed for each of the analysis stages.

In the phase of the comprehension of the elements and as a previous step, a data collection of the railway elements is intended, i.e. data related to the line and the nodes. The creation of a GIS based inventory is proposed for that purpose. This kind of inventories are easy to update and hence, it is possible to change or add information during the research process or after it. It should be recalled that the passage of time is one of the main problems in most of the researches related to disused heritage. Furthermore, GIS based inventories are especially useful in the analyses of different railway systems because they enable to compare them.

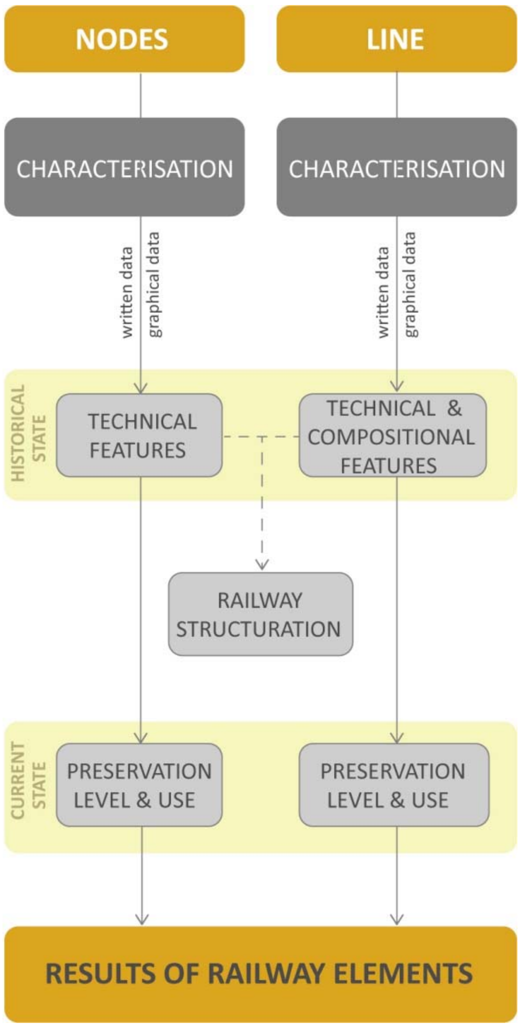
Data related to different railway periods must be compiled and structured in the inventory for the understanding of the whole railway process, including the disused period. The inclusion of future information is moreover possible. In this regard, the following data are proposed for the inventory: on the one hand, data related to the infrastructure (opening, electrification and closure years, historical and current routes, gauge and type of transport or current use) and current state of the different sections of that infrastructure (preservation level, type of pavement and interaction with surrounding areas); on the other hand, data related to the railway nodes (location, historical and current buildings and their uses, nº of floors and areas, and current preservation level and heritage protection). The different buildings of a same node should be distinguished in the data related to the current state, although data related to the whole node are also interesting for the comparison between different railway systems.

Accordingly, several data can be obtained and included in this kind of inventories, but it is also important to compile other specific data of the railway system, such as technical features, construction systems or materials. Previous authors’ analyses or studies and historical railway documents, such as the construction project of the railway, can be essential for that purpose.

LINE

The line (the linear infrastructure and all specific elements that make it possible) is understood as the main element of the railway system in this research. It generates flows along the

Figure 7.3 Analysis and results of the railway elements (line and nodes) as part of the Comprehensive Analysis Method (CAM)



linear infrastructure, creating longitudinal relations at territorial level.

As part of the CAM, the analysis of the infrastructure in different periods is proposed, taking into consideration data related to the railway and the disused periods. In this regard, the use of the two most common stages is proposed: the historical state and the current state (fig. 7.3).

In the case of the line, the analysis of the railway route is firstly proposed for the comprehension of the links that the railroad created in the territory. Furthermore, the different technical features (slopes, turns, etc.) must be taken into consideration, since they are currently maintained and they completely limit current and future uses along the infrastructure. The general technical features of the railway infrastructures (low slopes and large turning radiuses) easily promote the use of non-motorise transports and the consequent creation of greenways. Nevertheless, the study of the preservation level and current features (use, interaction with surrounding areas, types of pavement or existence of bypasses) of the different sections of the line is also essential for the definition and proposal of the future approach of each section.

On the other hand, the study of the different constructed elements or buildings that permit those favourable features is proposed, such as materials, overall dimensions or their distribution along the line. The latter is quite regular in the case of the service buildings (electrical substations and worker's housing), but it depends on the terrain in the case of structures like bridges or tunnels. Finally, the preservation level of these secondary elements will influence the current and future functionality of the linear infrastructure, but also the heritage value of the system itself.

NODE

The railway node (railway station areas or halts formed by either a simple shelter or a set of buildings) is also understood as an important element of the railway system in this research.

It generates connections between the railway infrastructure and the territory, creating crosscutting relations at urban level.

In the case of the nodes, the same two analysis periods are also distinguished (fig. 7.3). First of all, the identification and classification of nodes or railway station areas is proposed in order to comprehend the territorial structuration or hierarchy that the railway created. Furthermore, the buildings that are part of these nodes will be studied both as functional elements of the railway and as significative or eloquent elements.

Afterwards, the analysis of the current state of these element is proposed, identifying the disappeared elements and characterising the existing ones. On the one hand, the preservation level and current uses and owners will be studied, since they condition the future of the whole system. On the other hand, the limitations and opportunities stablished by different legislations will be identified, for example, the heritage protection status of the elements.

Finally, in addition to the line and the nodes, the study of the railway surrounding territory is proposed as the third element of the railway system. In this case, the railway or historical period will take on greater importance since the current state of the territory will be deepened in the following analysis areas.

LINE/TERRITORY RELATIONS

The analysis of the relations between the line and the territory aims to prove that disused railway lines may have potential as non-motorised infrastructures that operate in an urban or interurban scale for a more sustainable development. In this regard, the accessibility analysis of the disused network is proposed, focusing on the possibilities that it could offer in the area and defining in which areas could also support daily activities and uses in addition to leisure or tourism uses. The proposed analysis scales comprise all the areas around the railway infrastructure (fig. 7.4):

- **Accessibility Level 1 (AL1):** Regional approach or accessibility of cities and towns along the disused infrastructure.

- **Accessibility Level 2 (AL2):** Interurban approach or accessibility of the areas near the line.

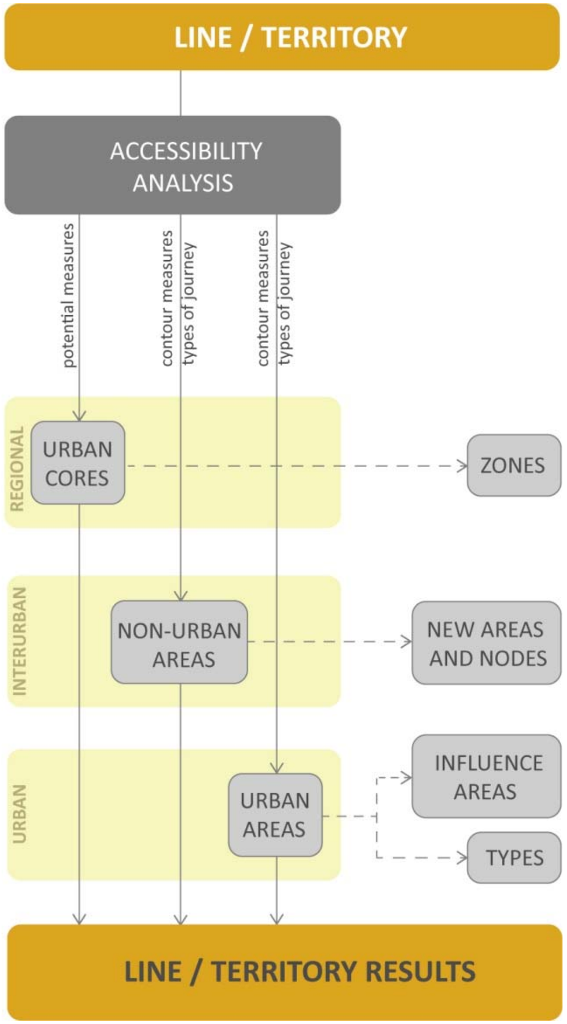
- **Accessibility Level 3 (AL3):** Urban approach or accessibility in urban areas.

At interurban and urban levels, different time and in consequence distance limits are proposed. Furthermore, different speeds are also stablished according to the transport mode (walking / cycling) and analysis level (urban / interurban).

Accessibility analysis in different levels and with different limits and non-motorised transport modes allows studying the different parts of a disused line through a diverse territory, measuring accessibility in urban and rural areas and obtaining results for each section of the line and each core that the line crosses. In this regard, this multilevel approach permits to analyse a territory with different land uses or spatial patterns around the linear infrastructure.

Accordingly, different accessibility measures are proposed to assess the different levels and fulfil the requirements of each of them, getting the balance between the theoretical and practical approaches. Location based measures are proposed for the different analyses, since they are broadly used in urban planning and geographical studies. Simple contour measures are considered suitable in the interurban and urban approaches, since the different transport modes and type of trips will define

Figure 7.4 Analysis and results of the relations between the line and the territory as part of the Comprehensive Analysis Method (CAM)



an adequate context to understand accessibility resulted of the disused railway network. However, in the regional approach, potential accessibility measures must be adopted.

The three presented approaches at different levels enable analysing non-motorised accessibility in a disused railway infrastructure and its environment, thus comprehending the potentiality of this infrastructure as a non-motorised axis and the connection with its urban or rural environment (fig. 7.4). Each approach provides results of different scale, but in turn provides results of the whole line areas. In this regard, it is possible to demonstrate the capability of non-motorised routes to organise the territory and attend several activities, giving rise to more sustainable transports.

Accessibility at regional level (AL1) shows the potential of the infrastructure as non-motorised axis of active transport, defining the areas where uses beyond greenways can be included.

Accessibility at interurban level (AL2) shows the potential of the disused line as non-motorised axis related to different type of transport modes and journeys.

Accessibility at urban level (AL3) defines the land use and activities areas that are included in the accessibility areas of the line or the nodes, which could be the origins or destinations of the journeys at different levels.

Furthermore, some useful information for the other analysis areas of the CAM can be also obtained from the different accessibility studies. First of all, territorial areas with similar characteristic can be identified in the regional approach comparing the accessibility levels of the different cities or towns. Moreover, strategic opportunity points or areas can be also identified comparing the accessibility level of each section of the analysed linear infrastructure. These points could act as future possible nodes in the non-motorised infrastructure. Finally, the service or accessibility areas of the infrastructure and each of its nodes, and the type of relation between these areas and the existing urban areas can be defined and classified in the urban approach. All these extra results are essential for the future use or reconversion of the disused railway system and the planning of its surrounding areas.

NODE/TERRITORY RELATIONS

The analysis of the relations between the nodes and the territory aims to show the potential that former railway nodes and surrounding new nodes may have for developments based on active transports and hence, for a more sustainable development. For that purpose, the measurement of the different transport systems and land uses located around each railway node and the study of the balance between them are proposed. This approach enables to understand each former railway node as a node in a network and as a place in the city and to propose them as future nodes in a non-motorised transport axis. The different chosen and created models (fig. 7.5) permits to implement this approach in DRSs located in varied territories.

- **Node/Place Model (N/P)**: The transport systems and land uses around each railway node are studied and diagrams of two axes are created (Bertolini, 1999).

- **Nodus/Civitas/Urbs Model (N/C/U)**: The transport systems, activities and morphological features around each railway node are studied and diagrams of three axes are created (Moreno, 2013).

- **Multiaxial Model (N1/N2/N3/C1/C2/C3/U1/U2/U3)**: The transport systems, activities and morphological features around each railway node are studied taking into consideration both urban and rural areas and diagrams of nine axes are created.

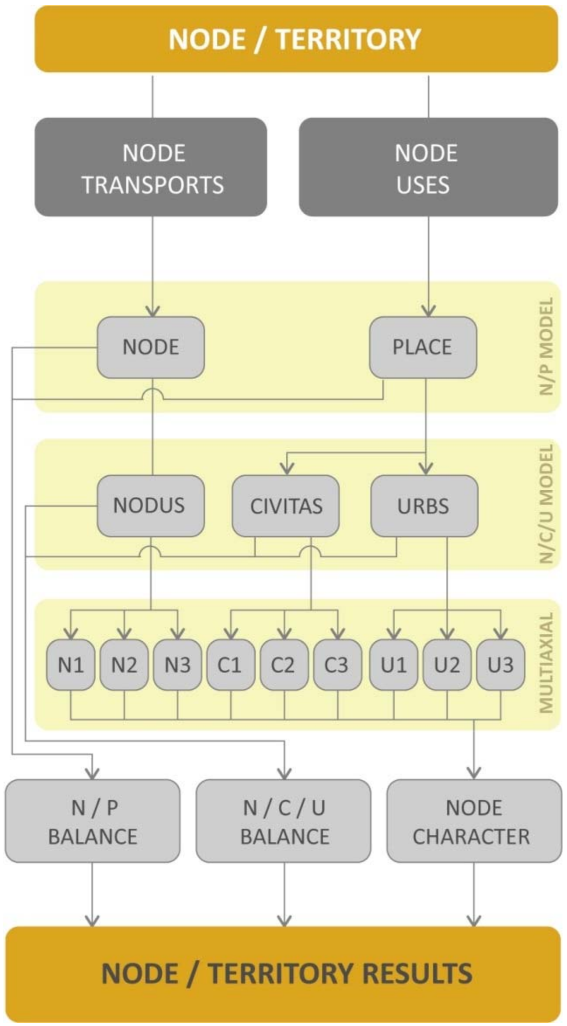
These models enable the analysis of the transport and land uses located in varied territories on the one hand, and the study of their balance on the other hand, taking into consideration both urban and rural areas. Hence, the diagrams of the three models complement one another, where the results refer to the potential of node areas in a non-motorised axis and the future possible directions that each node area could include (fig. 7.5).

The analysis of two axes (N/P) defines the balance level between transports (node) and land uses (place) showing the potential for physical human interaction (levels of transport supply) and the degree of actual realisation of this potential (activity level) (Bertolini, 1999). This balance is essential for the creation of developments based on active transports.

The analysis of three axes (N/C/U) defines the balance level between transport systems (nodus), activities (civitas) and morphological features (urbs). Hence, human activities and physical features of the area itself are distinguished for the place variable of the analysis of two axes. This is because the morphological features also represent the potential for human interaction in the foreseeable future.

The analysis of nine axes (N1/N2/N3/C1/C2/C3/U1/U2/U3) characterises the transport systems, activities and morphological features of varied territories. Although the previous three main variables (N, C and U) are used, three criteria (1, 2 and 3) are distinguished to represent urban and rural features. Criterion 1 refers to the urban approach of the node area, while criterion 3 corresponds to rural issues. Otherwise, criterion 2 includes the indicators that can be related to either urban or rural areas. Therefore, the created diagram illustrates the features that must be changed or created to encourage a particular development on the one hand, and comparing them, it also enables the classification and grouping

Figure 7.5 Analysis and results of the relations between the nodes and the territory as part of the Comprehensive Analysis Method (CAM)



of the node areas. This grouping refers to the nodes that could follow the same or similar guidelines in the foreseeable future.

Although different models are proposed, the methodological approach, and specially, the used indicators are the same for each of them, since this permits to compare the different models between them in addition to make the process easier. Accordingly, the proposed methodological process is the next one:

DEFINITION OF NODES AND THEIR CATCHMENT AREAS

The main nodes of a DRS are the former railway stations or other railway buildings of the system itself. However, there are more points around the system that could act as new nodes in the foreseeable future, since the connection points between the line and the territory are unlimited in a disused system. Accordingly, the analysis of the transport and land uses around the DRS is proposed for the identification of possible new nodes on the one hand. On the other hand, the accessibility analysis of the areas around the line is checked in order to identify the areas with better accessibility than their surrounding environments. As will be explained later, and although these two approaches are considered part of the line/territory analysis area, they influence the results of the relations between the node and its surrounding territory.

Once that railway former nodes and new nodes of territorial or accessibility approaches are identified, the limitation of their influence or catchment areas is proposed by means of the accessibility analysis at urban level (AL3) and related to different non-motorised transport modes.

DEFINITION OF VARIABLES AND INDICATORS

Indicators related to the variables (N, C and U) and criteria (1, 2 and 3) of the proposed models must be created taking into consideration the previous authors' proposals. In this regard, urban or rural activities and their mixture are measured in C1 and C3, while elements or areas of special interest are measured in C2. Urban and rural morphology is also measured based on the different land uses and their densities in U1 and

U3, and population is measured in U2. Finally, rail, bus and tram accessibility are measured as public transports in N1, car accessibility in N2 and non-motorised transports in N3.

ANALYSIS OF NODES. MULTI-CRITERIA DECISION ANALYSIS

The use of Multicriteria Decision Analysis (MCDA) is proposed in order to address the complex problem. For that purpose, firstly, all the criteria are structured and weighted according to their relative importance and using the Analytic Hierarchy Process (AHP), originally developed by Saaty (1980). Afterwards, values of each defined node area and referred to each indicator are measured and first results for each variable and model are obtained using the previously obtained weighting coefficients. On the one hand, this enables to create the three diagrams in order to show the potential of each defined node area and the level of balance of the different variables. On the other hand, a ranking of the different node areas can be created. Finally, a sensitivity analysis is proposed to determine the variability of the parameters and assess the suitability of previously established weights. If they are not suitable, the process starts again and AHP is reviewed and edited.

COMPARISON AND CLASSIFICATION OF NODES AREAS

The comparison of the results of the node areas is proposed in the three models for their classification and grouping. A single diagram can be used in the node/place model (each node is a point in a two-axes diagram), but not in the other two models. For that purpose, the use of different zones concluded in the accessibility analyses is proposed: zones obtained in the regional accessibility approach (AL1) and the groups depending on the relation between the node areas and the urban areas concluded in the accessibility at urban level (AL3). These enable the classification of node areas of similar features. Nevertheless, the use of several variables makes difficult the comparison between them. Accordingly, Principal Component Analysis (PCA) is proposed to overcome this shortcoming and create new components that combine different variables, and k-means clustering to compare and classify the different node areas.

7.1.2. Results of the CAM in a DRS

The different analysis areas that are necessary to take into consideration have been presented and developed in the previous section. However, it should be mentioned the difficulty to define the limits and the interactions that exist between them. In this regard, and although the analysis of the internal relations has been proposed in the initial study developed using different DRSs, it has been shown that they are closely related to the territory. Therefore, it is inferred that the development of the analyses of the external relations takes the main importance in the CAM. Likewise, the limits between the analysis areas of the external relations are also changeable in the final CAM, i.e. there are specific analyses of each type of relations (accessibility analyses in the line/territory relations and transport and land use analyses in the node/territory relations), but there are also other necessary studies that are not expressly located in one of them. For instance, the transport and land use analysis around the linear infrastructure is related to the line/territory study, but its results are necessary for the node/territory study. The same happens with the extra information obtained in the accessibility analyses. Accordingly, in addition to an evolution of results from the top down, a process from the left to right is also created in the relations that are identified in the system, which are represented in the general scheme of the comprehensive methodology (fig. 7.6).

Furthermore, the results of each analysis areas are interrelated to the results of other areas. In this regard, the potentials that are concluded from the relations between the railway system and the territory will be uncompleted if the current state of the elements themselves are not considered (fig. 7.6). Accordingly, the results obtained from the line/territory analysis will have limitations or opportunities that will depend on the features and preservation level of the linear infrastructure itself. That is to say, two sections of the linear infrastructure with high accessibility levels will have different opportunities if one of them is in a good state of conservation and have suitable territorial integration, and the other one has disappeared or is useless. At present, the first one obviously has more opportunities, while the second one could also achieve them in the future. The same happens with the nodes that are part of the railway system. Hence, in addition to the data related to the node area, information referred to the node itself must be considered. Accordingly, the potential of the nodes in the foreseeable future will be different if the railway station have a current use, is disused or has disappeared, although this point shows several opportunities in its surrounding area.

Being presented the methodological proposal for each analysis area and the connections between the different areas, the detailed scheme of the CAM is proposed (fig. 7.7). In this way, it represents the steps of the comprehensive methodology for the analysis of the elements and relations of a DRS, but it also shows the links and interrelations that exist between the different analysis areas. In this regard, the studies of the railway elements are located on the left. They contribute to the definition of the potential of each type of element in the territory, but they also enable to comprehend and document the heritage elements of the system. Moreover, the relations between the linear infrastructure and the territory are studied in the central area of the scheme. The accessibility analyses show the potential that the linear infrastructure can have as a non-motorised transport axis, while the transport and land use study, together with the extra information obtained in the accessibility analyses, defines the existing and possible nodes and their catchment areas for the node/territory analysis. Finally, the relations between the nodes and the territory are studied on the right.

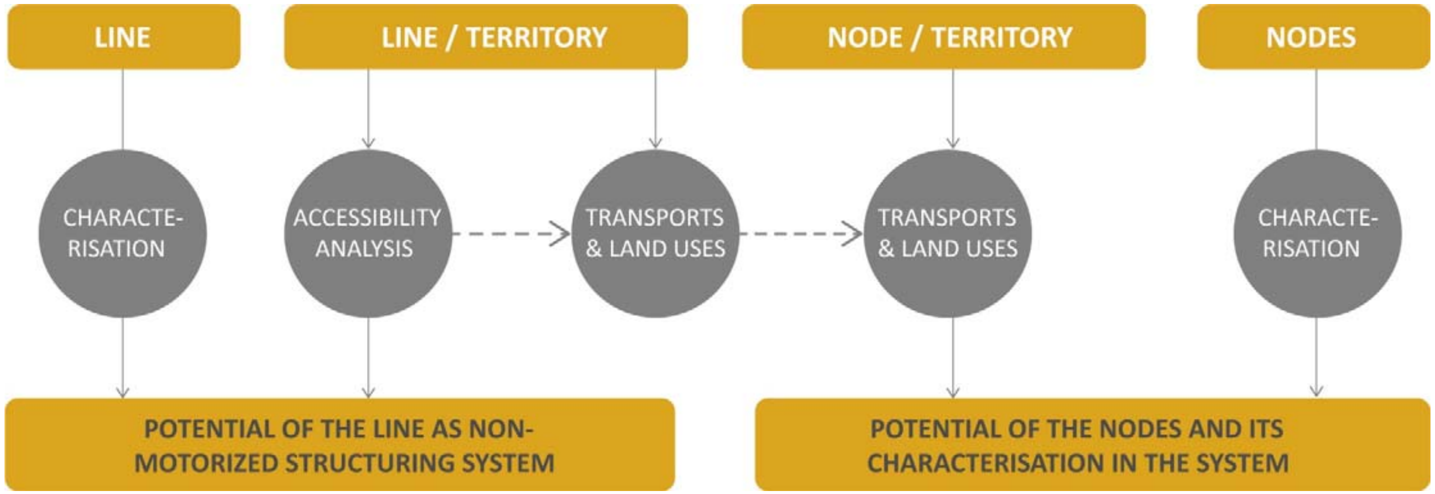
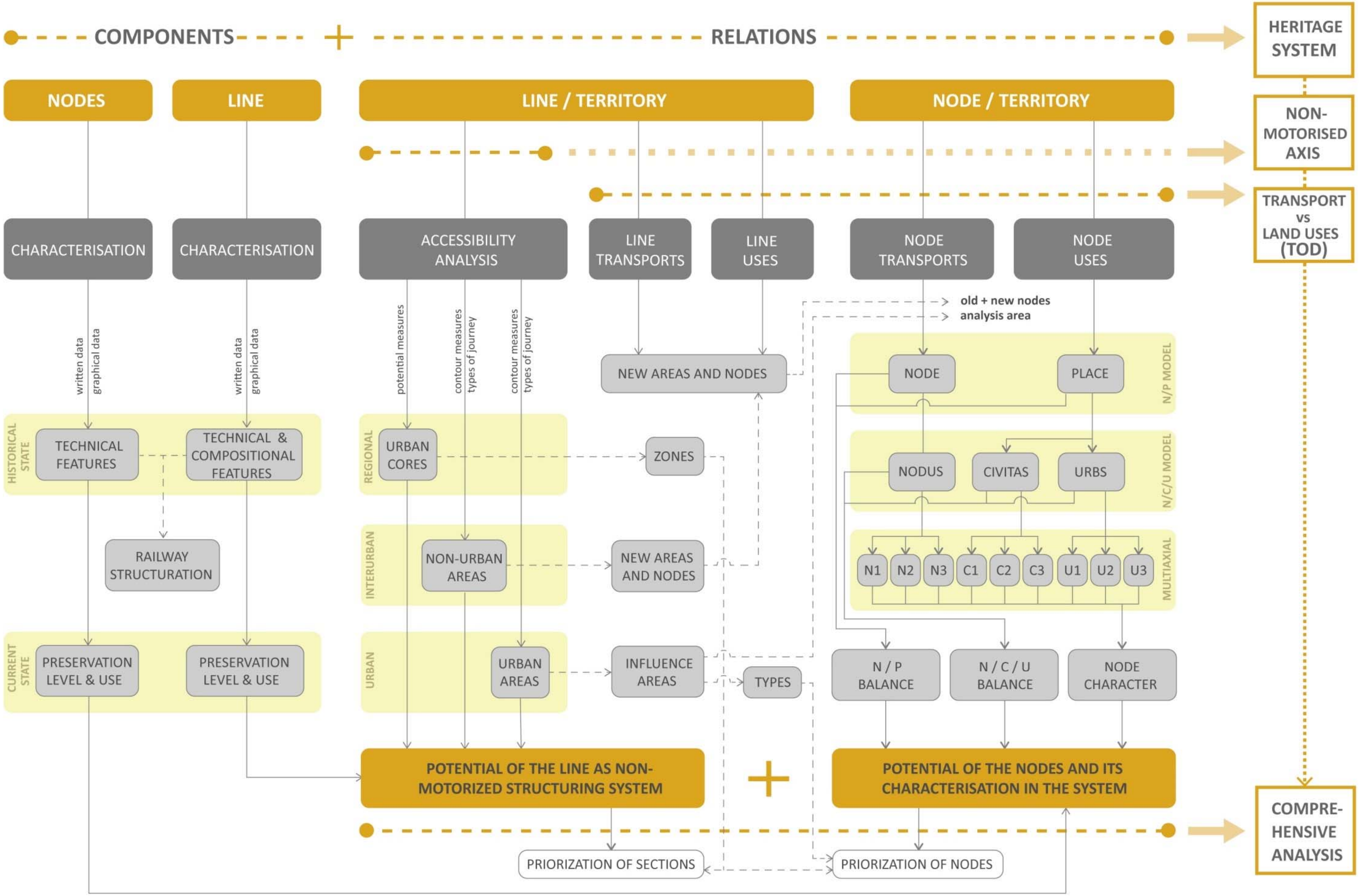


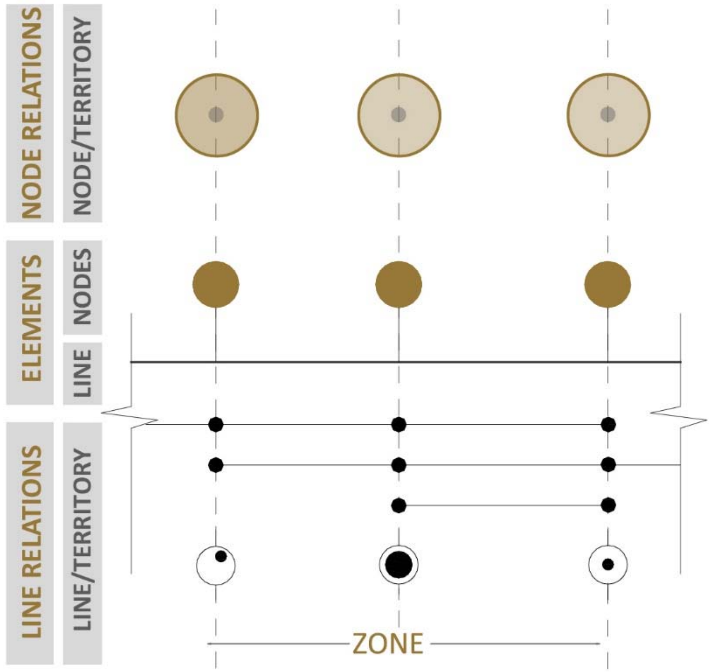
Figure 7.6 General scheme of the Comprehensive Analysis Method (CAM)



COMPONENTS
RELATIONS
HERITAGE SYSTEM
NON-MOTORISED AXIS
TRANSPORT vs LAND USES (TOD)
NODES
LINE
LINE / TERRITORY
NODE / TERRITORY
CHARACTERISATION
CHARACTERISATION
ACCESSIBILITY ANALYSIS
LINE TRANSPORTS
LINE USES
NODE TRANSPORTS
NODE USES
written data
graphical data
written data
graphical data
potential measures
contour measures
types of journey
contour measures
types of journey
old + new nodes
analysis area
NEW AREAS AND NODES
NODE
PLACE
N/P MODEL
HISTORICAL STATE
TECHNICAL FEATURES
TECHNICAL & COMPOSITIONAL FEATURES
REGIONAL
URBAN CORES
ZONES
NODUS
CIVITAS
URBS
N/C/U MODEL
RAILWAY STRUCTURATION
INTERURBAN
NON-URBAN AREAS
NEW AREAS AND NODES
N1
N2
N3
C1
C2
C3
U1
U2
U3
MULTIAXIAL
CURRENT STATE
PRESERVATION LEVEL & USE
PRESERVATION LEVEL & USE
URBAN
URBAN AREAS
INFLUENCE AREAS
TYPES
N / P BALANCE
N / C / U BALANCE
NODE CHARACTER
POTENTIAL OF THE LINE AS NON-MOTORIZED STRUCTURING SYSTEM
POTENTIAL OF THE NODES AND ITS CHARACTERISATION IN THE SYSTEM
COMPRE-HENSIVE ANALYSIS
PRIORIZATION OF SECTIONS
PRIORIZATION OF NODES

Figure 7.7 Detailed scheme of the Comprehensive Analysis Method (CAM) (left)

Figure 7.8 Schematic diagram of the general results of a DRS section of the Comprehensive Analysis Method (CAM) (right)



Taking all this into consideration, the potential of a point or section of a DRS will include the potential of the linear infrastructure of the defined area and the potential of the nodes located there. In function of this potential will be made the proposals of the disused system that can be created for its reconversion as non-motorised axis and territorial structuring element. Furthermore, different sections or points can be prioritised taking into account the line or the nodes, or bearing in mind both in general. In the case of the line, strategic points can be identified in the different zones. Meanwhile, in the case of the nodes, significant points can be defined according to the different zones and type of settlements.

Consequently, the following scheme that includes the general results (fig. 7.8) can be created for a section of a DRS by means of the proposed Comprehensive Analysis Method (CAM). On the one hand, the current state of the linear infrastructure and the nodes located on it are sited in the middle of the scheme. On the other hand, the accessibility level of the line and the conditions related to the nodes are represented below and above respectively.

7.2. Application and results of the CAM in the Vasco-Navarro Railway

Although the initial approach of the methodology has been applied to the different disused systems of the Basque-Navarre Territory, the final CAM has been applied to the Vasco-Navarro Railway, which is one of the main DRSs of this diverse territory and comprises different historical sections and current preservation levels, hence becoming an adequate example to test the proposed methodology. Nevertheless, the method could be widespread to other DRSs located not only in urban territories, or even to any territorial system composed of a territorial infrastructure and several nodes along it.

As mentioned before, after being applied the CAM to the case of the Vasco-Navarro Railway, a general scheme that includes the main data is obtained (fig. 7.9). Accordingly, the general results of each analysis area are compiled, but in turn, the result referred to a specific section or the whole railway system can be inferred, i.e. differences between the areas that have similar results in previous analysis areas can be distinguished. Hence, these results show a general characterisation of the DRS, which is essential for the future reconversion proposals of the different sections or areas of the system, or the creation of general guidelines related to the whole territorial system.

In this regard, the main results of the Vasco-Navarro system and some guidelines that take them into consideration are presented in the following paragraphs.

LACK OF EXTERNAL CONNECTIONS

First of all, the lack of external connections between the whole Vasco-Navarro system and its surrounding territories must be mentioned referring to public and non-motorised transport modes. It should be mentioned that although few links could only exist due to the abrupt terrains and the subsequent specific territorial structuration of the Basque-Navarre territories, these connections are not generally undertaken (fig. 7.9). For instance, there are a train stop and a cycling lane near Maltzaga (north end of the Vasco-Navarro Railway), but there is not any connection with the disused infrastructure, since the section between Maltzaga and Soraluze has disappeared. In this regard, the promotion and endorsement of the north end of the analysed axis becomes essential for its sustainable integration to the Bilbao-Donostia axis (railway and motorway axis) and the correct functioning of the proposed non-motorised axis. In the case of Vitoria-Gasteiz, there is an adequate connection with the Railroad of the North, which connects Irun and Madrid. Moreover, a connection with the same railway in Alegria-Dulantzi is located 4 km from Erentxun (previously defined as a strategic area between zones), which can be promoted as an entrance from Gipuzkoa and the north of Navarre. Finally, the dependence on Iruñea should be mentioned in Lizarra. Although there is a direct motorway connection (40 km) between them, the distances are considerable for non-motorised transports. The Way of St James that follows the same axis can be element that links the two cities referring to leisure or tourism activities.

DIFFERENT URBAN OR RURAL SETTLEMENTS

Furthermore, the general scheme clearly shows the differences of the urban or rural settlements of the different zones (fig. 7.9). Zone 1 (northern towns) is composed of main towns, where urban cores are similar in size to the accessibility areas of the nodes. Meanwhile, the small town of Leintz-Gatzaga is the only core in Zone 2 (the mountain pass of Arlaban). On the other hand, several small settlements where the cores are smaller than the node accessibility areas are influenced by a main city or town in Zone 3 (Vitoria-Gasteiz) and Zone 5 (Lizarra). Accordingly, the limits of these zones are drawn by the influence areas of these main cores. Finally, there is not any main city or town in Zone 4, where all cores are smaller than the accessibility areas of the railway nodes, but there are two cores (Maeztu and Kanpezu) that create an internal structuration of their surrounding areas. Their influence areas coincide with the influence areas of Vitoria-Gasteiz and Lizarra, so two strategic points are created.

STRATEGIC POINTS

Erentxun and Antzin are defined as strategic points between zones. As mentioned before, Erentxun shows a certain connection with the Railroad of the North and it is also the farthest point of the DRS that is linked to main road between Vitoria-Gasteiz and Lizarra before entering in the mountain area of Araba/Álava. Accordingly, Erentxun can be defined as a strategic point between the DRS and the external transport systems, and hence, it can be also defined as a future strategic area for the creation of activities at territorial scale. Meanwhile, there are disused heritage elements (hydroelectric plant in Granada) or tourism or leisure facilities (camping in Acedo or swimming pools in Acedo, Antzin and Murieta) in the surrounding areas of Antzin[1]. Furthermore, in both strategic points, the disused infrastructure has been converted into a greenway and the former railway node areas are of Group E, which means that, although the area shows strong morphological features and certain rural activities, urban activities and specially heritage and elements of interest are missing on the one hand. In this regard, it should be added that there are former railway nodes in a ruin state (Erentxun and Granada) in both cases. On the other hand, these areas are unsustained places with low levels of transport systems where sustainable transports modes should be promoted. However, the two areas show different results referred to their non-motorised accessibility. Antzin is connected to Granada and Murieta walking, from Acedo to Zufia running and until Lizarra cycling. Accordingly, it comprises the whole Navarre area of the DRS, but the accessibility of Antzin is only limited from/to four cores. Meanwhile, Erentxun is not connected to Trokoniz walking, but it is to Gauna and Uribarri-Jauregi. In addition, Erentxun is accessible from Otazu to Laminoria tunnel running and from Vitoria-Gasteiz to Zekuiano cycling. In this regard, cycling accessibility is the most important in this case due to the presence of the main city the high number of cores located in the area (seven), despite their size.

[1] The area of Granada-Antzin-Murieta was previously defined as a strategic area referring to accessibility.

IDENTIFICATION OF AREAS

Moreover, the identification of smaller areas (a-j) that can follow similar guidelines and connect the five previous zones is possible in order to ensure the proper functioning of the whole territorial axis.

- Area a: This area includes the whole Zone 1. It is composed by main towns, but only few railway heritage elements or buildings are preserved (Arrasate, Oñati and Eskoriatza). Although the linear infrastructure has been converted into a cycling lane in several sections, the original route has not been always used. Moreover, the cycling lanes are connected to or even are part of the existing street network in several cases, but the beginning and the end of this area are cut off. The reconversion of these initial and final sections is essential for the correct functioning of the system, since they ensure the connection between the different zones or areas and the external connection with the northern territories.

Furthermore, and according to the analyses of the external relations of the system, on the one hand, walking accessibility is limited to main cores and their surrounding nodes. However, a section of three cores is identified in the south of the area (Arrasate-Aretxabaleta-Eskoriatza) due to the closeness of the urban cores and the node areas located between them. In this regard, this section can operate all together and be promoted by the two railway buildings that are located in its extremes (Arrasate and Eskoriatza). Running or cycling accessibility limits obviously include larger areas. In this case, two cores are included in the north area, while three or even four cores (in Arrasate) are part of the accessibility areas in the south. Consequently, in addition to the walking trips related to each core and their surrounding areas, running and cycling trips between different urban cores can be included along the infrastructure. Taking into consideration the urban and also industrial character of the whole area, these trips should be mainly related to daily activities.

On the other hand, different types of node areas (Groups B, C and H) have been identified in the area. Group B refers to the main towns where sustainable transport systems should be promoted, while Group C mainly refers to industrial areas where in addition to sustainable transports, elements of interest or rural activities should be included in order to get the balance between transport and land uses. The incorporation of rural activities in these node areas can be interesting if the congestion or saturation of urban towns is considered. Finally, Group H comprises the monofunctional or non-developed areas, in which the connection to the main cores becomes crucial. All these node areas show running and cycling linkages while only Mekoalde and Castañares present walking connections.

- Area b: This area is located in Zone 2, comprising from the beginning of the zone to Leintz-Gatzaga. There is not any town in the area and the linear infrastructure has not been reused. The area covers the ascent of the mountain port of Arlaban, where the main slopes and turns of all the railway system are located, so several tunnels without any conservation measures are identified. Furthermore, all the nodes are located in non-developed areas (Group H). Nevertheless, all railway nodes are preserved, probably due to the lack of urbanistic pressures. As a result, two of them are maintained as houses, while the other is in a bad state of preservation.

According to the accessibility analyses, it is the only area that cannot include daily activities or uses. That is why future uses should be related to leisure or tourism trips, such as the ones that are part of larger routes[2] or the ones with destination to Leintz-Gatzaga and its elements of interest. Although the existing railway nodes could support these activities, in this case, private uses both ensure and facilitate the preservation of the nodes.

- Area c: This area includes the disused railway section from Leintz-Gatzaga to the entrance of Vitoria-Gasteiz. It also coincides with the beginning of the Vasco-Navarro Railway Greenway, which comprises the whole area. Nonetheless, the construction of the high speed railway has produced the disappearance of some disused infrastructure sections and the deviation of the greenway route. Furthermore, almost all the railway nodes are preserved in the area and most of them are in use. However, several buildings have disappeared and other ones are in a dilapidated state.

According to the external relations, on the one hand, certain levels of accessibility are reached running (or walking non round-trips) and cycling, but not walking (round-trip journeys).

[2] Several GR routes are located in the area.

Moreover, journeys between Legutio and Vitoria-Gasteiz can be performed cycling. On the other hand, most of the node areas are rural areas (Group F), but there are also non-developed node areas (Group H) in which although the node itself is related to a main core, such as Legutio or Leintz-Gatzaga, the line and consequently the node is located quite far from the urban area. In this regard, and although the node areas that have not include any core are quite balanced, sustainable transport systems should be promoted in all the node areas as part of the local rural development. Furthermore, the refurbishment of a node in a ruin state or the change of use of private use nodes can support the general use of the linear infrastructure and also include other new uses in the area. The node in a ruin state is Legutio, which is composed of three buildings, one of them an electrical substation. The warehouse of Landa is also disused and in a bad state of preservation. Moreover, the reservoir of Uribarri-Ganboa and the Provincial Park of Landa are located close to the area, so connections between the main city of Vitoria-Gasteiz and these elements of interest should be promoted by means of the railway buildings.

- Area d: It comprises the city of Vitoria-Gasteiz, which is currently built in almost the totally of the area. In the north of the city, the linear infrastructure has been converted into a cycling lane, but the lane goes through an industrial area and there is a lack of connections between the infrastructure and the surrounding streets. In the city centre, the original route has been substituted by streets and it has not being reused as a cycling lane. Moreover, all railway buildings that composed the main railway station area have disappeared. It would be interesting to maintain the historical link along the city and to convert the location of the disappeared station into a strategic point. This location comprised a bus station at the end of the previous century and it is currently a covered playground. Finally, the railway route is cut off in the south of the city. Alternative cycling lanes exist, but they are not related to the former railway and hence, the memory of the railway is not maintained. Nevertheless, there is a railway building in a ruin state at the south entrance of the city, where the Vasco-Navarro Railway Greenway starts again few metres away. Although a small section of the reconversion is missing, the construction works has begun, ensuring the link between the greenway and the city. Accordingly, the historical route along the city should be promoted in order to connect the northern and southern sections of the greenway on the one hand. On the other hand, the connections between the city and its surrounding natural areas should be ensured, since although high levels of activities are identified in the city, the presence of natural elements is limited.

- Area e: This area comprises the disused railway section from Vitoria-Gasteiz to Uribarri-Jauregi (part of the zones 3 and 4), including the branch to the sanctuary of Estibaliz. It has been reconverted into a greenway in its entire length and only small cores are located in the area. In the initial section, railway nodes were located in the core itself, while in the east section railway nodes were sited out of the walking influence of the core. This distinction obviously affects to the study of the node areas where although all of them are rural areas, the ones located in the initial section show certain activity areas and non-motorised transport routes (Groups D and E), while the last two node areas not (Group G). It should be added that one of the mentioned strategic points between zones (Erentxun) is located in this area. In this regard, the nodes located before Erentxun are in use and present a good state of preservation, while the nodes of Erentxun or the following ones are disused and show a bad state of conservation or have disappeared.

According to the line/territory analysis, Erentxun (along with

Trokoniz and Andollu) has the highest accessibility levels running or cycling, and the connection to the main road is also located in the area. Meanwhile, walking accessibility is the interesting one between Erentxun and Uribarri-Jauregi. Moreover, the presence of the railway connection 4 km from Erentxun must also be taken into consideration. It is clear that Erentxun is an interesting point in the system, and consequently, the reconversion of the node in a ruin state located there should also be interesting in order to promote new uses and services that reinforce the connections between the line and the other transport system. Finally, the disused railway building located in Uribarri-Jauregi is an electrical substation. Four of the five substation or subcentrals are currently preserved, all of them located along the existing greenway and distributed in a maximum distance of 20 km if the main city of Vitoria-Gasteiz (or even Lizarra) is considered also as an stop. Accordingly, tourist routes and activities of different durations along the railway system can be created based on the location of electrical substations and the one hour limit (20 km/h) stablished for non-motorised transports.

- Area f: This area includes the Laminoria tunnel and its surrounding areas from Uribarri-Jauregi to Zekuiano and hence, there is no urban or rural core in the area. The tunnel is currently closed due to the collapses produced in some of its parts, which produces the isolation of the area. Therefore, the refurbishment of the tunnel will enhance the running or cycling connections of the area. However, the length of the tunnel will divide the walking connections to one or the other side of the tunnel. Furthermore, the node located in one of its ends has disappeared and the other of the other extreme is in a dilapidated state, in addition to the limited influencing areas of both of them due to the lack of infrastructures in the area. Accordingly, the potential of the surrounding areas is limited, and although long routes are permitted, mobility related to daily activities is constrained. In this regard, this area should be part of a leisure and tourism strategy.

- Area g: This area includes the main cores of the Zone 4 (mountain area of Araba/Álava) and the connection to Navarre. The linear infrastructure has been reconverted into a greenway, but there are some sections where the original route has been dismissed and hence, bypasses have been included. However, the latter are short enough to ensure the proper functionality of the system. Furthermore, railway heritage buildings of different preservation levels are found in this area. Some of them have disappeared (the ones that do not have any core in the area) or are in a bad state of conservation, but there are other ones that are in a good preservation state and in use. In this regard, the railway station of Maeztu is the only that have a public use, but it should be mentioned that an interpretation centre is located in the railway station area of Antoñana (in a railway wagon).

According to the study of the transport and land uses, balanced node areas can be found between Antoñana and Kanpezu, but the other areas have been defined as unsustainable places. Consequently, sustainable transports should be promoted all along the Area g, but also urban activities and elements of interest in the area between Antoñana and Kanpezu in order to maintain the balance between transport and land uses. The nodes located in cores (Maeztu, Antoñana and Kanpezu) are of Groups D or E, while the others are of Group G. The latter show certain rural morphology and activities in addition to few population, but sustainable transport systems must be promoted, since they are unsustained places. Meanwhile, in the rural cores, node areas are balanced in Kanpezu and Antoñana (D) and unsustained in Maeztu (E). The latter is a strategic point in this area, and although high levels in activity and morphology approaches have been identified, again sustainable transports

(public and non-motorised transports) should be promoted. In this regard, its railway station is located in the main core of the area[3] and also has a public use (city council), so it should be promoted as the main focus of the area.
Referring to the walking accessibility, two sections are identified: one of them comprises from Zekuiano to Atauri and the other one from Fresnedo to Navarre. Accordingly, the area of Antoñana is out of the walking accessibility sections, so long stay trips or the use of bicycles should be promoted there. Meanwhile, daily trips (principally related to work, studies or shopping) will be mainly reduced to the areas of Maeztu or Kanpezu, from their surrounding areas to their core centres. Hence, the private use of the existing railway building of Kanpezu can be questionable. On the other hand, the three buildings (two of them with private use) and the railway wagon (interpretation centre) located the railway station area of Antoñana should comprise new uses related to natural tourism and leisure activities in order to promote the local development of the valley.

- Area h: In the same way of the Area f, this area comprises the zone of Arquijas, where the tunnel itself is located. There is not any urban and rural core in the area and walking accessibility is limited. Nevertheless, running and cycling accessibilities are similar to the surrounding areas, since the tunnel has been adapted for non-motorised transports. The only node, which is located in the entrance of the tunnel, is in a ruin state and its influencing area is limited due to the lack of infrastructures in the area. In this regard, the Vasco-Navarro Railway Greenway (non-motorised transport) and the main road (motorised transport) are the principal linking elements of the area, but there are not any connections between them.

[3] Maeztu is the main core of the municipality of Arraia-Maeztu.

- Area i: It comprises the end of the Zone 4 and almost the entire Zone 5. Although it is part of the Vasco-Navarro Railway Greenway, there are some small bypasses in Acedo and the road was constructed over the former railway infrastructure in the area of Zufia, where there is not any suitable alternative route. In this regard, the recovery of the section or the creation of an appropriate route becomes essential for the necessary connection to Lizarra. It should be added that the railway node located in this substituted section is the only that has disappeared. All the other nodes except Granada (in a ruin state) are in use.
On the one hand, Granada is the only node located out of any core and with a very limited influence area around it. Hence, the improvement of transport infrastructures around this area is necessary for the correct integration of the greenway. Besides the node in ruin state, a disused hydroelectric plant and its dams are considered potential elements in the area.
On the other hand, in the cases of the node areas located around population cores, the nodes of Acedo and Zufia are surrounded by rural areas, but a campsite and a horse riding centre are located nearby in the case of Acedo, which is linked to a tourism perspective strategy. Meanwhile, although the node area of Zubielqui is also a rural area, its certain urbanity and the proximity to Lizarra must be considered. Finally, Antzin and Murieta are considered strategic node areas taking into consideration the node/territory analysis and also related to the walking accessibility (strategic walking accessibility area), but Antzin is also considered a strategic point between the different zones. In both cases the railway nodes have been preserved and reconverted into city councils. However, a building of this size can include extra uses when it is located in such a small town. Moreover, the electrical substation of Antzin includes the necessary and complementary uses of the municipal swimming pool located in the area. Accordingly, the area of Granada-

Antzin-Murieta, together with the campsite of Acedo, is considered a potential zone of the system, which could operate at an interurban scale and structure the Navarre territory of the Vasco-Navarro Railway along with Lizarra. For that purpose, the connection to Lizarra should be ensured and sustainable transport modes should be promoted, since all the node areas are unsustained places.

- Area j: It comprises the municipality of Lizarra and the end of the greenway, which turns into the street network in the urban area. Although there are transport connections between Lizarra and its surrounding urban or rural cores, all of them are dependent on Iruñea, which is located out of the non-motorised transport distances (40-45 km). Likewise, the small cores along the disused railway are dependent on Lizarra, so the existing connections between them should be enhanced and improved. In this regard, the former railway station of Lizarra has been reconverted into a bus station and a cultural space, which can be considered a potential area to support the necessary intermodality. Accordingly, public and non-motorised transports should be promoted in the area and complementary uses that support these transports can be also included in the large railway building. In this case, in addition to the leisure trips, the railway infrastructure that link the different urban and rural settlements could comprise journeys related to daily activities, provided that they are associated with long stays or round-trips if they are cycling.
Finally, the only node located in the Area j shows high urbanity and activity levels, but does not present rural activities in the influence area itself. Nevertheless, the rural and natural character is significant around Lizarra, so the physical connections between the city and these type of areas should be enhanced.

STRATEGIC ACCESSIBILITY AREAS

As a final point, in addition to the territorial zones or smaller areas, strategic accessibility areas or comprehensive functionality areas have been identified at interurban scale: Arrasate-Aretxabaleta-Eskoriatza and Antzin-Murieta (fig. 7.9). Although they do not affect the general functionality of the DRS, they are comprised of urban or rural cores that are important in their surroundings (represented in bold) and the accessibility between them is integral for all kind of non-motorised transport modes. In this regard, the strategies or guidelines that are needed to create will be part of the same group, understanding them as a whole that encompasses the entire strategic area.

In the strategic accessibility area located in Gipuzkoa, in addition to the three towns, the nodes of the industrial areas located between them and the neighbourhood of Castañares are included. This mixture of uses facilitates the use of the non-motorised infrastructure for daily trips between the towns and their surrounding areas and for walking long stay or cycling trips between the towns. Furthermore, the preservation and use of the nodes located in the extremes of the area (Arrasate and Eskoriatza) could promote the use of the whole area. In this regard, these former railway buildings would include uses that support or complement the practises along or around the infrastructure.

In Navarre, the strategic accessibility area comprises the towns of Murieta and Antzin, and the area of Granada. In this case, although there are only two small rural towns in the area, on the one hand, the node areas of both of them are also strategic (Group E) and on the other hand, they comprise one of the strategic points or a junction between zones (in this case, Zones 4 and 5). Moreover, these node areas are unsustained places, so as mentioned before, public and non-motorised transport systems should be promoted in order to achieve the balance between transports and land uses. Accordingly, the main strategies can be focused in this issue: on the one hand, the daily trips of the local population, mainly to work or school; on the other hand, the journeys related to leisure and natural tourism, which are considered suitable to incentivize sustainable local development. Furthermore, the former railway station of Granada, which is in a dilapidated state, and a disused hydroelectric plant located nearby are identified as potential elements in one extreme of the area, while the campsite of Acedo is also sited relatively close to the area. However, the latter is out of the walking influence area. In contrast, the electrical substation of Antzin operates as part of the municipal swimming pool facilities and linked to leisure activities. Finally, the railway stations of Antzin and Murieta are currently the city councils of each municipality. They are some of the most singular and large buildings of the area, so in addition to those municipal services, other uses that promote sustainable transport modes could also incorporate, such as bicycle parking or bike rental facilities.

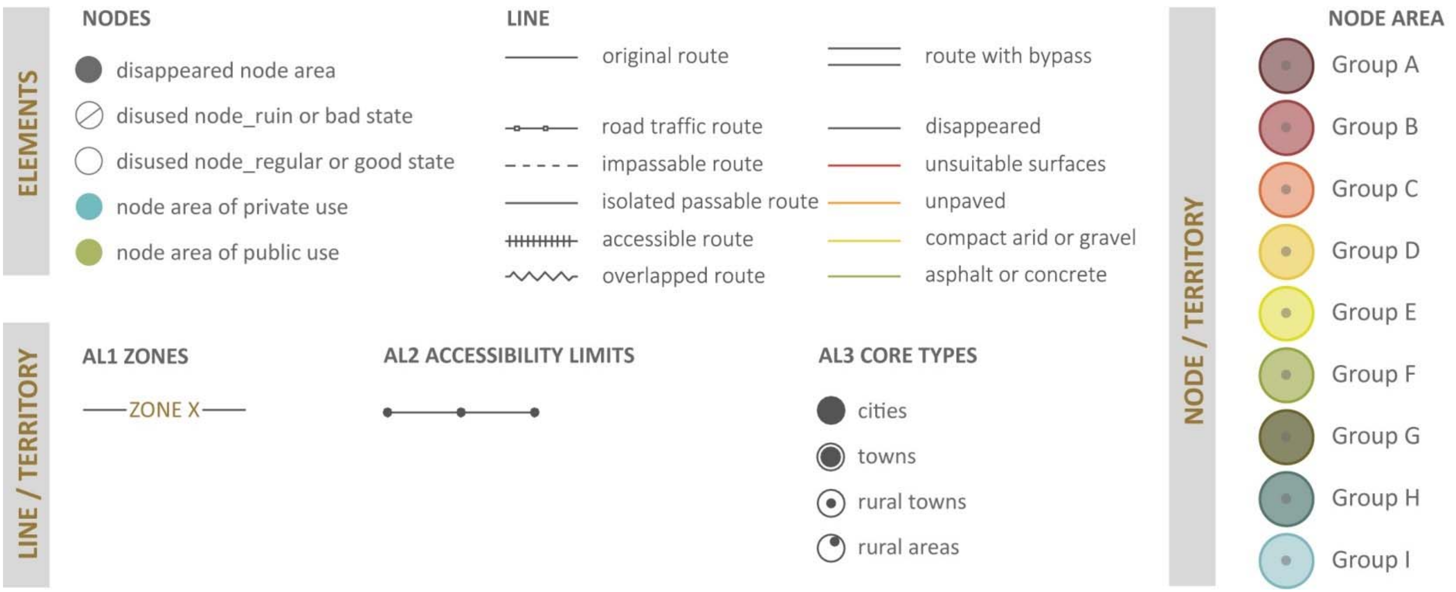
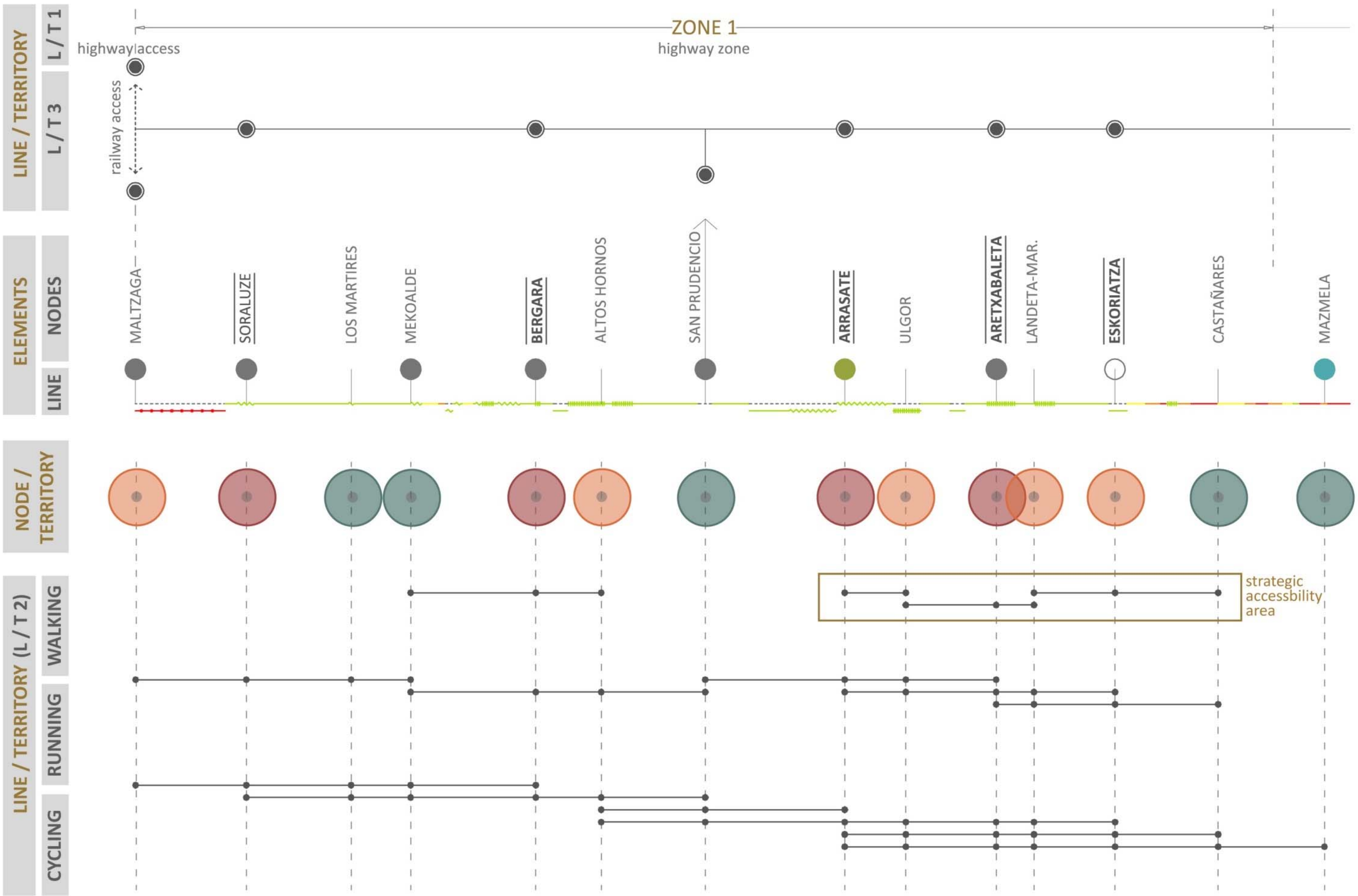
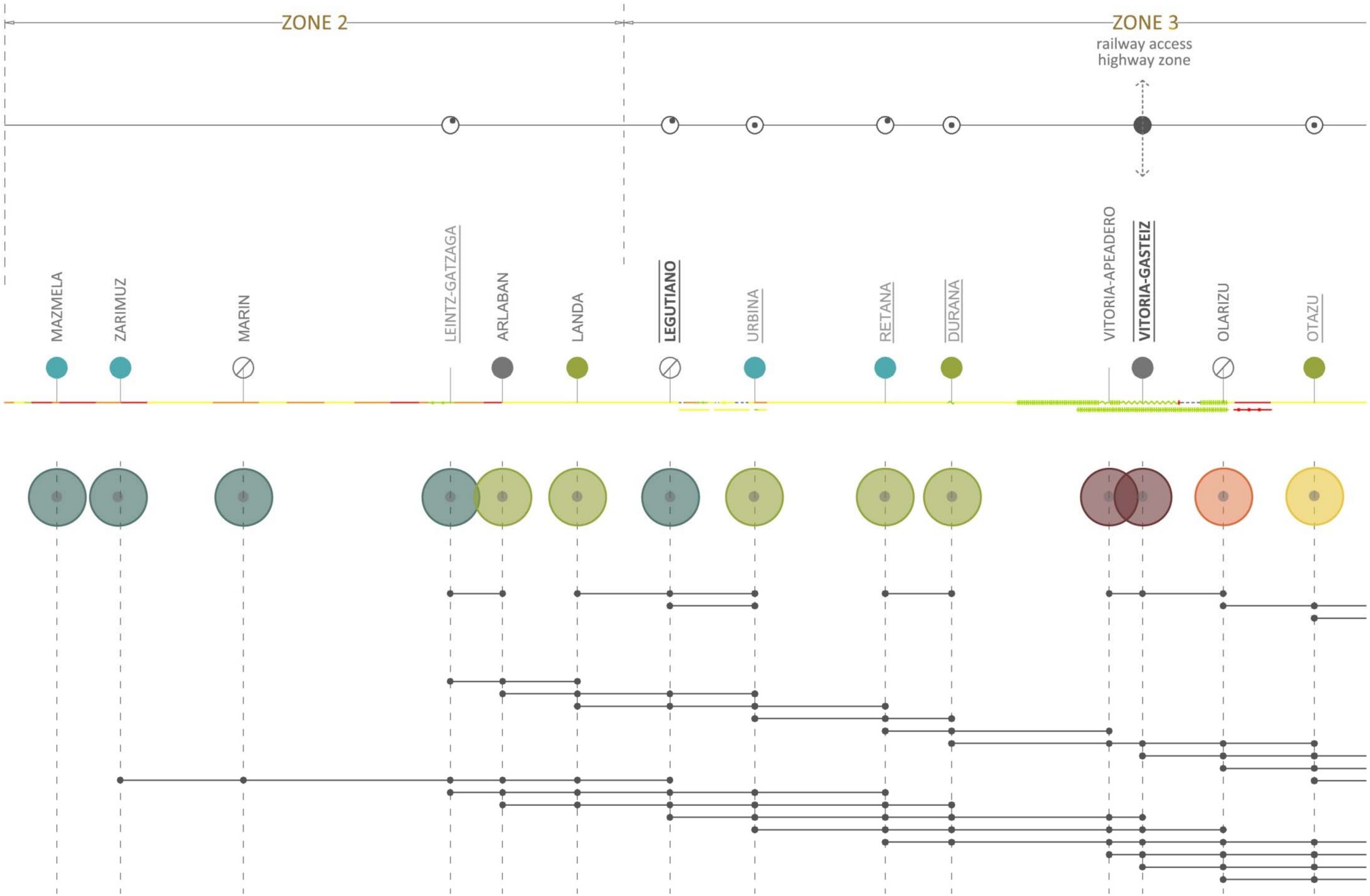
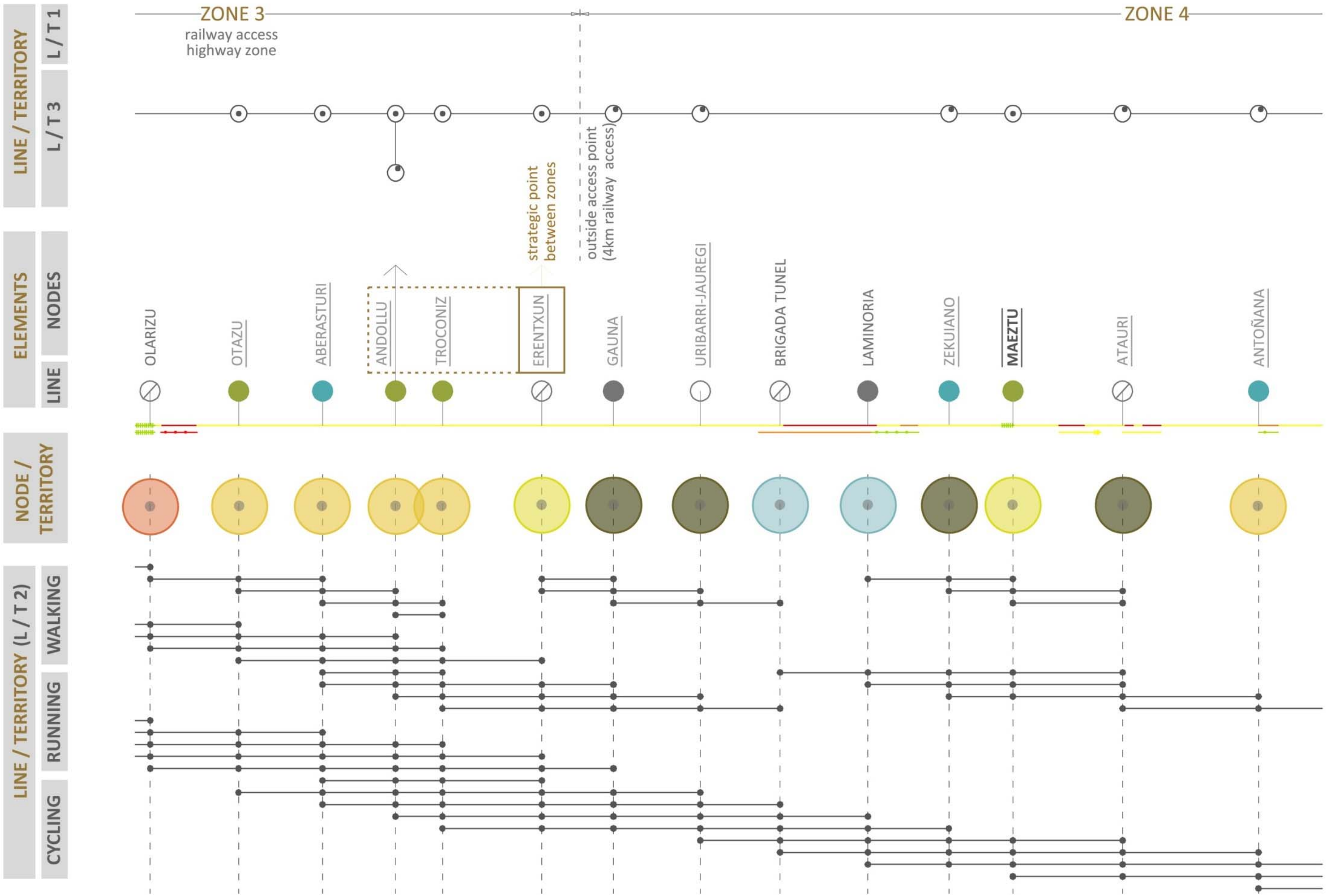


Figure 7.9 General results of the Comprehensive Analysis Method (CAM) for the Vasco-Navarro DRS. Legend on the right and results in the following pages

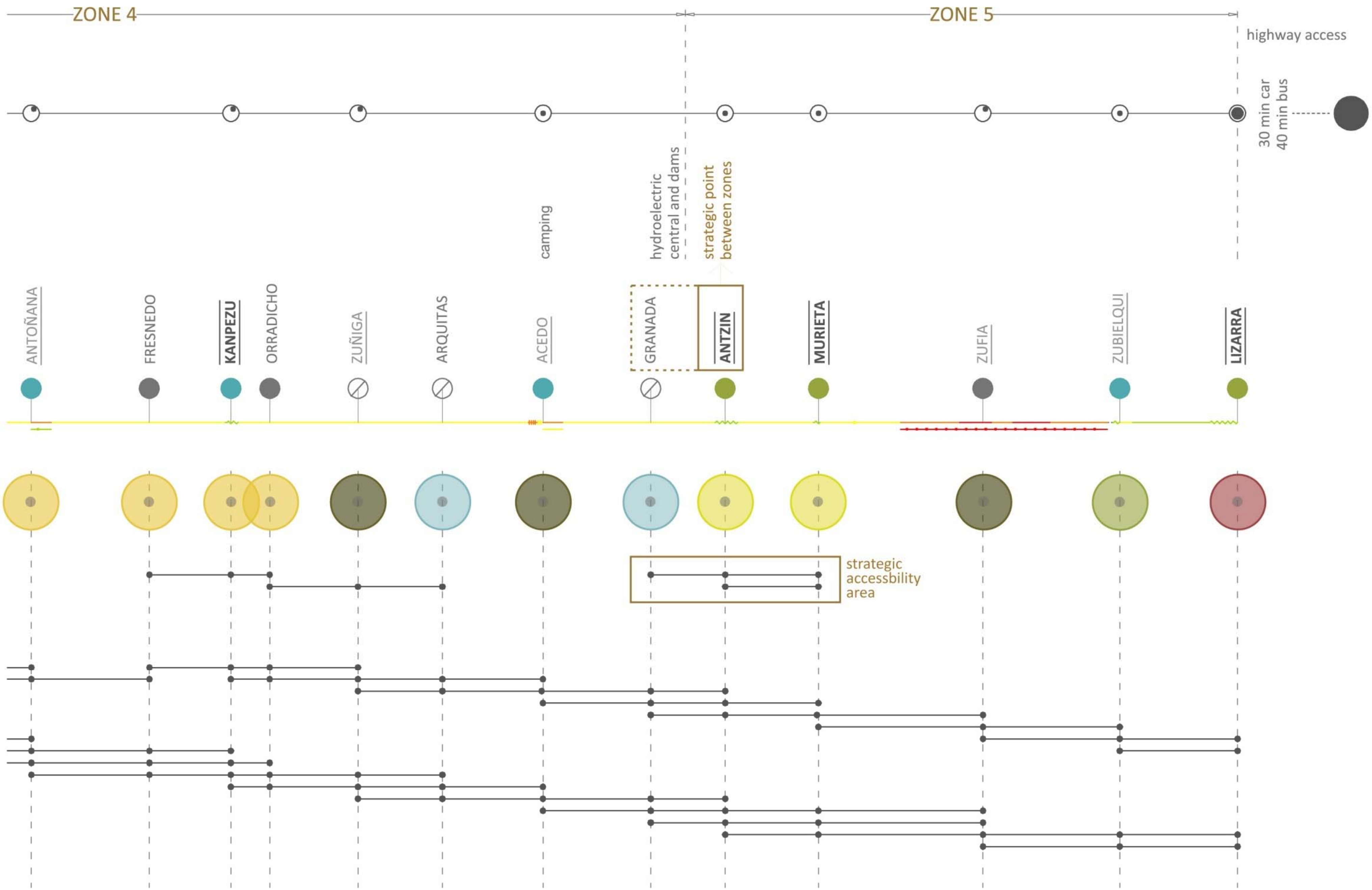


LINE / TERRITORY
L / T 1
L / T 3
ZONE 1
highway zone
highway access
railway access
ELEMENTS
NODES
LINE
MALTZAGA
SORALUZE
LOS MARTIRES
MEKOALDE
BERGARA
ALTOS HORNOS
SAN PRUDENCIO
ARRASATE
ULGOR
ARETXABALETA
LANDETA-MAR.
ESKORIATZA
CASTAÑARES
MAZMELA
NODE / TERRITORY
LINE / TERRITORY (L / T 2)
WALKING
RUNNING
CYCLING
strategic accessbility area


ZONE 2
ZONE 3
railway access
highway zone
MAZMELA
ZARIMUZ
MARIN
LEINTZ-GATZAGA
ARLABAN
LANDA
LEGUTIANO
URBINA
RETANA
DURANA
VITORIA-APEADERO
VITORIA-GASTEIZ
OLARIZU
OTAZU



LINE / TERRITORY
L / T 1
L / T 3
ZONE 3
railway access
highway zone
ZONE 4
strategic point
between zones
outside access point
(4km railway access)
ELEMENTS
NODES
LINE
OLARIZU
OTAZU
ABERASTURI
ANDOLLU
TROCONIZ
ERENTXUN
GAUNA
URIBARRI-JAUREGI
BRIGADA TUNEL
LAMINORIA
ZEKUIANO
MAEZTU
ATAURI
ANTOÑANA
NODE / TERRITORY
LINE / TERRITORY (L / T 2)
WALKING
RUNNING
CYCLING


ZONE 4
ZONE 5
highway access
30 min car
40 min bus
camping
hydroelectric central and dams
strategic point between zones
ANTOÑANA
FRESNEDO
KANPEZU
ORRADICHO
ZUÑIGA
ARQUITAS
ACEDO
GRANADA
ANTZIN
MURIETA
ZUFIA
ZUBIELQUI
LIZARRA
strategic accessbility area

In summary, although each zone or area must have its own strategies, all of them must follow the same approach in order to ensure the unity or cohesion of the system. In this case, all the areas present a common general need: the need of sustainable transport infrastructures. And disused railway lines are the most suitable infrastructures for the creation of non-motorise axes. Furthermore, the railway nodes or buildings located along the infrastructure will be related to the non-motorised axis in one way or another and, hence, will enable the potential offered by the linear infrastructure to be realised. For that purpose, activities and features that will refer to each specific node area must be considered and ensured. Some of them will be related to the need of cities, where large activity areas are located, but the need of natural areas has been identified. Others will focus on activities that could promote local development, while there are also areas completely related to leisure and tourism purposes. All of them must aim to achieve the balance between transport and land uses in the area, but in collaboration with its surrounding areas in order to avoid the decomposition of the system.

ACTION POINTS

After obtaining the results of the Comprehensive Analysis Method (CAM), ten main action points have been identified in the Vasco-Navarro Railway System:

1: Reconversion of the linear infrastructure between Maltzaga and Soraluze in order to ensure the integration of the non-motorised axis to the Bilbao-Donostia axis.

2: Enhancement of the railway stations of Arrasate and Eskoriatza as part of a strategic accessibility area.

3: Rehabilitation of the linear infrastructure of the mountain pass of Arlaban facilitating the connection between the two provinces and the integration of the non-motorised infrastructure into existing long-distance footpaths.

4: Restoration and rehabilitation of the railway node of Legutio.

5: Restoration and rehabilitation of the railway building of Olarizu and the connection between the city of Vitoria-Gasteiz and the Vasco-Navarro Railway Greenway.

6: Refurbishment of the railway node of Erentxun as part of a strategic point between zones.

7: Rehabilitation of the tunnel of Laminoria in order to facilitate the connection of the infrastructure section located in the mountain area of Araba/Álava with plain terrains of the province and the main city of Vitoria-Gasteiz.

8: Restoration and rehabilitation of the railway station of Atauri and change of use of the railway buildings of Antoñana and Kanpezu.

9: Restoration and rehabilitation of the railway node of Granada and enhancement of the railway stations of Antzin and Murieta as part of both a strategic point between zones and a strategic accessibility area.

10: Reconversion of the linear infrastructure from Murieta to Zubielqui in order to ensure the connection to Lizarra.

7.3. Conclusions

A Comprehensive Analysis Method (CAM) for the analysis of Disused Railway Systems (DRS) is presented in this chapter. For this purpose, three theoretical and methodological conceptions are assumed, from which one of them refers to the composition of the subject of study (a territorial heritage system), while the other two denote the future approaches of the DRS (a non-motorised transport axis with balanced node areas). Accordingly, different analysis areas and methods are used for the definition of the CAM. Each approach provides results of each type of railway element or created relation, but in turn provides results of the whole DRS. These results refer to the potential of a DRS as a territorial structuring system, including both the potential of the linear infrastructure and the potential of the nodes, in order to cover new uses beyond the current greenways while promoting the preservation of the railway heritage. In this regard, general strategies or guidelines and specific action points can be defined for its reconversion.

The CAM is applicable to disused railways located in diverse territories, where urban and rural cores appear minimally spaced and do not form a metropolitan area. Nevertheless, it could be widespread to other territorial systems, composed of a linear infrastructure (or even a network infrastructure) and several nodes distributed along it.

In this case, the CAM has been applied to a specific DRS (the Vasco-Navarro Railway) and a scheme that includes the general results has been created. In addition to the five territorial zones previously defined, smaller areas, where similar guidelines can be implemented, have been identified on the one hand and, accordingly, the disused railway has been divided into ten areas. The proposed strategies of the different areas mainly focus on the promotion of sustainable transport modes, especially non-motorised transports, but the restoration and rehabilitation of the former railway nodes also become essential to endorse the uses located along the linear infrastructure and the creation of new activities in the area, in addition to the preservation of the heritage itself. Furthermore, ten main action points have been also distinguished, which are essential for a suitable comprehensive reconversion of the DRS. On the other hand, several strategic areas or points that refer to specific approaches have been also identified. In this regard, there are two key points for the connection between the different territorial zones, while there are other two that have been defined as strategic accessibility areas. What is more, one of the areas of each approach is the same. Finally, the lack of external connections should be also taken into consideration for the reconversion of the Vasco-Navarro DRS.

Contribution 11:

A Comprehensive Analysis Method (CAM) has been created for the analysis of Disused Railway Systems (DRS) based on three theoretical and methodological conceptions: disused railways as heritage systems; former linear infrastructures as non-motorised axes; and the balance between transport and land uses around the former railway nodes.

CONCLUSIONS

Contributions and achievement of objectives, confirmation of hypotheses and inconveniences created

Thousands of kilometres of disused railway lines that compose a railway heritage of great interest have been the object of study of several authors over the last few decades. Meanwhile, interventions for their reuse or reconversion have also been created. Nevertheless, the mismatch between theoretical and practical achievements claimed by Porcal (2011) has been taken into consideration in this research with the aim to support that the analysis of the disused railway lines should have a comprehensive vision in order to achieve the same view in their protection or future interventions. In this regard, the objective of this work was to develop a methodological proposal for the analysis of disused railway lines as complex systems, thus demonstrating their potential in the territory.

For the design of the Comprehensive Analysis Method (CAM), several theoretical and methodological approaches and practical approximations have been used. The main and essential theoretical approach is based on the understanding of disused railway lines as territorial heritage systems, since as previously presented, a railway station in not only a heritage element that can reactivate its environment, but part of a territorial system that connects the infrastructure and its surrounding environment and, hence, part of a total value of the whole system. This added value can be easily deduced from the framework of the concept of system, where the relations between the different elements of the system are considered in addition to the elements themselves. Accordingly, the concept of Disused Railway System (DRS) has been defined, from which main analysis areas have been inferred.

In this framework, the initial approach of a comprehensive method (Part II) has been proposed by means of the analysis of different disused railway systems (DRS). Although the initial analysis method has resulted inaccurate for the characterisation of a DRS, it is suitable for the comparison of different DRSs as well as in the process of the method creation, which has enabled to evaluate the suitability of the identified analysis areas. In this regard, the analysis of elements and external relations have been validated while internal relations have been dismissed. For the development of the method (Part III), hence, four analysis areas based on the different railway elements (line and nodes) and their relations with the territory (line/territory and node/territory) have been assumed.

In this second phase, in addition to the first theoretical approach and its methodological outcome, other theoretical and methodological conceptions or approaches have been considered. If the first one referred to the composition of the subject of study (a territorial heritage system), the other two denote the future approaches of the DRS (a non-motorised transport axis with balanced node areas).

Accordingly, the Comprehensive Analysis Method (CAM) has been structured in the same way. The first leg of the method focuses on the comprehension of the elements, from their beginning to the present, giving emphasis to the importance of DRSs as heritage elements. Meanwhile, the second and third legs include the study of the opportunities that the railway system could give regarding a more sustainable development of the territory: on the one hand, the potential of the linear infrastructure in the territory as a non-motorised transport axis, and on the other hand, the potential of each node in its surroundings. Hence, different analysis areas and methods are used for the definition of the CAM. Each approach provides results of each type of railway element or created relation, but they all together provide results of the whole DRS. These results refer to the potential of a DRS as a territorial structuring system, including both the potential of the linear infrastructure and the potential of the nodes, in order to cover new uses beyond the current greenways while promoting the preservation of the railway heritage. In this regard, general strategies or guidelines and specific action points can be defined for its reconversion.

Furthermore, the application of the method to a specific DRS in the development phase of the method has enabled to show its suitability and to include any change if necessary. In this regard, in addition to the analysis areas, the specific methods, variables and indicators have been developing until the final method.

As the initial step of the final Comprehensive Analysis Method (CAM), the study of the elements that are part of the system has been proposed. Accordingly, the internal elements (the line and the nodes) have been considered on the one hand, while the territory has been studied as the external component. Although the territory was not initially included in the analysis of the elements (only in relations), a previous characterisation has been considered necessary (especially in the historical or constant state) to comprehend the historical and current organisation of a territory and the evolution of its urban areas.

For that purpose, the consideration of the main different periods of the system (historical and current state) has been proposed, which has enabled to define the historical railway organisation or structuration and its presence in the territory, in addition to identify and study the existing heritage elements that can be promoted in the foreseeable future. Accordingly, historical data have been useful not only to know which heritage elements have disappeared, but to comprehend the territorial hierarchy created by the historical axis. Meanwhile, current data have resulted essential for the definition of the preservation level of the existing elements.

Furthermore, GIS based inventories have been proposed as one of the main tools for data compilation of different periods, both at territorial level (analysis of different systems) and local level (elements of a system). All these variables have permitted the comprehension of the components or elements of a DRS.

It should be mentioned that the heritage value of each element has not been measured, since industrial heritage elements that are part of the same system would get a similar heritage value according to different evaluation criteria. In this regard, although it is possible to know the heritage value of each element, it is not possible to create a priorisation between them.

As the second leg of the CAM, a method based on accessibility analyses has been developed for the study of the relations between the linear infrastructure and the territory and, hence, to define its potential in the surrounding territory. For that purpose, a multilevel approach with different accessibility measures has been used in order to assess the non-motorised accessibility of a linear infrastructure located in a varied territory. The proposed three approaches (regional, interurban and urban levels) provide results at different scales, but in turn provide results of the whole line areas. Accordingly, different territorial zones and sections with different possibilities have been identified, proving that in this case, the analysed disused railway line has potential as a non-motorised infrastructure that operates at urban or interurban scale, providing alternatives to private vehicles or motorised public transports in daily relatively short trips. Particularly, the regional approach has shown the potential of the different sections as an active transport infrastructure related to daily purposes; the interurban approach has specified the accessibility level of each section related to different type of transport modes and journeys; and the urban level has defined the operability of core areas as origins of the interurban trips or destinations of local trips.

For the development of the methodology, on the one hand, optimal accessibility measures have been studied and selected (potential and contour measures) for each approach, taking into consideration theoretical requirements and easy of interpretation. Moreover, adaptation of existing measures has been also necessary in some case. In this regard, the travel impedances of the potential measures have been limited in order to reduce the effect of the end of the line that occurs in linear infrastructures. On the other hand, several variables, such as time (1 h, 45 min and 10 min), means of transportation (walking or running and cycling), speed or type of journey (round and non-round trips) have been defined in accordance with the analysed system and its territory.

Finally, it should be added that although the features of the accessible area are usually considered in the accessibility analyses at urban level, the third accessibility level of the CAM does not mix transport and land-use components. This is because the analysis of the relations between the nodes and the territory would posteriorly include these issues, in addition to the small size of the towns or cities along the linear infrastructure in such varied territories.

As the third leg of the CAM, a method centred on transport based developments has been developed for the study of the relations between the railway nodes and the territory and, hence, to define their potential in the surrounding territory. For that purpose, the transport systems and land uses located in the non-motorised influence areas of the nodes have been measured and the balance between them has been assessed, which enables to understand each former railway node as a node in a network and as a place in the city. The use of different models and the adaptation of another (node/place, nodus/civitas/urbs and multiaxial models) have permitted to implement this approach in DRSs located in varied territories, proving that in this case, the analysed disused railway nodes have potential as future nodes of a non-motorised transport axis in developments based on active transports.

Accordingly, optimal transport and land-use models have been studied and adapted to the specific requirements of both urban and rural areas. In this regard, on the one hand, indicators of literature have been studied and adapted, while new indicators have been also created. On the other hand, in addition to the common variables presented in the first two models, criteria related to varied territories have been included in the multiaxial model, which has enabled the characterisation of the node areas.

MCDA has been proposed for the analysis of the node areas, where the AHP method has been used to structure and weight the different criteria. In this regard, the capability of the MCDA has been demonstrated for the analysis of disused railway node areas located in varied territories, since it has permitted to easily obtain the results for the three different models (based in the same variables) in addition to create different node rankings. It should be added that although own judgment has been used for the priorisation of the different criteria, sensitivity analysis has been used to assess the suitability of the weights obtaining the percentages of improvement in general results. However, it has not been used to detect changes in the ranking of nodes, since small changes in weights produced variations in a large ranking.

Furthermore, a classification of the node areas has been proposed taking into consideration both a graphical comparison of the three models, based on previous zones or groupings (AL1 and AL3), and statistical methods (PCA and k-means), which are able to validate or enhance the initial grouping. Moreover, the distribution of the different type of node areas in the line has been useful to identify singular and strategic nodes within a zone or zones where the implementation of similar strategies can occur.

Finally, besides the former railway nodes, two methods for the identification of possible new nodes along the disused railway line have been created. One of them refers to the study of the transport and land uses around the DRS, while the other corresponds to the accessibility level of the different areas along the infrastructure.

Nevertheless, some limitations referred to the data collection or study have been detected in the node/territory analysis. On the one hand, the geographic area of a DRS might not coincide with the administrative boundaries of a territory, so data of different nature and sources must be merged. Accordingly, the creation of an own dataset or extrapolation of some data can result necessary. In this regard, although most of the values correspond to real data in the application of the method, some others are percentages of real data or are grouped in order to obtain comparable results. On the other hand, the variable values have been rescaled between 0 and 1, so the existence of a unique main city, as in the application of the method, can considerably alter the results of the small cores. Accordingly, log-transformation has been used to reduce the disparity of some variable, where the difficulty lies in the choice of which variables must be log-transformed.

As a result of the CAM, the potential of a whole system has been defined by means of the different analysis areas and their corresponding methods. This potential is based on both the potential of the line and the potential of the nodes, which are composed of the relations referred to each element and its corresponding characterisation.

In this regard, the CAM is an open procedure where each analysis area is not entirely independent of the others and, hence, its results are useful for all the others, i.e. there is a feedback between them. Therefore, the interventions undertaken in the linear infrastructure will influence the use of the nodes and vice versa. Nevertheless, the accessibility of the linear infrastructure is the feature that on the one hand, ensures the longitudinal connections and, hence, the existence of a territorial axis and on the other hand, defines the approach of the reconversion for each zone of the system. Therefore, the line is the major element of the system, which shows the structuring nature that railway lines originally had in each territory, which is precisely, as previously said, one of the most important features to enhance the railway heritage in the new territorial view of the 21th century.

In the light of the results of the CAM, general intervention proposals of the whole system can be created lead by autonomic governments, but more focused proposals can be also developed by regional councils comprising some of the mentioned areas, or even local actions by city councils or other public or private stakeholders. All of them, however, must be part of a general strategy marked by the results of the whole analysis. Only thus could the integrity of the system be maintained, although the interventions are specific or distributed over time. Therefore, it is also important to provide the possibility to update the analysis data, enabling proposals to adapt and show the new territorial reality of each specific moment. In this regard, on the one hand, GIS is used for data collection and on the other hand, MCDA is used for transport and land use analyses, where results can be automatically updated when data are changed because all the mathematical operations have been programmed.

In this work, the CAM has been applied to the Vasco-Navarro Railway. However, in addition to this specific system or any other DRS of the Basque-Navarre territory, the method is applicable to other DRSs of similar territories (diverse territories). Furthermore, it could be widespread to other DRSs or territorial systems composed of a linear infrastructure (or even a network infrastructure) and several nodes distributed along it: rivers and their hydroelectric plants, cattle routes, pilgrimage routes, heritage roads and their auxiliary constructions, public transport infrastructures of a polinuclear system of cities, etc.

Therefore, several changes can be easily made for the analysis of any other DRS. On the one hand, values of the trip variables (distances) of the accessibility analyses can be modified depending on the type of transport or time limits. On the other hand, different criteria and variables of the multicriteria analysis can be also adapted referring to the type of territory where the system is located. Nevertheless, the appropriateness of the initial theoretical approaches should be first questioned in these cases. Finally, in the cases where other type of territorial system wanted to be studied, the characterisation of the elements should be also modified and, in some cases, even the type of elements themselves.

As a final point, the usefulness of the initial analysis should be mentioned, since in addition to the validation of the different analysis areas, the similarity in the results between the initial and developed analyses has been confirmed for the Vasco-Navarro Railway. Accordingly, the zone of the mountain port of Arlaban shows few territorial potential, while the other zones do have certain potential. In this regard, by means of the initial analysis of different systems, besides the definition of the general character of each system, the extrapolation of general results can be made once the exhaustive analysis of a specific system is performed. For instance, the internal relations analysis includes accurate and average distances between nodes, so the values can be easily compared to the accessibility distance limits stablished for interurban trips. Moreover, the population level and the personal knowledge about the territory can facilitate the recognition of the urbanity level of these areas. Based on that, the initial and developed methods can operate together in order to understand the different realities of the different DRSs of a territory. Urola, for example, shows relatively high levels of accessibility and urbanity, so future strategies in its northern zone can be similar to those in the Deba Valley. Meanwhile, cycling accessibility should be mainly promoted in the southern area, since the distances are greater. Hence, although the conclusions of this initial analysis are not precise enough, they are appropriate to create a first approximation of the final results referred to the whole system or its different zones.

Nevertheless, due to the lack of historical data, the comparison of the different periods is only possible with few data. That is why the initial analysis comprises few and specific railway and territorial information that is comparable in the two periods. Therefore, in the final CAM, the analysis of the historical data have been limited to the study of elements, while a great deal of current data have been used in the external relations.

The next lines summarize the main contributions performed by this work, which can be encompassed in theoretical, practical and political implications:

- The concept of Disused Railway System (DRS) has been defined in order to study the disused railway lines as territorial systems. The definition of the concept has permitted the development of a comprehensive analysis method.

- The different analysis areas for the understanding of disused railway lines as systems have been defined. On the one hand, the two areas related to the elements (line and nodes) have been proposed to consider for the comprehension of the railway itself. On the other hand, the areas referred to the relations should be studied. Although internal and external relations were initially defined, the analysis area related to the internal relations (line/node) has been dismissed for the development of the comprehensive analysis. This is because the distribution of nodes in a line depends on the location of the urban or rural settlements, so territorial characteristics are already included. Accordingly, the two analysis areas referred to the external relations have been only justified for the development of the methodology: line/territory and node/territory areas. Both areas should be studied in a multilevel approach in order to comprise all the necessary data.

- In the methodology for the analysis of different DRSs, historical data have been taken into consideration in addition to the current data to comprehend the territorial structuring nature of these systems. For that purpose, specific data have been selected in order to create a comparison between the different periods and systems. Nonetheless, this few selected data have resulted imprecise for the development of the comprehensive methodology.

- A Comprehensive Analysis Method (CAM) has been created for the analysis of Disused Railway Systems (DRS) based on three theoretical and methodological conceptions: disused railways as heritage systems; former linear infrastructures as non-motorised axes; and the balance between transport and land uses around the former railway nodes. Going beyond previous heritage approach analysis methods (see chapter 2.1.2 and 2.3.3), these three conceptions enable to comprehend a disused railway as a territorial system, which in turn, facilitates the creation of comprehensive proposals. In this regard, this methodology could alter the political approach to address the future of disused railway lines.

- As part of the CAM, the different elements of a DRS have been studied taking into consideration both current and historical periods, providing historical railway structuration and current node distributions depending on their preservation level and use, in order to note the maintenance or mismatches between the initial and current schemes or to compare them.

- As part of the CAM, the relations between the disused railway line and its surrounding environment have been studied by means of a multilevel accessibility analyses and studying the former railway infrastructure as a non-motorised axis. This conception makes possible the comprehension of the linear infrastructure as both a territorial and a system structuring element.

- Accessibility along a linear infrastructure has been measured for varied territories, including urban and rural communities and non-built natural areas. Hence, three different scales of analysis have been used for the comprehension of the potential of the entire axis in its surrounding environment: a regional approach, referred to the cities and towns which are connected by the disused railway line; an interurban approach related to the areas near the line; and an urban approach referred to the areas of urban or rural cores around the line.

- Existing potential measures have been adapted to linear infrastructures by limiting the travel impedance in order to reduce the effect of the end of the line that occurs in linear infrastructures.

- As part of the CAM, the relations between the disused railway nodes and their surrounding environments have been studied implementing TOD concepts on DRSs and studying former railway station areas as nodes of a non-motorised axis. This conception makes possible the comprehension of railway heritage elements as territorial structuring elements.

- Previous transport and land use models have been adapted to DRSs and their surrounding territories, while a specific multiaxial model has been also created. Together, they are able to characterise each node area as well as to assess their transport and land use balance. Furthermore, several indicators that were not included in previous proposals and mainly represent rural features have been incorporated. Hence, general, urban and rural criteria are used for a comprehensive approach of the territories where DRSs go through.

- Two approaches for the identification of future new nodes along the non-motorised infrastructure have been proposed. One of them refers to the accessibility analysis of the areas around the infrastructure, while the other is based on transport and land use features.

Further work

This work, on the one hand, have revealed new weaknesses to which further research can be oriented and on the other hand, have exposed new research issues that can be developed in the future. This section proposes some of them.

First of all, the application of the CAM to the twelve DRSs of the Basque-Navarre territory, in order to comprehend the territorial potential of all the systems with the aim of defining their future approach and preserving the railway heritage. Accordingly, further research can be developed in some of the analysis areas of the CAM. On the one hand, the heritage value of each built element should be assessed, since elements of different systems could show significant variations in their result. For that purpose, optimal valuation criteria should be identified first. On the other hand, the relations between node and territory of all the nodes of different systems should be studied and, hence, the rescalation should be applied to all of them. Accordingly, all the nodes of a territory would be comparable and priorisations all over the territory could be created. The main shortcoming could lie on the data collection referred to a larger territory that has several administrative boundaries.

Furthermore, instead of the sensitivity analysis, multiple decision makers can be also included in the initial judgment of the variables in the analysis of the relations between node and territory in order to avoid an individual evaluation. Finally, the identification of other territorial systems that are susceptible to being analysed by means of the CAM and the subsequent adaptation of the method can be developed.

Besides the application or adaptation of the CAM, further study is proposed:

- Future reconversion actions that follows the main anticipated strategies can be assessed and evaluated by means of variations in results of the proposed method. For instance, the variations in results of a same action developed in different locations; or the actions that are necessary to create in order to achieve a balanced node or certain level of certain variable.

- The use of new technologies for data collection referred to the number of users in the analysed system. On the one hand, the existing number of users can comprise a new variable of the proposed method and on the other hand, variation on users over the time can represent the suitability of the undertaken actions.

- The influence of the use of electric bicycles in the territorial potential of a disused railway system. Urban and interurban accessibility distances are extended and, hence, competitiveness with private motor vehicles can be increased.

As a final point and an essential requirement of any future reconversion of disused railway lines, the collaboration between the different departments that are involved in the matter should be highlighted. In the case of the Basque Country, for example, the departments responsible for the matters of regional planning or environment focus on the greenway or green route proposals for the reuse of disused linear infrastructures, while the departments responsible for the matters of culture intend to ensure the preservation of built heritage elements, where the railway nodes are included. This division emphasises the decomposition of the system and the subsequent wastage of its territorial potential.

Public dissemination of research results

Eizaguirre-Iribar, A., Etxepare, L., Hernández-Minguillón, R.J., 2015. An approach to a methodology for the analysis and characterization of disused railway lines as complex systems. *WIT Transactions on The Built Environment* 153, 811–823.

Eizaguirre-Iribar, A., Etxepare, L., Hernández-Minguillón, R.J., 2016. A multilevel approach of non-motorised accessibility in disused railway systems: The case-study of the Vasco-Navarro railway. *Journal of Transport Geography* 57, 35–43.

Eizaguirre-Iribar, A., Etxepare, L., Hernández-Minguillón, R.J., 2017. The analysis of disused railway lines as complex systems: GIS based inventory and Comprehensive Analysis Method. *International Journal of Sustainable Development and Planning* 12 (6), 1018–1031.

REFERENCES

[001] Abubakar, I. R., & Aina, Y. A. (2006). GIS and space syntax: An analysis of accessibility to urban green areas in Doha district of Dammam metropolitan area. In *Proceedings of Map Middle East Conference*. Dubai.

[002] Aguilar, I. (1988). *La estación de ferrocarril puerta de la ciudad*. Valencia: Generalitat Valenciana.

[003] Aguilar, I. (1999). *Arquitectura industrial: Concepto, método y fuentes.* Valencia: Diputación de Valencia.

[004] Aguilar, I. (2001). La investigación sobre el patrimonio industrial. una revisión bibliográfica. *TST: Transportes, Servicios y Telecomunicaciones*, (1), 169-186.

[005] Aguilar, I. (2007). Paisajes Del Transporte. Paisajes De La Modernidad. In *Paisaje cultural EURAU 08 Actas del 4º congreso europeo de investigación arquitectónica y urbana* (pp. 46-50). Madrid: Centro de Estudios y Experimentación de Obras Públicas.

[006] Aguilar, I. (2008). *La Estación del Trenet: Puerta de la Marina: Historia y puesta en valor del patrimonio FGV*. Valencia: Cátedra Demetrio Ribes, UVEG-FGV.

[007] Aguilar, I. (2010). El transporte en el Paisaje Industrial. Trazados y redes en el territorio. In *Patrimonio industrial y paisaje. V congreso conservación del patrimonio industrial y de la obra pública en España* (pp. 319-332). Gijón: Cicees.

[008] Aguilar, I. (2011). *AVE Valencia - Madrid: diálogos sobre el territorio y escenas desde el tren.* Valencia: Conselleria d'Infraestructures, Territori i Medi Ambient.

[009] Aguinaga, R. (1910). *F.C. de Estella-Vitoria-Los Mártires. Antecedentes, datos, plano*s. Vitoria-Gasteiz: Araba/Álava Provincial Press.

[010] Alberdi, J. C. (2010). Euskal herriko nekazaritza-guneen inguruko gogoeta. In J. Arbaiza & P. Lozano (Eds.), *Lurralde-antolamendua Euskal Herrian: Gaur egungo egoera, gatazkak eta erronkak* (pp. 175-189). Bilbao: Udako Euskal Unibertsitatea.

[011] Albers, G. (1974). Modellvorstellungen zur siedlungsstruktur in ihrer geschichtlichen entwicklung. Akademie für raumforschung und landesplanung: Zur ordnung der siedlungsstruktur. Hannover: Jänecke.

[012] Altadill, J. (1918). *Geografía General del País Vasco-Navarro. Provincia de Navarra*. Barcelona: Establecimiento editorial de Alberto Martín.

[013] Andreae, C. (1997). *Lines of Country: An Atlas of Railway and Waterway History in Canada*. Boston Mills Press

[014] Apparicio, P., Shearmur, R., Brochu, M., & Dussault, G. (2003). The measure of distance in a social science policy context: Advantages and costs of using network distances in eight Canadian metropolitan areas. *Journal*

of Geographic Information and Decision Analysis, 7 (2), 105-131.

[015] Araba/Álava (2012). Norma foral 1/2012, de 23 de enero, de itinerarios verdes del Territorio Histórico de Álava. B.O. del Territorio Histórico de Álava, 3 de febrero, 2012.

[016] Arratzua-Ubarrundia (2013). Plan general de ordenación urbana. B.O. del Territorio Histórico de Álava, 29 de noviembre, 2013.

[017] Association of Spanish Railways (n.d.). Plan de Identificación, protección y puesta en valor del Patrimonio Histórico Cultural Ferroviario. Fundación de Ferrocarriles Españoles.

[018] Association of Spanish Railways (1993). Inventario de las líneas ferroviarias en desuso Fundación de Ferrocarriles Españoles.

[019] Atelier Zuidvleugel (2007). Space and line: A spatial survey for Stedenbaan 2010-2020, The South Wing of the Randstad. *Nova terra, connected cities* (pp. 11-16). Den Haag: Nederlands Insitut voor Ruimtelijke Ordening en Volkshuisvesting, NIROV.

[020] Aycart, C. (2001). Vías verdes, reutilización de ferrocarriles en desuso para movilidad sostenible, ocio y turismo. *Informes De La Construcción*, 53 (475), 17-29.

[021] Aycart, C. (2010). El programa vías verdes: Un instrumento para el desarrollo rural sostenible. In *Patrimonio industrial y paisaje. V congreso conservación del patrimonio industrial y de la obra pública en España*. Gijón: Cicees.

[022] Balz, V., & Schrijnen, J. (2009). From concept to projects: Stedenbaan, the Netherlands. In C. Curtis, J. L. Renne & L. Bertolini (Eds.), *Transit oriented develoopment: Making it happen* (pp. 75-90). Farnham, England: Ashgate Publishing, Ltd.

[023] Basque Country (1990a). Ley 4/1990, de 31 de mayo, de Ordenación del Territorio del País Vasco. B.O. del País Vasco, 3 de julio de 1990.

[024] Basque Country (1990b). Ley 7/1990, de 3 de julio, de Patrimonio Cultural Vasco. B.O. del País Vasco, 6 de agosto de 1990.

[025] Basque Country (2011). Anteproyecto de Ley de Patrimonio Cultural Vasco.

[026] Basque Country (2015). Anteproyecto de Ley de Patrimonio Cultural Vasco.

[027] Basque Country (2017). Anteproyecto de Ley de Patrimonio Cultural Vasco.

[028] Basque Government (1997). Decreto, 28/1997, de 11 de febrero, Directrices de Ordenación Territorial de la Comunidad Autónoma del País Vasco. Gobierno Vasco, Departamento de Ordenación del Territorio, Vivienda y Medio Ambiente.

[029] Basque Government (2000). Avance del Plan Territorial Sectorial del Patrimonio Cultural Vasco. Gobierno Vasco, Departamento de Cultura.

[030] Basque Government (2001). Plan Territorial Sectorial de la Red Ferroviaria en la CAPV. Gobierno Vasco, Departamento de Transportes y Obras Públicas.

[031] Basque Government (2002). Plan Director del Transporte Sostenible. La política común de transportes en Euskadi 2002-2012. Gobierno Vasco, Departamento de Transportes y Obras Públicas.

[032] Basque Government (2008a). Euskal Hiria NET: Nueva Estrategia Territorial. Monografías temáticas: Análisis socioeconómico de la CAPV. Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial, Agricultura y Pesca.

[033] Basque Government (2008b). Euskal Hiria NET: Nueva Estrategia Territorial. Monografías temáticas: El medio físico. Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial, Agricultura y Pesca.

[034] Basque Government (2008c). Euskal Hiria NET: Nueva Estrategia Territorial. Monografías temáticas: Movilidad, accesibilidad y energía. Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial, Agricultura y Pesca.

[035] Basque Government (2008d). Euskal Hiria NET: Nueva Estrategia Territorial. Monografías temáticas: Sistema de asentamientos. Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial, Agricultura y Pesca.

[036] Basque Government (2011). El diagnóstico de las necesidades de intervención en la renovación del parque edificado de Euskadi. Gobierno Vasco, Departamento de Vivienda.

[037] Basque Government (2012). Euskal Hiria NET: Nueva Estrategia Territorial. Modificación de las DOT, como consecuencia de su reestudio (documento para aprobación inicial). Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial, Agricultura y Pesca.

[038] Basque Government (2013). Modificación del Plan Territorial Sectorial de ordenación de los ríos y arroyos de la CAPV (vertientes cantábrica y mediterránea). Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial y Vivienda.

[039] Basque Government (2014). Modificación de Las DOT, en lo relativo a la Cuantificación Residencial (documento de aprobación inicial). Gobierno Vasco, Departamento de Medio Ambiente y Política Territorial.

[040] Basque Government (2016). Revisión de las Directrices de Ordenación Territorial (DOT) (avance). Gobierno Vasco, Departamento de Medio Ambiente, Planificación Territorial y Vivienda.

[041] Bertolini, L. (1996a). Des gares en transformation, nœuds de réseaux et lieux dans la ville. *Annales de la Recherche Urbaine*, (71) pp. 86-92.

[042] Bertolini, L. (1996b). Nodes and places: complexities of railway station redevelopment. *European Planning Studies*, 4 (3), 331-345.

[043] Bertolini, L. (1999). Spatial Development Patterns and Public Transport: The Application of an Analytical Model in the Netherlands. *Planning Practice and Research*, 14 (2), 199-210.

[044] Bertolini, L. (2000). Planning in the borderless city. A

conceptualisation and an application to the case of station area redevelopment. *Town Planning Review*, 71 (4), 455.

[045] Bertolini, L. (2006). Fostering urbanity in a mobile society: Linking concepts and practices. *Journal of Urban Design*, 11 (3), 319-334.

[046] Bertolini, L., & Spit, T. (1998). *Cities on rails: The redevelopment of railway stations and their surroundings.* London and New York: E & FN Spon.

[047] Bertolini, L., Le Clercq, F. & Kapoen, L. (2005). Sustainable accessibility: a conceptual framework to integrate transport and land use plan-making. Two test-applications in the Netherlands and a reflection on the way forward. *Transport Policy*, 12 (3) 207-220.

[048] Bhat, C., Handy, S., Kockelman, K., Mahmassani, H., Chen, Q., & Weston, L. (2000). Development of an urban accessibility index: Literature review. University of Texas, Austin: Center for Transportation Research.

[049] Bill Hillier, & Shinichi Iida. (2005). Network and psychological effect in urban movement. In Anthony G. Cohn, & David M. Mark (Eds.), *Spatial information theory* (pp. 475-490). New York: Springer.

[050] Breheny, M., & Rookwood, R. (1993). Planning the sustainable city region. In A. Blowers (Ed.), *Planning for a sustainable environment* (pp. 150-189). London: Earthscan.

[051] Broseau, M., Knight, J., & Witham, J. (1974). *Inventory of Railway Station Buildings in Canada.* Otawa: Environment Canada, Parks Service.

[052] Burns, L. D. (1979). *Transportation, temporal, and spatial components of accessibility*. Lexington and Toronto: Lexington Books.

[053] Calthorpe, P. (1993). *The Next American Metropolis: Ecology, Community, and the American Dream*. Princeton: Princeton Architectural press.

[054] Canada (1985). Heritage Railway Stations Protection Act R.S.C. 1985, c. 52 (4th Supp.)

[055] Capel, H. (2003a). A modo de introducción. Los problemas de las ciudades: urbs, civitas y polis. In *Ciudades, Arquitectura y Espacio Urbano* (pp 9-22).

[056] Capel, H. (2003b). Redes, chabolas y rascacielos. Las transformaciones físicas y la planificación en las áreas metropolitanas. In *Ciudades, Arquitectura y Espacio Urbano* (pp. 199-238).

[057] Caravaca, I., Colorado, D., Fernández, V., Paneque, P., & Puente, R. (1996). Patrimonio cultural y desarrollo regional. *Revista De Estudios Urbano Regionales EURE*, 22 (66) 89-99.

[058] Cascetta, E., & Pagliara, F. (2009). Rail friendly transport and land-use policies: The case of the regional metro system of Naples and Campania. In C. Curtis, J. L. Renne & L. Bertolini (Eds.), *Transit oriented development: Making it happen* (pp. 49-63). Farnham, England: Ashgate Publishing, Ltd.

[059] Cervero, R. (2009). Public transport and sustainable urbanism: Global lessons. In C. Curtis, J. L. Renne & L.

Bertolini (Eds.), *Transit oriented development: Making it happen* (pp. 23-35). Farnham, England: Ashgate Publishing, Ltd.

[060] CHCfE Consortium (2015). Cultural Heritage Counts for Europe. Krakow: International Cultural Centre.

[061] Chorus, P., & Bertolini, L. (2011). An application of the node place model to explore the spatial development dynamics of station areas in Tokyo. *Journal of Transport and Land use*, 4 (1), 45-58.

[062] City Council of Vitoria-Gasteiz (2008). Plan de movilidad y espacio público, Vitoria-Gasteiz (draft). City Council of Vitoria-Gasteiz.

[063] Claver, J. (2016). Metodología para el análisis e interpretación de bienes patrimoniales españoles de tipo industrial. Aplicación al estudio de los bienes de la Comunidad Autónoma de Madrid. Doctoral Thesis, Universidad Nacional de Educación a Distancia, UNED. Departamento de Ingeniería de Construcción y Fabricación.

[064] Committee on Spatial Development (2011). Territorial agenda of the European Union 2020: Towards an inclusive, smart and sustainable Europe of diverse regions. Agreed at the Informal Ministerial Meeting of Ministers responsible for Spatial Planning and Territorial Development on 19th May 2011 Gödöllő, Hungary.

[065] Congress for the New Urbanism (1996). CNU charter. 3-5 May, Charleston.

[066] Congress for the New Urbanism (2000). Charter of the New Urbanism. New York: McGraw-Hill.

[067] Coutts, C. J. (2008). Greenway accessibility and physical activity behavior. *Environment and Planning B: Planning and Design*, 35 (3), 552-563.

[068] Cromley, E., & McLafferty, S. (2002). *GIS and public health.* New York: Guilford Press.

[069] Cruz, L. (2010). El convenio europeo del paisaje. La oportunidad del territorio. In *Patrimonio industrial y paisaje. V congreso conservación del patrimonio industrial y de la obra pública en España* (pp. 289-294). Gijón: Cicees.

[070] Curtis, C., & Scheurer, J. (2010). Planning for sustainable accessibility: Developing tools to aid discussion and decision-making. *Progress in Planning*, 74 (2), 53-106.

[071] Curtis, C., Renne, J. L., & Bertolini, L. (2009). *Transit oriented development: Making it happen*. Farnham, England: Ashgate Publishing, Ltd.

[072] Dalvi, M. Q., & Martin, K. (1976). The measurement of accessibility: Some preliminary results. *Transportation*, 5 (1), 17-42.

[073] Daly, C. (1846). Des gares de chemins de fer. De l'architecture commerciale et industrielle. *Revue Générale De l'Architecture Et Des Travaux Publics*, 509-540.

[074] de Jong, T., & Ritsema van Eck, J. R. (1996). Location profile-based measures as an improvement on accessibility modelling in GIS. *Computers, Environment and Urban Systems*, 20 (3), 181-190.

[075] de Munck Mortier, E. (1996). Hollen en stilstaan bij het station; onderzoek naar de beleving van de omgeving van Rotterdam CS door reizigers en passanten. Unpublished Thesis, University of Utrecht, Utrecht.

[076] Dittmar, H., & Poticha, S. (2004). Defining transit-oriented development: The new regional building block. In Dittmar, H., Ohland, G. (Ed.), *The new transit town: Best practices in transit-oriented development* (pp. 20-55). Washington DC: Island Press.

[077] Eizaguirre-Iribar, A. (2013) El ferrocarril en desuso y su relación con el urbanismo del entorno: el ferrocarril del Urola. Unpublished Master Thesis, University of the Basque Country, Department of Architecture.

[078] Environmental Activities and Greenways Management (FFE) (2011). Desarrollo sostenible y empleo en las vías verdes. Dirección de Actividades Ambientales y Vías Verdes, Fundación de los Ferrocarriles Españoles.

[079] ERA Architects (2014). Distillery District Review Study. A Review of Heritage Conservation at the Distillery District since the Adoption of the 1995 Heritage Plan. Toronto.

[080] Etor. (1991). Carreteras en el País Vasco. In *Ibaiak eta Haranak: El agua, el río y los espacios agrícola, industrial y urbano* (pp. 177-202). Donostia: Etor.

[081] European Commission (1990). Green paper on urban environment. Brussels: European Commission.

[082] European Commission (1999). Estrategia territorial europea (ETE): Hacia un desarrollo equilibrado y sostenible del territorio de la UE. Luxembourg: Office for Official Publications of the European Communities.

[083] European Commission (2000a). The European Greenways Good Practice Guide: Examples of Actions Undertaken in Cities and the Periphery. Namur, Belgium: European Greenways Association.

[084] European Commission (2000b). Study Programme on European Spatial Planning. Brussels/Stockholm: Office for Official Publications of the European Communities.

[085] European Commission (2002). Libro Blanco. La política europea de transportes de cara al 2010: la hora de la verdad. Luxemburgo: Office for Official Publications of the European Communities

[086] European Commission (2007). Green Paper on Urban Mobility: Towards a new culture for urban mobility. Brussels: Directorate General for Energy and Transport.

[087] European Commission (2010). Europe 2020: A strategy for smart, sustainable and inclusive growth. Brussels: European Commission.

[088] European Council (1983). European Regional/Spatial Planning Charter. 6th Conference of European Ministers responsible for Regional Planning. Torremolinos, Spain.

[089] European Council (2000). Convenio Europeo Del Paisaje. Florencia.

[090] Fábos, J. G., & Ryan, R. L. (2004). International greenway planning: an introduction. *Landscape and Urban Planning*, 68 (2), 143-146.

[091] Federal Ministry for Regional Planning, Construction and

Urban Development (1995). Principios de una Política Europea de Desarrollo Territorial. Bonn

[092] Fernández, J. R. (2010). Avances de planificación de los sistemas territoriales patrimoniales. Aproximación a una sistematización patrimonial de los enclaves históricos industriales. Los casos de Almadén, Sabero, Rurón, Arnao. In *Patrimonio industrial y paisaje. V congreso conservación del patrimonio industrial y de la obra pública en España* (425-430). Gijón: Cicees.

[093] Fernández, V., Puente, R., Paneque, P., Colorado, D., & Pedregal, B. (1996). Bases para una carta sobre patrimonio y desarrollo en Andalucía. Junta de Andalucía, Consejería de Cultura, Instituto Andaluz del Patrimonio Histórico.

[094] Ferrari, M. (2010). Patrimonio ferroviario en el noroeste argentino. La línea Jujuy-La Quiaca. Unpublished Doctoral Thesis, Universidad Pablo Olavide de Sevilla, Departamento de Geografía, Historia y Filosofía. Sevilla.

[095] Ferrari, M. (2011). El sistema ferroviario en el noroeste argentino: arquitectura e instalaciones complementarias. *Apuntes* 24 (1), 44-61.

[096] Ferrari, M. (2012). Paisaje y patrimonio en la línea ferroviaria 'Jujuy-La Quiaca'. Una propuesta de reutilización para el desarrollo local. Revista *Labor & Engenho*, 6 (1), 2012.

[097] Ferrer, M. (1991). Población, industria y urbanización en Navarra. In *Ibaiak eta haranak: El agua, el río y los espacios agrícola, industrial y urbano* (pp. 303-316). Donostita: Etor.

[098] Foth, N., Manaugh, K., & El-Geneidy, A. M. (2013). Towards equitable transit: examining transit accessibility and social need in Toronto, Canada, 1996–2006. *Journal of Transport Geography*, 29, 1-10.

[099] Gaindegia (2016). Euskal hiriburuetako auzoen bizigarritasun-neurgailua. Available in: *http://www.auzoak.eus/*

[100] Galindo, J., & Sabaté, J. (2009). El valor estructurante del patrimonio en la transformación del territorio. Apuntes: Revista De Estudios Sobre Patrimonio Cultural-Journal of Cultural Heritage Studies, 22(1), 20-33.

[101] García, A. (2007). Patrimonio ferroviario aragonés. Propuesta para una red de museos especializados. In *Jornadas Patrimonio Industrial y Obra Pública* (pp. 239-252). Zaragoza: Gobierno de Aragón, Departamento de Educación, Cultura y Deporte.

[102] Garmendia, M., Ribalaygua, C., & Ureña, J. M. (2012). High speed rail: Implication for cities. *Cities*, 29, S26-S31.

[103] Garreau, J. (1991). *Edge cities: Life on the new frontier*. New York: Doubleday.

[104] Geurs, K. T., & Ritsema van Eck, J. R. (2001). Accessibility measures: Review and applications. Evaluation of accessibility impacts of land-use transportation scenarios, and related social and economic impacts. National Institute of Public Health and the Environment.

[105] Geurs, K. T., & Van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport Geography*,

12 (2), 127-140.

[106] Gipuzkoa (2007). Norma Foral 1/2007 de 24 de enero, de Vías Ciclistas del Territorio Histórico de Gipuzkoa.

[107] Göderitz, J., Rainer, R., & Hoffmann, H. (1957). Die gegliederte und aufgelockerte stadt. Tübingen: Wasmuth.

[108] Goffman, E. (1959). *Behavior in public spaces: notes on the social organization of gathering*s. New York: The Free Press.

[109] González, M. (1999). Ferrocarril e industrialización: la articulación del País Vasco en la década intersecular. In *Jornadas sobre el Sistema Ferroviario Vasco. Resumen de las ponencias* (pp. 305-307). Gasteiz: Gobierno Vasco, Departamento de Transporte y Obras Públicas.

[110] González, M., Urrutikoetxea, J., & Zárraga, K. (2012). Ferrocarril y Capital Humano. Dos Eslabones Fundamentales En El Proceso Vasco De Modernización (1877-1930). In *VI Congreso de Historia Ferroviaria*. Vitoria-Gasteiz.

[111] Government of Navarre (1991). Plan Sectorial de Incidencia Supramunicipal para la recuperación del trazado del antiguo Plazaola. Gobierno de Navarra, Departamento de Industria, Comercio y Turismo.

[112] Government of Navarre (2000). Proyecto Sectorial de Incidencia Supramunicipal para la recuperación del antiguo trazado del ferrocarril Tudela-Tarazona (vía verde del Tarazonica). Gobierno de Navarra.

[113] Government of Navarre (2005). Estrategia Territorial De Navarra. Gobierno de Navarra.

[114] Government of Navarre (2006). Plan Director de la Bicicleta de Navarra (resumen divulgativo). Gobierno de Navarra, Departamento de Medio Ambiente, Ordenación del Territorio y Vivienda.

[115] Government of Navarre (2010). Proyecto Sectorial de Incidencia Supramunicipal para la recuperación del antiguo trazado del Plazaola (tramo Pamplona-Irurtzun). Gobierno de Navarra.

[116] Government of Navarre (2011). Planes de Ordenación Territorial de Navarra. Gobierno de Navarra, Departamento de Medio Ambiente, Ordenación del Territorio y Vivienda.

[117] Government of Navarre (2012). Proyecto Sectorial de Incidencia Supramunicipal para la recuperación del antiguo trazado del ferrocarril del Bidasoa (tramo Endarlatsa-Doneztebe). Gobierno de Navarra.

[118] Hägerstraand, T. (1970). What about people in regional science? *Papers in Regional Science*, 24 (1), 7-24.

[119] Halden, D., Jones, P., & Wixey, S. (2003). Accessibility analysis literature review. Measuring accessibility as experienced by different socially disadvantaged groups (working paper). University of Westminster, Transport Studies Group.

[120] Hall, P. G., & Ward, C. (1998). Sociable Cities: The legacy of Ebenezer Howard. Chichester: John Wiley & Sons.

[121] Handy, S. (1993). Regional Versus Local Accessibility: Implications for Nonwork Travel. University of California

Transportation Center.

[122] Handy, S. L., & Niemeier, D. A. (1997). Measuring accessibility: an exploration of issues and alternatives. *Environment and Planning A*, 29 (7), 1175-1194.

[123] Hansen, W. G. (1959). How accessibility shapes land use. *Journal of the American Institute of Planners*, 25 (2), 73-76.

[124] Herreras, B. (2011-2012). Caracterización y valoración del paisaje del ferrocarril Vasco-Navarro. In *Inventario de paisajes industriales en el ámbito de la Comunidad Autónoma del País Vasco*. Basque Government, Department of Education, Language Policy and Culture.

[125] Herreras, B. (2012). Los paisajes de la industrialización de Gipuzkoa y Álava. In *Patrimonio Industrial en el País Vasco* (pp. 69-96). Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

[126] Herreras, B., & Zabala, M. (2012). El inventario del patrimonio industrial y de la obra pública del País Vasco. In *Patrimonio Industrial en el País Vasco* (pp. 97-131). Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

[127] Hillier, B., Turner, A., Yang, T., & Park, H. (2007). Metric and topo-geometric properties of urban street networks. In *Proceedings Space Syntax. 6th International Space Syntax Symposium*. Istanbul.

[128] Howard, K. (1902). *La ciudad jardín del mañana*. Madrid: Ayuso.

[129] Hoyos, D. (2010). Mugikortasun iraunkorra: benetako alternativa edo betiko politika izendatzeko etiketa berria? In J. Arbaiza & P. Lozano (Eds.), *Lurralde-antolamendua Euskal Herrian: Gaur egungo egoera, gatazkak eta erronkak* (pp. 215-224). Bilbao: Udako Euskal Unibertsitatea.

[130] Iacono, M., Krizek, K. J., & El-Geneidy, A. (2010). Measuring non-motorized accessibility: issues, alternatives, and execution. *Journal of Transport Geography*, 18 (1), 133-140.

[131] ICOMOS (1999). Railways as World Heritage Sites. Occasional Papers for the World Heritage Convention.

[132] ICOMOS (2008). Carta de Itinerarios Culturales.

[133] ICOMOS (2011). Joint ICOMOS-TICCIH principles for the conservation of industrial heritage sites, structures, areas and landscapes. XVII General Assembly, Paris.

[134] IDAE (2006). Guía práctica para la elaboración de implantación de Planes de Movilidad Urbana Sostenible PMUS. Madrid: Instituto para la Diversificación y Ahorro de la Energía IDEA.

[135] Iles, L., & Wiele, K. (1993). From rails to trails: the benefits of rail-trails and greenways. Recreation Canada, 51, 25-28.

[136] Ingram, D. R. (1971). The concept of accessibility: a search for an operational form. *Regional Studies*, 5 (2), 101-107.

[136] IOHLEE (coord.) (2012). *Patrimonio industrial en el País Vasco*. Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

[137] Izquierdo, B. (2007). *Desarrollo rural en el País Vasco: hacia un modelo de evaluación cualitativa*. Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

[138] Jaramillo, G. (2013). Valoración patrimonial del ferrocarril de Antioquia como itinerario cultural: apropiaciones y significaciones. *Revista Geográfica del Sur*, 4 (5), 79-94.

[139] Juaristi, J. (2012). El paisaje industrial como elemento de patrimonio en el territorio de Bizkaia. In *Patrimonio industrial en el País Vasco* (pp. 44-68). Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

[140] Kenworthy, J. R., & Laube, F. B. (1999). Patterns of automobile dependence in cities: an international overview of key physical and economic dimensions with some implications for urban policy. *Transportation Research Part A: Policy and Practice*, 33 (7–8), 691-723.

[141] Krizek, K., Horning, J., & El-Geneidy, A. (2012). Perceptions of accessibility to neighbourhood retail and other public services. In Geurs, K., Krizek, K.R., Reggiana, A. (Ed.), *Accessibility and Transport Planning: Challenges for Europe and North America* (pp. 96-117). London, UK: Edward Elgar.

[142] Larsen, K., & Gilliland, J. (2008). Mapping the evolution of 'food deserts' in a Canadian city: supermarket accessibility in London, Ontario, 1961-2005. *International Journal of Health Geographics*, 7, 16-072X-7-16.

[143] Law, S., Chiaradia, A., & Schwander, C. (2012). Towards a multi-modal space syntax analysis. A case study of the London Street and underground network. In *8th International Space Syntax Symposium* (pp. 3-6). Santiago de Chile.

[144] Le Corbusier. (1933). *La Ville Radieuse*.

[145] Lindsey, G., Drew, J., Hurst, S. & Galloway, S. (2001). Summary report: Indiana trails study.

[146] Little, C. E. (1995). *Greenways for America* (First published October 1st 1990). Baltimore: JHU Press.

[147] Llano-Castresana, U. (2017). Burdinbide ondare arkitektonikoaren berrerabilpenerako hastapen jarraibideak: Urolako burndinbidea ikerketa kasu gisa / The reactivation of the architectural railway heritage: guidelines for an effective identification, documentation and valuation. Unpublished Doctoral Thesis, University of the Basque Country, Department of Architecture.

[148] Llano-Castresana, U., Azkarate, A., & Sánchez, S. (2013). The value of railway heritage for community development. In *Structural studies, repairs and maintenance of heritage architecture XIII*. (pp. 61-72). UK.

[149] London City Council (1961). *The planning of a new town*. London: London City Council.

[150] Loren-Méndez, M., Mata-Olmo, R., Ruiz, R. & Pinzón-Ayala, D. (2016). An interdisciplinary methodology for the characterization and visualization of the heritage of roadway corridors. *Geographical Review*, 106 (4), 489-515.

[151] Lozano, P. J., & Arbaiza, J. K. (2010). Lurralde-

antolamenduaren oinarriak. In J. Arbaiza & P. Lozano (Eds.), *Lurralde-antolamendua Euskal Herrian: Gaur egungo egoera, gatazkak eta erronkak* (pp. 11-41). Bilbao: Udako Euskal Unibertsitatea.

[152] Lynch, K. (1981). *Good city form*. Cambridge, MA: MIT press.

[153] Macías, M. O. (1994). Ferrocarriles y desarrollo económico en el país vasco (1914-1936). Doctoral Thesis, University of the Basque Country, Department of Contemporary History.

[154] Macías, M.O. (2001). El ferrocarril del Plazaola y el Ferrocarril Vasco-Navarro: dos propuestas para la integración ferroviaria vasca. *Gerónimo de Uztariz*. vol. 17-18, pp. 185-200.

[155] Madoz, P. (1946-50). *Diccionario geográfico-estadístico-histórico de España y sus posesiones de ultramar*. Madrid: Establecimiento tipográfico de P. Madoz y L. Sagasti,

[156] Maluquer y Salvador, M. (1919). Ferrocarril de Estella por Vitoria a empalmar con el de Durango a Zumárraga. *Revista de obras públicas,* vol. 2297, pp. 485-488.

[157] Maluquer y Salvador, M. (1923). Inauguración del ferrocarril de Oñate a San Prudencio. *Revista de obras públicas,* vol. 2391, pp. 202-204.

[158] Marchetti, C. (1994). Anthropological invariants in travel behavior. *Technological Forecasting and Social Change*, 47 (1), 75-88.

[159] Martinena, J. J. (1998). *Navarra y el tren*. Navarra: Gobierno de Navarra.

[160] Masnavi, M. R., & Fathi, M. (2011). An empirical study to enhance sustainable development of the urban highway landscape and environmental conditions based on greenway approach and user's visual preferences, the case of Behesht-e-Zahra and Tondgouyan highways, Southern Tehran, Iran. *Armanshahr*, 4, 77-89.

[161] Meaza, G. (1989). La articulación, geográfica del País Vasco. In *Ibaiak eta haranak: El agua, el río y los espacios agrícola, industrial y urbano* (pp. 13-44). Donostia: Etor.

[162] Méndez, R. (2005). Procesos de innovación en ciudades intermedias, actores locales y desarrollo territorial. El desarrollo local en su complejidad: Diálogo entre actores locales y protagonismo del territorio. In *IV jornadas del grupo de desarrollo local de la asociación de geógrafos españoles* (pp. 33-60). Santiago de Compostela: Universidad de Santiago de Compostela.

[163] Mendizábal, A. (1926). Ferrocarril de Estella a Vitoria. *Revista de obras públicas*, vol. 74, pp. 225-230.

[164] Meyer, M. D., & Miller, E. J. (2001). *Urban transportation planning: A decision-oriented approach* (2nd edition). New York: McGraw-Hill.

[165] Millward, H., Spinney, J., & Scott, D. (2013). Active-transport walking behavior: destinations, durations, distances. *Journal of Transport Geography*, 28, 101-110.

[166] Moneo, R. (1978). On typology. In oppositions 13 or *Sobre el concepto de tipo en arquitectura: Textos de arquitectura de la cátedra de composición II* (pp. 189)

[167] Montaner, J. M. (2008). *Sistemas arquitectónicos contemporáneos*. Barcelona: Gustavo Gili.

[168] Moreno, J. (2013). Esquinas territoriales. Movilidad y planificación territorial, un modelo de integración: el Randstad-Holland. Unpublished Doctoral Thesis, Universitat Politècnica de Catalunya, Departament d'Urbanisme i Ordenació del Territori.

[169] Morris, J. M., Dumble, P., & Wigan, M. R. (1979). Accessibility indicators for transport planning. *Transportation Research Part A: General*, 13 (2), 91-109.

[170] Múgica, S. (1918). *Geografía General del País Vasco-Navarro. Provincia de Guipúzcoa*. Barcelona: Establecimiento editorial de Alberto Martín.

[171] Navarre (2002). Ley Foral 35 /2002 De Ordenación Del Territorio y Urbanismo. B. O. de Navarra, 27 de diciembre de 2002.

[172] Navarre (2005). Ley Foral 14/2005, de 22 de noviembre, del Patrimonio Cultural de Navarra. B.O. de Navarra, 25 de noviembre de 2005.

[173] Nefs, M., Gerretsen, P., Dooghe, D., Mayer, I.S. & Meijer, S. (2010). Gaming the Interrelation between Rail Infrastructure and Station Area Development: Part 1 – Modeling the Serious Game 'SprintCity'. In *Third International Conference on Infrastructure Systems and Services: Next Generation Infrastructure Systems for Eco-Cities (INFRA)*, China.

[174] Newman, P. W., & Kenworthy, J. R. (1996). The land use—Transport connection: an overview. *Land use Policy*, 13 (1), 1-22.

[175] Oja, P., Vuori, I., & Paronen, O. (1998). Daily walking and cycling to work: their utility as health-enhancing physical activity. *Patient Education and Counseling*, 33, Supplement 1, S87-S94.

[176] Olaizola, J. (2002). *El Ferrocarril Vasco Navarro*. Bilbao: Eusko Trenbideak.

[177] Olaizola, J. (2004). Cien años de tracción eléctrica en vía estrecha. *Vía Libre*, 471.

[178] Olaizola, J. (2007). *Trenbidea Bilbotik Donostiara: trenbidearen 125 urte Durangon. El ferrocarril de Bilbao a San Sebastián: 125 años de ferrocarril a Durango*. Bilbao: Eusko Tren.

[179] Olaizola, J. (2012). Estación de Maestu. Ferrocarril Anglo-Vasco-Navarro. In *Patrimonio industrial en el País Vasco* (pp. 1041-1045). Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

[180] Olaizola, J., & Vaillant, C. G. (2011). *Historia del ferrocarril en el País Vasco: siglo XX = Trenbideraren historia Euskal Herrian: XX. mendea*. Lasarte-Oria: Etor-Ostoa.

[181] Ontario (1990). Ontario Heritage Act, R.S.O. 1990, c.0.18 (last amendment in 2009).

[182] Ormaechea, A. M. (1999). Los ferrocarriles vascos: una necesidad de las burguesías comercial y minera. In M. Muñoz, J. Sanz & J. Vidal (Eds.), *Siglo y medio del ferrocarril en España 1848-1998. Economía, industria y sociedad* (pp. 433-456)

[183] Ortega, E., López, E., & Monzón, A. (2012). Territorial cohesion impacts of high-speed rail at different planning levels. *Journal of Transport Geography*, 24, 130-141.

[184] Owens, S. (1992). Energy, environmental sustainability and land-use planning. In M. J. Breheny (Ed.), *Sustainable development and urban form* (pp. 79-105). London: Pion Limited.

[185] Penn, A., Hillier, B., Banister, D., & Xu, J. (1998). Configurational modelling of urban movement networks. *Environment and Planning B: Planning and Design*, 25 (1), 59-84.

[186] Poiraud, A., Chevalier, M., Claeyssen, B., Biron, P., & Joly, B. (2016). From geoheritage inventory to territorial planning tool in the Cercors massif (French Alps): Contribution of statistical and expert cross approaches. *Applied Geography*, 71, 69-82.

[187] Porcal M. C. (2011). El patrimonio rural como recurso turístico. La puesta en valor turístico de infraestructuras territoriales (rutas y caminos) en las áreas de montaña del País Vasco y de Navarra. *Cuaderno De Turismo. Universidad De Murcia*, 27, 759-784.

[188] Precedo, A. (2004a). El modelo de desarrollo comarcal. *Boletín de la A.G.E.*, 38, 29-45.

[189] Precedo, A. (2004b). *Nuevas realidades territoriales para el siglo XXI: desarrollo local, identidad territorial y ciudad difusa*. Madrid: Síntesis.

[190] Provincial Council of Araba/Álava (2014). Catálogo de la red de itinerarios verdes del territorio histórico de Álava. Provincial Council of Araba/Álava.

[191] Regional Council of Gipuzkoa (2013). Plan Territorial Sectorial de Vías Ciclistas de Gipuzkoa. Diputación Foral de Gipuzkoa, Departamento de Movilidad e Infraestructuras de Gipuzkoa.

[192] Reusser, D. E., Loukopoulos, P., Stauffacher, M., & Scholz, R. W. (2008). Classifying railway stations for sustainable transitions–balancing node and place functions. *Journal of Transport Geography*, 16 (3), 191-202.

[193] Rice, J. (2009). There goes the neighbourhood? Or saving the world? Community views about transit oriented development. In C. Curtis, J. L. Renne & L. Bertolini (Eds.), *Transit oriented development: Making it happen* (pp. 171-183). Farnham, England: Ashgate Publishing, Ltd.

[194] Rivera, A. (2008). Vitoria y el ferrocarril. Una relación difícil. In J.M. Beascoechea (Ed.) *El ferrocarril y Vitoria-Gasteiz. Haciendo ciudad* (pp. 19-41).

[195] Rodríguez, F. J., Coronado, J. M., & Ruiz, R. (2010). Del nodo a la red. El patrimonio de la obra pública y las infraestructuras lineales históricas. In *Patrimonio industrial y paisaje. V congreso conservación del patrimonio industrial y de la obra pública en España* (pp. 365-372). Gijón: Cicees.

[196] Rodríguez, R. (2005). Espacios rurales: Ordenación y desarrollo. In *El desarrollo local en su complejidad: Diálogo entre actores locales y protagonismo del territorio. IV Jornadas del Grupo de Trabajo de Desarrollo Local de la Asociación de Geógrafos Españoles*. (pp. 61-72). Santiago de Compostela: Universidade de Santigo de

Compostela.

[197] Rowe, P. G. (1991). *Making a middle landscape*. Cambridge, MA: MIT Press.

[198] Ruiz, R. (2016). Modern Road Archaeology: Identification and Classification Proposal. *International Journal of Historical Archaeology* 20, 437-462.

[199] Ruiz, R., Rodríguez, F. J. & Coronado, J. M. (2014). Identification and assessment of engineered road heritage: a methodological approach. *Journal of Cultural Heritage* 15, 36-43.

[200] Saaty, T. L. (1980). *The Analytic hierarchy process*. New York: McGraw-Hill.

[201] Sabaté, J. & Schuster, J. M. (2001). *Designing the Llobregat Corridor. Cultural Landscape and Regional Development*. Barcelona: Universitat Politécnica de Catalunya, Massachusetts Institutte of Technology.

[202] Salmerón, C. & Olaizola, J. (1990). *Eusko trenbideak: Historia eta teknika = Ferrocarriles vascos: Historia y técnica*. Barcelona: Terminus.

[203] Sánchez, D. (2012). *Metodología para la recuperación y puesta en valor del patrimonio industrial arquitectónico. Antiguas fábricas de Grao de Valencia*. Doctoral Thesis, Polytechnic University of Valencia.

[204] Sanz, P. (1992). *El ferrocarril anglo-vasco y la Restauración en Alava (1880-1931)*. Vitoria-Gasteiz: Diputación Foral de Álava, Departamento de Cultura.

[205] Sauer, C. (1925). The morphology of landscape. *University of California Publications in Geography*, 2 (2), 19-53.

[206] Scheiner, J. (2010). Interrelations between travel mode choice and trip distance: Trends in Germany 1976–2002. *Journal of Transport Geography*, 18 (1), 75-84.

[207] Schlossberg, M., & Brown, N. (2004). Comparing transit-oriented development sites by walkability indicators. *Transportation Research Record: Journal of the Transportation Research Board*, (1887), 34-42.

[208] Serlie, Z. (1998). Stationslocaties in vergelijkend perspectief. Unpublished Master thesis, Universiteit Utrecht.

[209] Serrano, A. (1999). El ferrocarril y la configuración del territorio. 1848-1930. In M. Muñoz, J. Sanz & J. Vidal (Eds.), *Siglo y medio del ferrocarril en España 1848-1998. Economía, industria y sociedad* (pp. 851-902).

[210] Shoaybi, A., Shabani, N., & Oskuie, P. H. (2006). Conservation of Stream Sorridors as an Urban Infrastructure. Case study: Evin-Darakeh Stream Sorridor. *Environmental Sciences*, 12, 1-6.

[211] Sobrino, J. (1996). *Arquitectura Industrial en España, 1930-1990*. Madrid: Editorial Cátedra.

[212] Sobrino, J. (2005). Nuevas estrategias de gestión patrimonial: El Programa de Rehabilitación del Patrimonio Arquitectónico Industrial de la Consejería de Obras Públicas y Transportes de la Junta de Andalucía. *Tst: Transportes, Servicios y Telecomunicaciones*, (8), 165-184.

[213] Sobrino, J. (2008). La arquitectura ferroviaria en Andalucía. Patrimonio ferroviario y líneas de investigación. In *150 años de Ferrocarril en Andalucía: Un balance* (pp. 825-887). Sevilla: Junta de Andalucía, Consejería de Obras Públicas y Transportes.

[214] Soria y Mata, A. (1882). La ciudad lineal. Diario El Progreso, April 10, 1882 (pp. 1815-1876). Madrid.

[215] Soria, A. (1997). Una visión territorial del patrimonio de las obras públicas. La red peninsular de parques lineales históricos. *Revista de obras públicas*, 40, 28-37.

[216] Spain (1933). Ley de 13 de mayo de 1933, sobre Defensa, Conservación y Acrecentamiento del Patrimonio Histórico-Artístico Nacional.

[217] Spain (1985). Ley 16/1985, de 25 de junio, del Patrimonio Histórico Español. BOE de 29 de junio de 1985.

[218] Spanish Institute of Cultural Heritage (2011). Plan Nacional De Patrimonio Industrial.

[219] Spanish Institute of Cultural Heritage (2012). Plan Nacional De Paisaje Cultural.

[220] State of Florida (1985). An inventory of abandoned railroads in Florida. Department of Natural Resources, Division of Recreation and Parks.

[221] Steadman, P. (2004). Developments in space syntax. *Environment and Planning B: Planning and Design*, 31 (4), 483-486.

[222] Stewart, J. Q. (1947). Empirical mathematical rules concerning the distribution and equilibrium of population. *Geographical Review*, 37 (3), 461-485.

[223] Suso, I. (1999). Impacto social de la supresión del ferrocarril Vasco-Navarro (Estella-Vitoria-Bergara), de vía estrecha, en Alava y Navarra: 1966-1968. In M. Muñoz, J. Sanz & J. Vidal (Eds.), *Siglo y medio del ferrocarril en España 1848-1998. Economía, industria y sociedad*.

[224] Suso, I. (2012): Vasco-Navarro (Lizarra-Gasteiz-Bergara) trenbidearen desagerpena: 1966-1968. *Vasconia*, 38, 1033-1054.

[225] Suso, J. (2009a): El Ferrocarril Vasco-Navarro (I). Sus orígenes de 1878 a 1903. *TrenManía*, 48, 25-31.

[226] Suso, J. (2009b): El Ferrocarril Vasco-Navarro (II). Construcción y desarrollo de 1914 a 1938. *TrenManía*, 49, 19-24.

[227] Suso, J. (2009c): El Ferrocarril Vasco-Navarro (III). El trazado y sus edificios. *TrenManía*, 50, 32-36.

[228] Suso, J. (2009d): El Ferrocarril Vasco-Navarro (IV). El trazado y sus edificios. *TrenManí,* 51, 42-49.

[229] Talen, E., & Anselin, L. (1998). Assessing spatial equity: An evaluation of measures of accessibility to public playgrounds. *Environment and Planning A*, 30 (4), 595-613.

[230] Tarchini, M. L. (2010). Infraestructura ferroviaria; reflexiones sobre el rol del patrimonio en las ciudades. In *X Congreso Internacional de Rehabilitación del Patrimonio Arquitectónico y Edificación CICOP*. Santiago de Chile.

[231] TICCIH (2003). Carta de Nizhny Tagil sobre el patrimonio industrial.

[232] TICCIH (2009). Conclusiones. V Congreso del Patrimonio Industrial y de la Obra Pública en España. Ferrol.

[233] Town of Georgina (2014). Trails & active transportation (AT) master plan (draft report). Georgina, Canada.

[234] Trachana, A. (2011). La recuperación de los paisajes industriales como paisajes culturales. *Ciudades: Revista Del Instituto Universitario De Urbanística De La Universidad De Valladolid*, 14, 189-212

[235] Troitiño, M. Á. (1998). Patrimonio arquitectónico, cultura y territorio. *Ciudades: Revista Del Instituto Universitario De Urbanística De La Universidad De Valladolid*, (4), 95-104.

[236] Turner, T. (2006). Greenway planning in Britain: Recent work and future plans. *Landscape and Urban Planning*, 76 (1–4), 240-251.

[237] UNESCO (1972). Convenio del Patrimonio Mundial de la UNESCO (Ratificada por España, BOE, 01/07/1982). Paris.

[238] UNESCO (2013). Hangzhou declaration. Placing culture at the heart of sustainable development policies. Paris: UNESCO.

[239] UNESCO (2015). Operational Guidelines for the Implementation of the World Heritage Convention. World Heritage Centre.

[240] United Nations (1987). Our common future. New York: World Commission on Environment and Development. Oxford University Press.

[241] United Nations (1992). Rio Declaration on Environment and Development 1992. Rio de Janeiro.

[242] United States (2009). The National Trails System Act. P.L. 90-543, as Amended through P.L. 111-11, March 30, 2009 (also found in United States Code, Volume 16, Sections 1241-1251).

[243] Unzurrunzaga, X. (1999). Los sistemas de comunicación y el desarrollo regional y urbano. In *Jornadas sobre el sistema ferroviario vasco. Resumen de las ponencias*. (pp. 298-304). Vitoria/Gasteiz: Gobierno Vasco, Departamento de Transporte y Obras Públicas.

[244] Unzurrunzaga, X. & Urteaga, K. (1972): *Industria-herri baten azterketa. Arrasate eta bere etorkizuna*. Bilbao: Etor.

[245] Ureña, J. M., Menerault, P. & Garmendia, M. (2009). The high-speed rail challenge for big intermediate cities: A national, regional and local perspective. *Cities*, 26 (5), 266-279.

[246] Vale, D. S. (2015). Transit Oriented Development, integration of land use and transport, and pedestrian accessibility: Combining node-place model with pedestrian shed ratio to evaluate and classify station areas in Lisbon. *Journal of Transport Geography*, 45, 70-80.

[247] Vale, D. S., Saraiva, M. & Pereira, M. (2016). Active accessibility: A review of operational measures of walking and cycling accessibility. *Journal of transport and*

land use, 9 (1), 209-235.

[248] Vera, V. (1915-21). *Geografía General del País Vasco-Navarro. Provincia de Navarra*. Barcelona: Establecimiento editorial de Alberto Martín.

[249] Vickerman, R. W. (1974). Accessibility, attraction, and potential: A review of some concepts and their use in determining mobility. *Environment and Planning A*, 6 (6), 675-691.

[250] Vitoria-Gasteiz (2003). Plan general de ordenación urbana. B.O. del Territorio Histórico de Álava, 31 de marzo, 2003.

[251] von Bertalanffy, L. (1968). *General systems theory: Foundations, development, applications*. New York: George Braziller.

[252] Walz, W. (1977). *Erlebnis Eisenbahn*. Motorbuch-Verlag.

[253] Wegener, M., & Fürst, F. (1999). Land-use transport interaction: State of the art. In Institut für Raumplanung (Ed.), *Deliverable 2a of the project TRANSLAND of the 4th RTD Framework Programme of the European Commission*. Dortmund.

[254] Wickstrom, G. V. (1971). Defining balanced transportation. A question of opportunity. *Traffic Quarterly*, 25 (3), 337-349.

[255] Wright, F. L. (1932). *The disappearing city*. New York: William Farquhar Payson.

[256] Wright, F. L. (1945). *When democracy builds*. Chicago: University of Chicago Press.

[257] Wright, F. L. (1958). *The living city*. New York: Horizon.

[258] Zahavi, Y. (1974). *Traveltime budgets and mobility in urban areas*. Washington: US Department of transportation.

[259] Zarazaga-Soria, F., García, M., Hernández, M., Biel, P., López, F. & Valero, J. (2005). La IDEE como herramienta de ayuda a la elaboración del inventario del patrimonio industrial de Aragón. In *Actas de Jornadas Técnicas de la Infraestructura de Datos Espaciales de España (JIDEE´05)*. Madrid.

[260] Zarraluqui, L. (2011). La Estrategia Territorial de Navarra, primera experiencia en España de aplicación de los principios de planificación y desarrollo espacial europeos a un nivel regional. *Urban*, (8), 111-122.

[261] Zweedijk, A. (1997). Knoop of plaats? naar een operationalisering van het begrip stationslocatie. Unpublished Master thesis, Universiteit Utrecht.

ANNEX 1 (CHAPTER 3)

1.1. Inventory of the Basque-Navarre DRLs

1.1.1. Inventory of the lines

DISUSED RAILWAY LINES OF THE BASQUE-NAVARRE TERRITORY

ID	NAME	OPENING YEAR	ROUTE	ROUTE DISTANCE (KM)	GAUGE	TYPE OF TRANSPORT	YEAR OF ELECTRIFICATION	YEAR OF CLOSURE	CURRENT ROUTE	CURRENT ROUTE DISTANCE (KM)	CURRENT USE
1	UROLA	1926	ZUMARRAGA-ZUMAIA	36.65	1	GOODS + PASSENGERS	1926	1988	ZUMARRAGA-ZUMAIA	36.65	GREENWAY (PARTLY)
2	MALTZAGA-ZUMARRAGA	1889	DURANGO- ZUMARRAGA/ELGOIBAR	58.04	1	GOODS + PASSENGERS	1929	1975	MALTZAGA-ZUMARRAGA	22.70	CYCLING LINE (PARTLY)
3	VASCO-NAVARRO	1927	MEKOALDE-GASTEIZ-LIZARRA	139.14	1	GOODS + PASSENGERS	1929-1938 -1948	1967	MEKOALDE-GASTEIZ-LIZARRA	139.14	GREENWAY (PARTLY)
4	DURANGO-ELORRIO	1905	DURANGO- ELORRIO/ARRAZOLA	15.18	1	GOODS + PASSENGERS	1946	1975	DURANGO- ELORRIO/ARRAZOLA	15.18	GREENWAY (PARTLY)
5	PLAZAOLA	1914	IRUÑA-LASARTE	84.15	1	GOODS + PASSENGERS	-	1958	IRUÑA-LASARTE	84.15	GREENWAY (PARTLY)
6	TUDELA-TARAZONA	1886	TUDELA-TARAZONA	21.39	1 - 1,67	GOODS + PASSENGERS	-	1972	TUDELA-TARAZONA	21.39	GREENWAY
7	TRASLAVIÑA-CASTRO	1898	TRASLAVIÑA-CASTRO / SOPUERTA-GALDAMES	32.70	1	GOODS + PASSENGERS	-	1966	TRASLAVIÑA-CASTRO / SOPUERTA-GALDAMES	32.70	GREENWAY (PARTLY)
8	SESTAO-GALDAMES	1876	SESTAO-GALDAMES	22.31	1.15	GOODS + PASSENGERS	-	1969	SESTAO-GALDAMES	22.31	GREENWAY (PARTLY)
9	SONDIKA-MUNGIA	1894	LUTXANA-MUNGIA	18.00	1	GOODS + PASSENGERS	1950	1977	SONDIKA-MUNGIA	13.00	GREENWAY (PARTLY)
10	BILBAO-LEZAMA	1895	BILBAO-LEZAMA	15.00	1	GOODS + PASSENGERS	1950	1908	BILBAO-DERIO	10.00	PATH
11	IRATI	1911	IRUÑA-ZANGOZA	59.00	1	GOODS + PASSENGERS	1911	1955	IRUÑA-ZANGOZA	59.00	GREENWAY (PARTLY)
12	BIDASOA	1916	IRUN-ELIZONDO	51.50	1	GOODS + PASSENGERS	-	1956	IRUN-ELIZONDO	51.50	GREENWAY

1.1.2. Inventory of the nodes

MALTZAGA-ZUMARRAGA RAILWAY

MALTZAGA-ZUMARRAGA RAILWAY

ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	MALTZAGA	545719.00	4782341.00	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
2	SORALUZE	547774.00	4780407.00	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	LOS MARTIRES	548366.10	4778317.10	HALT	-	-	-	-	-	0	0
3	LOS MARTIRES	548213.74	4778243.74	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	WAREHOUSE	BAD	134	1
4	MEKOALDE	547642.00	4776821.00	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
5	BERGARA	547415.00	4774621.00	STATION	STATION_WAREHOUSE_ ELECTRICAL SUBSTATION	WAREHOUSE_ ELECTRICAL SUBSTATION	PUBLIC USE	REHEARSAL STUDIOS	REGULAR	470	2
6	ANTZUOLA	549652.00	4772680.00	HALT	-	-	-	-	-	0	0
7	AMILLETA	550765.00	4772189.00	STATION	STATION	STATION	DISUSED	-	DISAPPEARED	0	0
8	ZUMARRAGA	555325.00	4770749.00	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0

UROLA RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	ZUMARRAGA	555320.83	4770805.31	STATION	STATION_WAREHOUSE	STATION	DISUSED	-	BAD	434	3
2	URRETXU	555897.96	4771379.52	STATION	STATION_WAREHOUSE	STATION	PUBLIC USE	YOUTH CENTRE	GOOD	224	2
2	URRETXU	555546.49	4772379.9	GATEKEEPER´S HOUSE	HOUSE	HOUSE	DISUSED	-	GOOD	106	2
2	AGUIÑETA	555116.25	4773438.66	HALT	SMALL BUILDING	-	-	-	-	0	0
3	AIZPURUTXO	552732.4	4775884.06	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	AIZPURUTXO	552758.23	4776294.04	STATION	STATION	STATION	DISUSED	-	BAD	258	3
4	OLOTZAGA	554466.34	4779316.95	HALT	SMALL BUILDING	SMALL BUILDING	PRIVATE USE	WAREHOUSE	REGULAR	66.4	1
4	FORJAS JUBILAGA	555113.33	4779851.84	HALT	SMALL BUILDING	-	-	-	-	0	0
4	AZKOITIA	556171.59	4780686.02	STATION	STATION_WAREHOUSE	STATION	PUBLIC USE	LIBRARY	GOOD	498	3
4	SAN JUAN	556736.79	4779992.45	HALT	SMALL BUILDING	-	-	-	-	0	0
5	LOIOLA	558577.57	4780457.14	STATION	STATION_WAREHOUSE	STATION	DISUSED	-	REGULAR	219	2
6	BARRENETXEA	559329.93	4780716.87	HALT	?	-	-	-	-	0	0
6	AZPEITIA	560063.09	4781350.9	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PUBLIC USE	REHEARSAL STUDIOS	REGULAR	106	2
6	AZPEITIA	560022.25	4781708.54	STATION	STATION_WAREHOUSE_ OFFICES_WAGON SHED_POWER PLANT	STATION_OFFICESS_ DEPOT_POWER PLANT	PUBLIC USE	RAILWAY MUSEUM	GOOD	4602	3
7	DANONA-ANARDI	560572.71	4784222.97	HALT	SMALL BUILDING	-	-	-	-	0	0
7	LASAO	560349.73	4785359.04	STATION	STATION_ELECTRICAL SUBSTATION	STATION_ELECTRICAL SUBSTATION	PUBLIC USE	RAILWAY MUSEUM	REGULAR	356	2
7	LASAO	560338.8	4785506.58	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
8	ZESTOA-BALNEARIO	560348.41	4787077.06	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	REGULAR	340	2
9	ZESTOA-VILLA	560032.54	4787870.07	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	BAD	451	3
10	IRAETA	559702.42	4789400.36	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	BAD	312	2
11	ARROA	559099.25	4790156.99	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
11	ARROA	559462.74	4792052.44	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	BAD	316	2
12	ZUMAIA	560500.14	4793157.68	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	106	2
12	ZUMAIA-EMPALME	560688.14	4793458.96	STATION	STATION_WAREHOUSE/ WAGON SHED	STATION	RAILWAY	STATION	GOOD	200	2
13	ZUMAIA PUERTO	560293.97	4793909.69	STATION	STATION_WAREHOUSE	STATION	DISUSED	-	GOOD	411	3

PLAZAOLA RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	PAMPLONA CIUDAD	610808.38	4740876.01	STATION	STATION_WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0
1	PAMPLONA CIUDAD	610908.58	4740796.54	OLD STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
2	PAMPLONA-	610047.06	4742575.98	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	ANZOAIN	607534.91	4744398.96	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
4	SARASA	602237.52	4747850.29	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
5	GULINA	597478.38	4751562.93	HALT	SMALL BUILDING	-	DISUSED	-	DISAPPEARED	0	0
6	IRURTZUN	595889.99	4752619.47	STATION	STATION_WAREHOUSE_ WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0
7	LATASA	595946.97	4756482.42	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PRIVATE USE	HOUSING	GOOD	385	3
8	LEKUNBERRI	590499.08	4761569.09	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PRIVATE USE	TOURIST OFFICE_ PLAZAOLA CONSORTIUM OFFICES	GOOD	679	3
9	UITZI	589141.96	4764717.55	STATION	STATION_WAREHOUSE	STATION	PRIVATE USE	HOUSING	GOOD	282.5	3
10	LEITZA	588126.1	4771036.43	STATION	STATION_WAREHOUSE_ WAGON SHED	STATION_WAREHOUSE_ WAGON SHED	PUBLIC USE	FUTURE HOSTEL	GOOD	1055	3
11	PLAZAOLA	586446.65	4773439.78	STATION	STATION	STATION	DISUSED	-	RUIN	41.85	1
12	BIZKOTX	586582.51	4774292.06	HALT	-	KILNS_HOPPERS	-	-	-	0	0
13	MUSTAR	586436.75	4776010.59	HALT	-	KILNS	-	-	-	0	0
14	AMERAUN	585348.57	4776921.46	HALT	-	-	-	-	-	0	0
15	BEIÑES	584171.43	4779123.09	HALT	-	-	-	-	-	0	0
16	OLLOKI	584572.06	4779983.76	STATION	STATION	STATION	DISUSED	-	RUIN	85	1
17	ANDOAIN	580085.46	4785963.52	STATION	STATION_WAGON SHED_WORKSHOPS	-	DISUSED	-	DISAPPEARED	0	0
18	LASARTE	579109.64	4792074.04	STATION	STATION_WAREHOUSE_ ELECTRICAL SUBSTATION	ELECTRICAL SUBSTATION	RAILWAY	OFFICES	GOOD	396.7	2

DURANGO-ELORRIO RAILWAY

DURANGO-ELORRIO RAILWAY											
ID	**NAME**	**LOCATION (X)**	**LOCATION (Y)**	**GENERAL USE**	**BUILDINGDS**	**CURRENT BUILDINGS**	**CURRENT USE**	**SPECIFIC USE**	**CURRENT STATE**	**FLOOR AREA**	**Nº FLOORS**
1	DURANGO	529755.55	4779691.63	STATION	-	-	RAILWAY	-	-	0	0
2	ABADIÑO	531520.01	4777859.77	HALT	SMALL BUILDING	-	-	-	-	0	0
3	ANDRA MARI	532264.00	4776744.00	HALT	SMALL BUILDING	SMALL BUILDING	PRIVATE USE	WAREHOUSE	REGULAR	187.66	1
4	APATAMONASTERIO	533746.16	4775497.25	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PUBLIC USE	YOUTH CENTRE	GOOD	475.92	3
5	SAN AGUSTIN	535715.93	4775131.99	HALT	SMALL BUILDING	-	-	-	-	0	0
6	ELORRIO	537311.41	4774939.68	STATION	STATION_WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0
7	ARRAZOLA	534158.22	4772067.82	HALT	-	-	-	-	-	0	0
8	EL TOPE	534907.67	4771250.01	STATION	STATION	STATION	PUBLIC USE	RECREATION AREA	GOOD	95	1

TUDELA-TARAZONA RAILWAY

TUDELA-TARAZONA RAILWAY											
ID	**NAME**	**LOCATION (X)**	**LOCATION (Y)**	**GENERAL USE**	**BUILDINGDS**	**CURRENT BUILDINGS**	**CURRENT USE**	**SPECIFIC USE**	**CURRENT STATE**	**FLOOR AREA**	**Nº FLOORS**
1	TUDELA	616018.04	4657321.65	STATION	STATION	STATION	RAILWAY	STATION	GOOD	1059.3	3
2	MURCHANTE	611987.72	4653011.32	HALT	STATION_WAREHOUSE_ HOUSE	STATION_WAREHOUSE_ HOUSE	DISUSED	-	BAD	635.95	2
3	CASCANTE	609843.14	4649982.46	STATION	STATION_WAREHOUSE_ OLD STATION	STATION_WAREHOUSE_ OLD STATION	PRIVATE USE	HOUSING	GOOD	866.98	2
5	MALON	609455.41	4644888.08	STATION	STATION_WAREHOUSE_ OLD STATION	STATION_WAREHOUSE_ OLD STATION	DISUSED	-	REGULAR	893	2
4	TULEBRAS	609783.51	4647928.97	HALT	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	REGULAR	381	2
6	TARAZONA	606099.76	4640088.41	STATION	STATION_WAREHOUSE_ RAILCAR SHED	STATION_RAILCAR SHED	PUBLIC USE	SOCIAL ASSOCIATIONS	GOOD	1832.64	2

VASCO-NAVARRO RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	MEKOALDE	547644.75	4776826.89	STATION	SMALL BUILDING	-	DISUSED	-	DISAPPEARED	0	0
2	BERGARA	547461.92	4773750.4	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	ALTOS HORNOS DE BERGARA	546652.07	4772167.24	SIDING	-	-	-	-	-	0	0
4	SAN PRUDENCIO	545114.38	4770035.96	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
5	ZUBILLAGA	545751.52	4767675.61	HALT	STATION	-	DISUSED	-	DISAPPEARED	0	0
6	SAN PEDRO	546803.05	4765932.72	HALT	-	-	-	-	-	0	0
7	OÑATI	547544.94	4764787.54	STATION	STATION_WAREHOUSE_ WAREHOUSE_ WAGON SHED	STATION_WAGON SHED	PUBLIC USE	POST OFFICE	GOOD	538	3
8	ARRASATE	542043.31	4768014.91	STATION	STATION_WAREHOUSE_ ELECTRICAL SUBSTATION	STATION	PUBLIC USE	EMPLOYMENT OFFICE	GOOD	588	3
9	ULGOR	541312.67	4766923.37	HALT	-	-	-	-	-	0	0
10	ARETXABALETA	540454.6	4764617.78	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
11	LANDETA-MARIANISTAS	539870.79	4763781.16	HALT	-	-	-	-	-	0	0
12	ESKORIATZA	538072.29	4762438.33	STATION	STATION_WAREHOUSE	STATION	DISUSED	-	REGULAR	176	2
13	CASTAÑARES	536292.99	4761435.78	HALT	-	-	-	-	-	0	0
14	MAZMELA	536266.41	4762289.06	HALT	STATION	STATION	PRIVATE USE	HOUSING	GOOD	100.8	1
15	ZARIMUZ	535672.55	4761525.52	WORKER´S HOUSING	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	169.5	2
16	MARIN	534034.37	4761164.79	STATION	STATION	STATION	DISUSED	-	BAD	132	2
17	SALINAS DE LENIZ	534929.86	4759075.98	HALT	-	-	-	-	-	0	0
18	SALINAS DE LENIZ	534655.46	4758006.38	STATION	OLD STATION	-	DISUSED	-	DISAPPEARED	0	0
19	LANDA	533478.94	4756507.61	STATION	STATION_OLD STATION	STATION_OLD STATION	PUBLIC USE	LOCAL SERVICE CENTRE	GOOD	288	2
20	VILLAREAL	531038.73	4756343.17	STATION	STATION_OLD STATION_ ELECTRICAL SUBSTATION	STATION_OLD STATION_ ELECTRICAL SUBSTATION	DISUSED	-	BAD	472	2
21	URBINA	529859.12	4754467.01	STATION	OLD STATION	OLD STATION	PRIVATE USE	HOUSING	GOOD	143	1
22	RETANA	529250.27	4750876.08	STATION	STATION_OLD STATION	STATION_OLD STATION	PRIVATE USE	HOUSING	GOOD	466.5	3
23	DURANA	528984.34	4749014.88	STATION	STATION_OLD STATION	OLD STATION	PRIVATE USE	CATERING	GOOD	260	2
24	VITORIA APEADERO	527550.9	4744945.86	HALT	-	-	-	-	-	0	0

VASCO-NAVARRO RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
25	VITORIA-CIUDAD	527301.08	4744125.1	STATION	STATION_WAREHOUSE_ WORKSHOPS_ WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0
26	VITORIA-NORTE	526749.16	4743265.77	STATION	STATION	STATION	RAILWAY	-	GOOD	0	0
27	OLARIZU	528274.89	4742164.21	ESTACION	STATION_WAREHOUSE_ WAGON SHED_ RAILCAR SHED	RAILCAR SHED	DISUSED	-	RUIN	375	2
28	OTAZU	530695.38	4741959.44	HALT	STATION	STATION	PUBLIC USE	HOSTEL	GOOD	212	2
29	ABERASTURI	533145.91	4741854.94	STATION	STATION	STATION	PRIVATE USE	HOUSING	GOOD	200	2
30	ANDOLLU	535230.09	4742021.95	STATION	STATION	STATION	PUBLIC USE	PROBATION CENTRE	GOOD	350	2
31	ESTIBALIZ	535092.04	4743883.89	HALT	-	-	DISUSED	-	REGULAR	0	0
32	TROCONIZ	536464.98	4741604.26	WORKER´S HOUSING	HOUSE	HOUSE	PUBLIC USE	SCHOOL	GOOD	201	2
33	ERENTXUN	539093.25	4740610.04	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	RUIN	199	2
34	GAUNA	541171.55	4740509.14	WORKER´S HOUSING	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
35	ULLIBARRI-JAUREGUI	543336.95	4739426.22	STATION	STATION_ELECTRICAL SUBSTATION	ELECTRICAL SUBSTATION	DISUSED	-	BAD	209	2
36	BRIGADA TUNEL	544424.08	4738056.72	WORKER´S HOUSING	HOUSE	HOUSE	DISUSED	-	RUIN	343	3
37	LAMINORIA	545549.63	4735819.98	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
38	CICUJANO	545644.18	4733528.49	WORKER´S HOUSING	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	190	2
39	MAEZTU	545487.02	4731918.88	STATION	STATION_WAREHOUSE	STATION	PUBLIC USE	CITY HALL	GOOD	720	4
40	ATAURI	546971.42	4729868.55	STATION	STATION	STATION	DISUSED	-	RUIN	249	3
41	ANTOÑANA	549315.35	4726791.79	STATION	STATION_WAREHOUSE_ ELECTRICAL SUBCENTRAL	STATION_WAREHOUSE_ ELECTRICAL SUBCENTRAL	PRIVATE USE	HOUSING	GOOD	758	4
42	FRESNEDO	551587.46	4724934.88	WORKER´S HOUSING	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
43	SANTA CRUZ DE CAMPEZO	553919.78	4724977.64	STATION	STATION_WAREHOUSE_ WAGON SHED_ RAILCAR SHED	RAILCAR SHED	USO PRIVADO	DISUSED	GOOD	476	2
44	ORRADICHO	554980.61	4725390.39	WORKER´S HOUSING	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
45	ZUÑIGA	557358.26	4726436.46	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	DISUSED	-	RUIN	197.52	2

VASCO-NAVARRO RAILWAY											
ID	**NAME**	**LOCATION (X)**	**LOCATION (Y)**	**GENERAL USE**	**BUILDINGDS**	**CURRENT BUILDINGS**	**CURRENT USE**	**SPECIFIC USE**	**CURRENT STATE**	**FLOOR AREA**	**Nº FLOORS**
46	ARQUITAS	559334.99	4725447.82	WORKER´S HOUSING	HOUSE	HOUSE	DISUSED	-	RUIN	320	2
47	ACEDO	561822.31	4723995.6	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PRIVATE USE	HOUSING	GOOD	357.01	3
48	GRANADA	564394.3	4723982.59	WORKER´S HOUSING	HOUSE	HOUSE	DISUSED	-	RUIN	484	2
49	ANCIN	566373.29	4723515.16	STATION	STATION_WAREHOUSE_ ELECTRICAL SUBSTATION_ WATER TOWER	STATION_ELECTRICAL SUBSTATION_ WATER TOWER	PUBLIC USE	CITY HALL_ CATERING	GOOD	728.96	3
50	MURIETA	569020.01	4723226.46	STATION	STATION_WAREHOUSE	STATION	PUBLIC USE	CITY HALL	GOOD	417	3
51	ZUFIA	573665.67	4723237.3	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
52	ZUBIELQUI	576707.38	4725534.42	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PRIVATE USE	HOUSING	REGULAR	275.96	3
53	ESTELLA	579225.58	4724640.46	STATION	STATION_WAREHOUSE_ WAGON SHED_ RAILCAR SHED	STATION	PUBLIC USE	BUS STATION, CULTURAL CENTRE	GOOD	1376.1	4

SONDIKA-MUNGIA RAILWAY

SONDIKA-MUNGIA RAILWAY											
ID	**NAME**	**LOCATION (X)**	**LOCATION (Y)**	**GENERAL USE**	**BUILDINGDS**	**CURRENT BUILDINGS**	**CURRENT USE**	**SPECIFIC USE**	**CURRENT STATE**	**FLOOR AREA**	**Nº FLOORS**
1	MUNGIA	512093.05	4800397.11	STATION	STATION_WAREHOUSE_ WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0
2	ATXURI	511305.13	4799667.41	HALT	-	-	-	-	-	0	0
3	ZABALONDO	511331.67	4798601.54	HALT_GATEKEEPER´S HOUSE	SMALL BUILDING_HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	118.22	2
4	ARTEBAKARRA	510133.75	4796265.54	HALT_GATEKEEPER´S HOUSE	SMALL BUILDING_HOUSE	-	DISUSED	-	DISAPPEARED	0	0
5	AIARTZA	508380.08	4795411.7	HALT	SMALL BUILDING	-	-	-	-	0	0
6	GAZTAÃ‘AGA	508246.77	4794302.03	HALT	SMALL BUILDING	-	-	-	-	0	0
7	ELOTXELERRI	507478.77	4794104.05	HALT	-	-	-	-	-	0	0
8	SONDIKA	506102.31	4794130.54	HALT	SMALL BUILDING ?	-	-	-	-	0	0

TRASLAVIÑA-CASTRO RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	TRASLAVIÑA-HERBOSA	483933	4786745	STATION	STATION_WAREHOUSE	STATION	RAILWAY	-	-	0	0
2	LAS BARRIETAS	484031.29	4789607.67	STATION	STATION_WAREHOUSE_ LOADING DOCK	STATION_WAREHOUSE_ LOADING DOCK	PRIVATE USE	HOUSING	REGULAR	234.29	3
3	EL HOYO	487134.29	4790666.61	HALT	-	-	-	-	-	0	0
4	EL CASTAÑO	486635.69	4791801.41	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
5	LA CATALINA	486270.11	4792822.02	HALT	-	KILNS_OFFICES_DINING ROOM	-	-	-	0	0
6	LAS MUÑECAS	486311.35	4793165.91	HALT	-	-	-	-	-	0	0
7	HERRERO	485672.45	4794937.09	HALT_SIDING	-	-	-	-	-	0	0
8	BERNILLA	485195.05	4796551.35	LOADING DOCK	LOADING DOCK	-	-	-	-	0	0
9	OTAÑES	484391.77	4797701.43	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PUBLIC USE	CATERING	GOOD	433	4
10	LOS CORRALES	483675.64	4798331.7	HALT	HOUSE	HOUSE	DISUSED	-	RUIN	160	2
11	LUSA-SANTULLAN	483230.87	4800071.39	HALT	-	-	-	-	-	0	0
12	MIOÑO	483348.17	4800627.42	STATION	STATION	STATION	PRIVATE USE	HOUSING	GOOD	245	3
13	BRAZOMAR	482575.96	4801771.69	SIDING	-	-	-	-	-	0	0
14	CASTRO-URDIALES	482092.84	4803073.73	STATION	STATION_WAREHOUSE_ WAGON SHED_ OFFICES_WORKSHOP	-	DISUSED	-	DISAPPEARED	0	0
15	CASTRO-URDIALES	481969.04	4804242.01	LOADING DOCK	LOADING DOCK 1_ LOADING DOCK 2	-	-	-	-	0	0
16	EL ARENAO	488611.02	4791728.14	STATION	-	-	-	-	-	0	0
17	SAN PEDRO DE GALDAMES	491983.64	4789256.52	STATION	STATION	STATION	PRIVATE USE	HOUSING	GOOD	220.95	3

BIDASOA RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	IRUN-CIUDAD	597195.14	4799170.93	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
2	IRUN-FRONTERA	598029.47	4800084.94	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
3	IRUN-BIDASOA	598328.17	4799687.79	STATION	STATION_OFFICES_WAGON SHED_WORKHOPS	-	DISUSED	-	DISAPPEARED	0	0
4	MENDIBIL	598437.88	4799639.96	LOADING DOCK	-	-	-	-	-	0	0
5	ARTEAGA	599135.54	4799414.64	HALT	STATION	-	DISUSED	-	DISAPPEARED	0	0
6	ISLA DE LOS FAISANES	600196.91	4799548.37	SIDING	-	-	-	-	-	0	0
7	BEHOBIA	600361.59	4799535.59	STATION	STATION?	-	DISUSED	-	DISAPPEARED	0	0
8	GASTAÑALDE	601298.81	4798344.89	HALT	-	-	-	-	-	0	0
9	ALUNDA	602158.23	4798135.59	HALT	-	-	-	-	-	0	0
10	LASTAOLA	602023.41	4797350.93	HALT	-	-	-	-	-	0	0
11	SAN MIGUEL	602348.42	4796037.19	HALT	STATION	STATION	DISUSED	-	RUIN	166	2
12	ENLARDATSA	603036.61	4794194.3	STATION	STATION_WAREHOUSE	STATION	PRIVATE USE	HOUSING	GOOD	510.57	3
13	ZALAIN	604526.72	4792165.61	HALT	-	-	-	-	-	0	0
14	ALKAIGA-BERA	606251.86	4792217.03	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
15	LESAKA-ETXALAR	607008.68	4789927.76	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
16	IGANTZI-ARANTZA	607332.57	4786805.07	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
17	Espelosin-Casilla	608314.32	4781278.77	HALT						0	0
18	Espelosin	607506.49	4780926.66	HALT						0	0
19	LATSA	607808.57	4780200.28	HALT		-		-		0	0
20	SUMBILLA	608102.1	4778771.97	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
21	SANESTEBAN-ELGORRIAGA	608575.49	4776386.49	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
22	LEGASA	610101.34	4776005.93	STATION	STATION	STATION	PRIVATE USE	HOUSING	GOOD	146	2
23	REPARACEA	611272.43	4776282.17	HALT	STATION	-	DISUSED	-	DISAPPEARED	0	0
24	NAVARTE	611799.86	4776409.28	HALT	STATION	-	DISUSED	-	DISAPPEARED	0	0
25	ORONOZ-MUGAIRE	613095.12	4777193.04	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
25	ORONOZ-MUGAIRE	612874.97	4776970.46	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	90	2
26	ARRAIOZ	616562.98	4777475.47	HALT	STATION	-	DISUSED	-	DISAPPEARED	0	0

BIDASOA RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
26	ARRAIOZ	616562.98	4777475.47	HALT	STATION	-	DISUSED	-	DISAPPEARED	0	0
27	CAMINO DEL MOLINO	617373.55	4777350.99	HALT	-	-	-	-	-	0	0
28	IRURITA-LACAROZ	618378.9	4776946.01	GATEKEEPER´S HOUSE	HOUSE	HOUSE	PRIVATE USE	HOUSING	GOOD	114	1
28	IRURITA-LACAROZ	618403.72	4776941.52	STATION	STATION_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
29	COLEGIO-LECAROZ	619434.47	4776999.44	HALT	-	-	-	-	-	0	0
30	ELIZONDO	620560.04	4777800.1	STATION	STATION_WAREHOUSE_ WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0

BILBAO-LEZAMA RAILWAY

BILBAO-LEZAMA RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDING:	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	LAS CALZADAS	506363.63	4789547.56	STATION	STATION	STATION	PUBLIC USE	ARCHAEOLOGICAL MUSEUM	GOOD	977.47	4
2	BEGOÑA	506753.26	4789706.63	HALT	SMALL BUILDING?	-	-	-	-	0	0
3	ARTXANDA	505972.67	4791241.9	HALT	SMALL BUILDING	SMALL BUILDING	PRIVATE USE	WAREHOUSE	REGULAR	70	1
4	SAN ROQUE	506618.09	4792568.27	HALT	SMALL BUILDING?	-	-	-	-	0	0
5	BIDEKURTZE	506993.64	4792836.81	HALT	SMALL BUILDING?	-	-	-	-	0	0

IRATI RAILWAY												
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	SANGUESA	640571.4	4715424.33	STATION	STATION_WAREHOUSE_ WAGON SHED	WAGON SHED	PRIVATE USE	WAREHOUSE	REGULAR	448.08	1
2	LIEDENA	641211	4719714	STATION	STATION_WAREHOUSE_ WAREHOUSE	STATION_WAREHOUSE_ WAREHOUSE	PRIVATE USE	HOUSING	GOOD	1187.41	2
3	LUMBIER	638943	4723927	STATION	STATION_WAREHOUSE_	-	DISUSED	-	DISAPPEARED	0	0
4	RIPODAS	638844	4727391	HALT	SMALL BUILDING_ GATEKEEPER´S HOUSE	GATEKEEPER´S HOUSE	PRIVATE USE	HOUSING	REGULAR	76	1
5	ARTIEDA	637039	4730475	STATION	STATION_WAREHOUSE	STATION_WAREHOUSE	PRIVATE USE	HOUSING	GOOD	152.86	2
6	ARTAJO	635910	4732225	HALT	HALT	-	DISUSED	-	DISAPPEARED	0	0
7	MURILLO	633655	4734001	HALT	HALT	-	DISUSED	-	DISAPPEARED	0	0
8	AOS	632420	4734869	STATION	STATION	STATION	DISUSED	-	RUIN	57.6	1
9	VILLAVETA	631388.84	4735720.65	STATION	STATION_WAREHOUSE_	-	DISUSED	-	DISAPPEARED	0	0
10	AOIZ	633161	4738219	STATION	STATION_WAREHOUSE_	-	DISUSED	-	DISAPPEARED	0	0
10	ECAY	632350	4736618	SAWMILL NEIGHBOURHOOD	WAREHOUSES_FACTORIES _HOUSES…	WAREHOUSES_FACTORIES _HOUSES…	DISUSED	-	RUIN	0	0
11	LIBERRI	627626	4737015	HALT	HALT	HALT	PRIVATE USE	HOUSING	GOOD	40	1
12	URROZ-VILLA	626793	4737314	STATION	STATION_WAREHOUSE_	-	DISUSED	-	DISAPPEARED	0	0
13	LIZOAIN	624953.22	4739414.16	HALT	HALT	-	DISUSED	-	DISAPPEARED	0	0
14	MENDIOROZ-UROZ	622295	4740869	STATION	STATION_WAREHOUSE_	-	DISUSED	-	DISAPPEARED	0	0
15	IBIRICU	620331	4742299	HALT	HALT	-	DISUSED	-	DISAPPEARED	0	0
16	EGÃœÃ‰S	618370	4742120	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
17	HUARTE	615582	4743403	STATION	STATION?	-	DISUSED	-	DISAPPEARED	0	0
18	VILLAVA	613963	4742813	STATION	SMALL BUILDING	-	-	-	-	0	0
19	BURLADA	612882	4742151	SIDING		-	-	-	-	0	0
20	PAMPLONA COCHERAS	611463	4740983	HALT	WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0
21	PAMPLONA SARASATE	610799	4741208	HALT	HALT	-	DISUSED	-	DISAPPEARED	0	0
22	PAMPLONA TACONERA	610481	4741284	STATION	STATION_WAGON SHED	-	DISUSED	-	DISAPPEARED	0	0

SESTAO-GASDAMES RAILWAY											
ID	NAME	LOCATION (X)	LOCATION (Y)	GENERAL USE	BUILDINGDS	CURRENT BUILDINGS	CURRENT USE	SPECIFIC USE	CURRENT STATE	FLOOR AREA	Nº FLOORS
1	SESTAO	499126.37	4795858.8	LOADING DOCK	-	-	-	-	-	0	0
1	SESTAO	499137.98	4795738.56	STATION	STATION_OFFICES_ADMINISTRATION HOUSE AND ANNEX_WAREHOUSE_ WORKSHOPS_WAGON SHED_RAILCAR SHED	-	DISUSED	-	DISAPPEARED	0	0
2	BALLONTI	497565.23	4795459.19	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
3	URIOSTE	496752.61	4795533.45	GATEKEEPER´S HOUSE	HOUSE	-	DISUSED	-	DISAPPEARED	0	0
4	SANTA JULIANA	493732	4796141	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
5	BODABILLE	493482.42	4795316.23	STATION	STATION	.	DISUSED	-	DISAPPEARED	0	0
6	BALASTERA	492826.05	4795417.42	GATEKEEPER´S HOUSE	HOUSE_WAREHOUSE	-	DISUSED	-	DISAPPEARED	0	0
7	PUTXETA	492654	4794833	STATION	STATION	STATION	PUBLIC USE	CATERING	REGULAR	83.86	1
7	SAN FERMIN	492651.53	4795243.48	LOADING DOCK	-	-	-	-	-	0	0
8	MINA RUBIA	492299	4794639	LOADING DOCK	-	-	-	-	-	0	0
9	BORJA	490545.71	4795214.61	STATION	STATION_OLD STATION	-	DISUSED	-	DISAPPEARED	0	0
10	EL CERCO	489328.68	4792226.12	STATION	STATION	-	DISUSED	-	DISAPPEARED	0	0
11	GALDAMES	490277	4791258	STATION	ADMINISTRATION HOUSE_WAREHOUSE	ADMINISTRATION HOUSE	PUBLIC USE	BIKE RENTAL	GOOD	461.29	3
12	LA PUNTA	491603	4790213	LOADING DOCK	-	-	-	-	-	0	0

1.2. Uniformity analysis of the Basque-Navarre DRSs

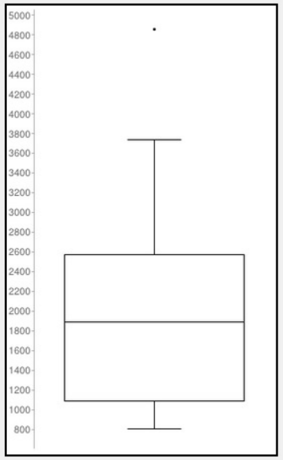
1.2.1. Box-plot graphs

UROLA RAILWAY

Historical state:

Population size: 18
Median: 1890.465
Minimum: 808.25
Maximum: 4854.26
First quartile: 1086.005
Third quartile: 2574.3775
Interquartile Range: 1488.3725
Outlier: 4854.26

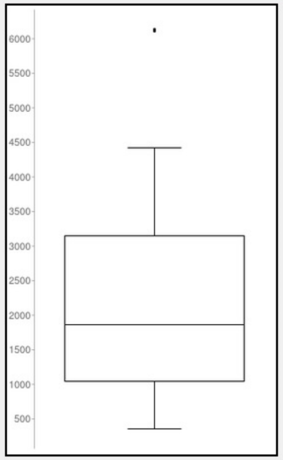
Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data



Constant state:

Population size: 15
Median: 1861.61
Minimum: 359.38
Maximum: 6133.55
First quartile: 1044.11
Third quartile: 3153.69
Interquartile Range: 2109.58
Outliers: 6133.55 6105.30

Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data

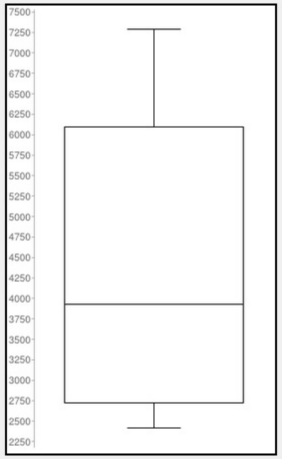


MALTZAGA-ZUMARRAGA RAILWAY

Historical state:

Population size: 6
Median: 3931.335
Minimum: 2419.26
Maximum: 7286.51
First quartile: 2722.5525
Third quartile: 6095.915
Interquartile Range: 3373.3625
Outliers: none

Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data



Constant state:

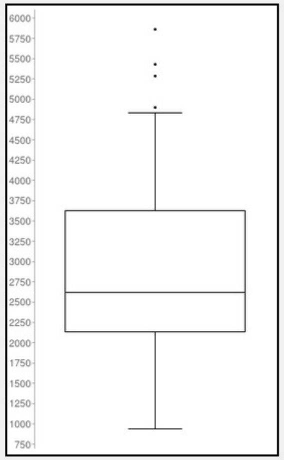
There are not enough population (nodes) to develop the analysis.

VASCO-NAVARRO RAILWAY

Historical state:

Population size: 47
Median: 2620.01
Minimum: 941.85
Maximum: 5858.79
First quartile: 2131.73
Third quartile: 3630.47
Interquartile Range: 1498.74
Outliers: 5858.79 5432.28 5288.45 4894.12

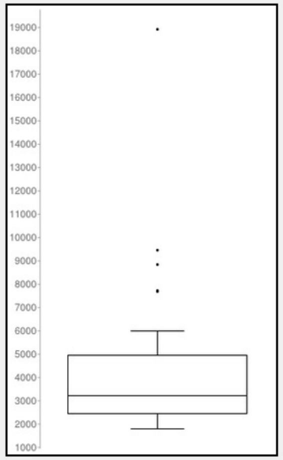
Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data



Constant state:

Population size: 31
Median: 3206.17
Minimum: 1799.97
Maximum: 18912.09
First quartile: 2454.38
Third quartile: 4933.37
Interquartile Range: 2478.99
Outliers: 18912.09 9462.65 8850.37 7727.63 7693.08

Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data

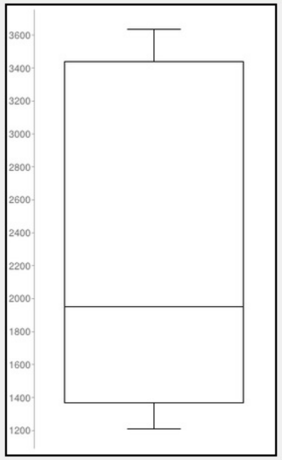


DURANGO-ELORRIO RAILWAY

Historical state:

Population size: 7
Median: 1950.41
Minimum: 1210.87
Maximum: 3633.97
First quartile: 1365.55
Third quartile: 3440.70
Interquartile Range: 2075.15
Outliers: none

Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data



Constant state:

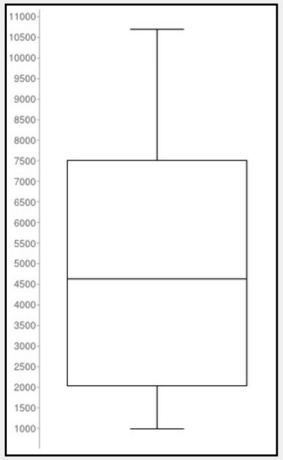
There are not enough population (nodes) to develop the analysis.

PLAZAOLA RAILWAY

Historical state:

Population size: 17
Median: 4619.20
Minimum: 992.59
Maximum: 10688.66
First quartile: 2041.78
Third quartile: 7512.815
Interquartile Range: 5471.035
Outliers: none

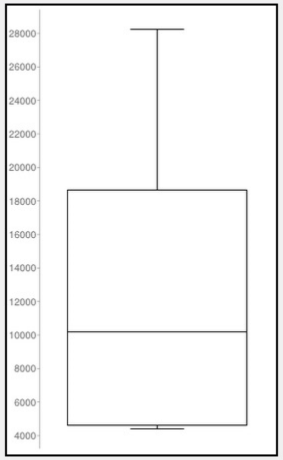
Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data



Constant state:

Population size: 7
Median: 10167.23
Minimum: 4415.36
Maximum: 28227.74
First quartile: 4619.20
Third quartile: 18677.86
Interquartile Range: 14058.66
Outliers: none

Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data

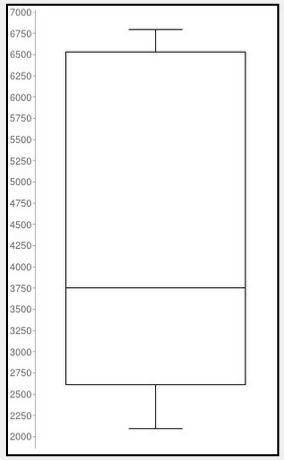


TUDELA-TARAZONA RAILWAY

Historical state:

Population size: 5
Median: 3754.46
Minimum: 2097.47
Maximum: 6792.62
First quartile: 2608.8
Third quartile: 6531.21
Interquartile Range: 3922.41
Outliers: none

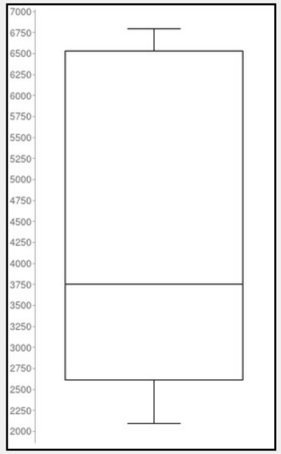
Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data



Constant state:

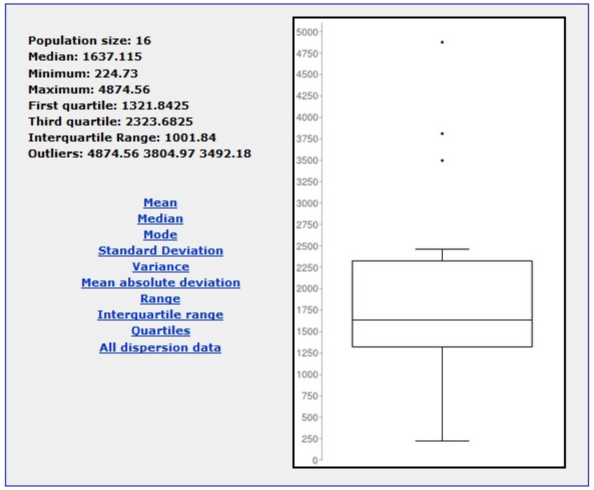
Population size: 5
Median: 3754.46
Minimum: 2097.47
Maximum: 6792.62
First quartile: 2608.8
Third quartile: 6531.21
Interquartile Range: 3922.41
Outliers: none

Mean
Median
Mode
Standard Deviation
Variance
Mean absolute deviation
Range
Interquartile range
Quartiles
All dispersion data

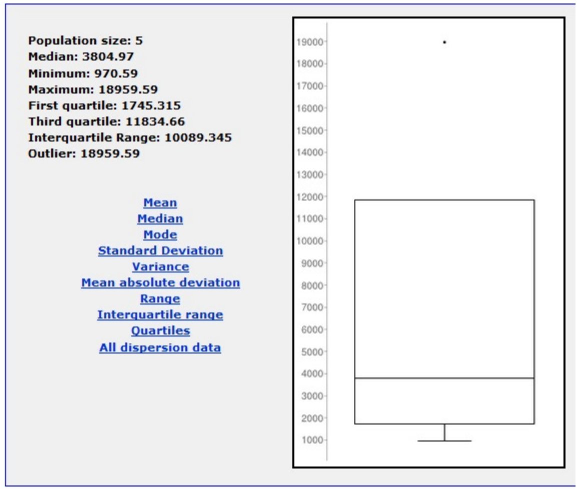


TRASLAVIÑA-CASTRO RAILWAY

Historical state:

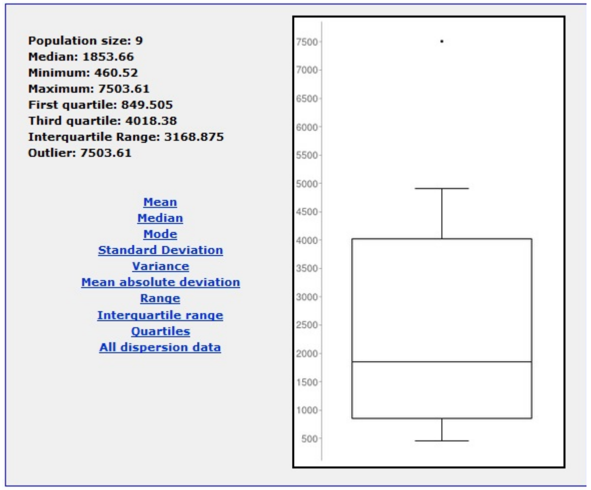


Constant state:



SESTAO-GALDAMES RAILWAY

Historical state:

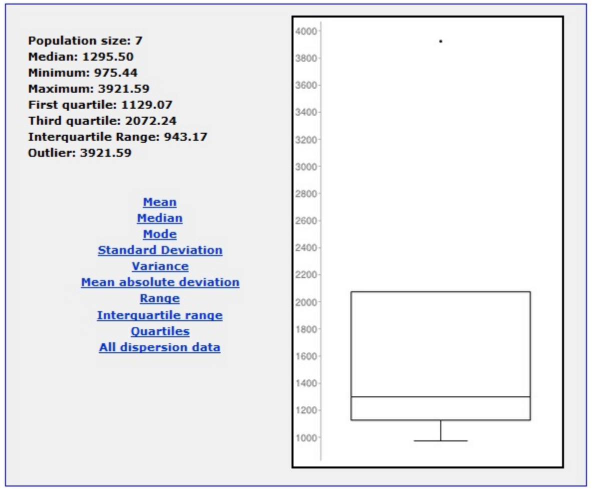


Constant state:

There are not enough population (nodes) to develop the analysis.

SONDIKA-MUNGIA RAILWAY

Historical state:

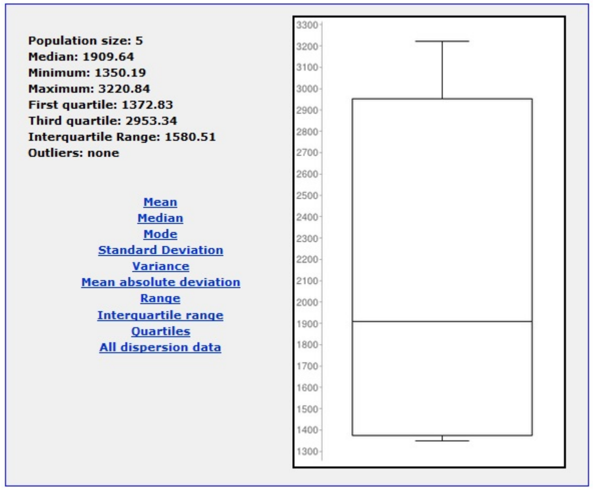


Constant state:

There are not enough population (nodes) to develop the analysis.

BILBAO-LEZAMA RAILWAY

Historical state:

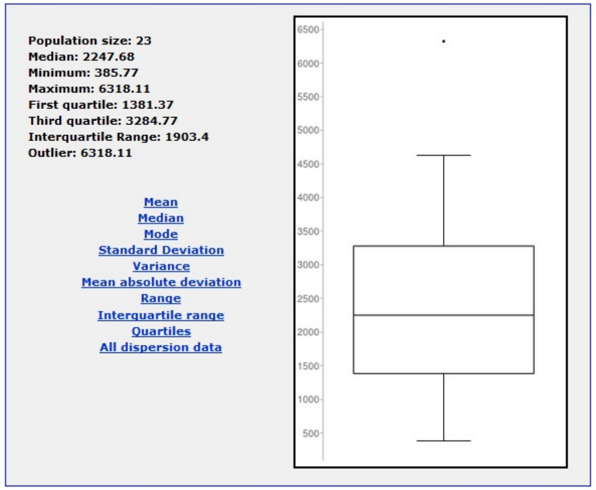


Constant state:

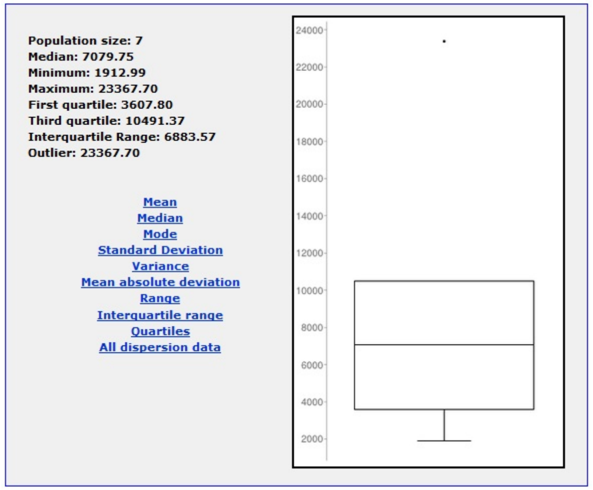
There are not enough population (nodes) to develop the analysis.

IRATI RAILWAY

Historical state:

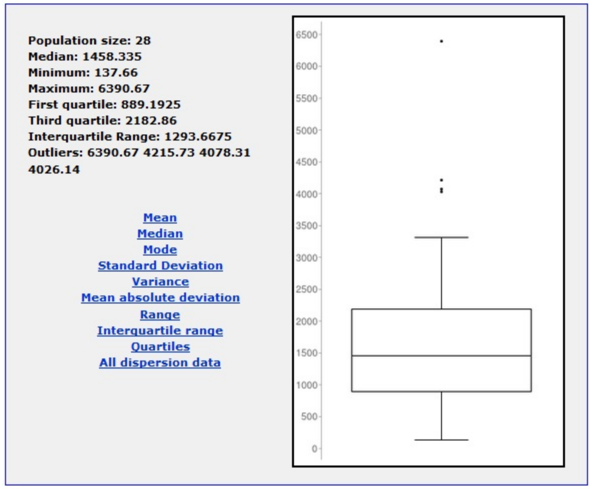


Constant state:

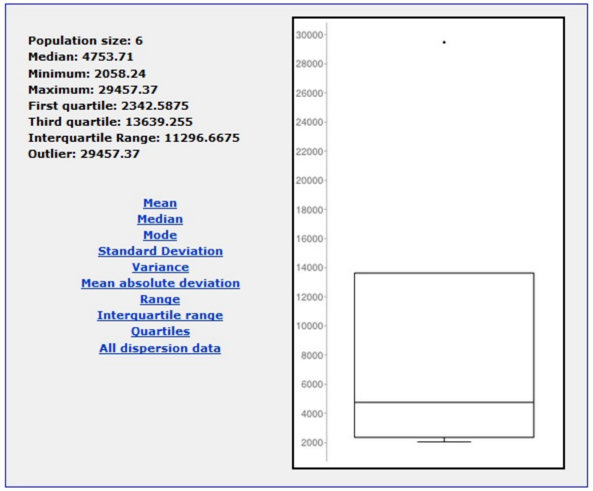


BIDASOA RAILWAY

Historical state:



Constant state:

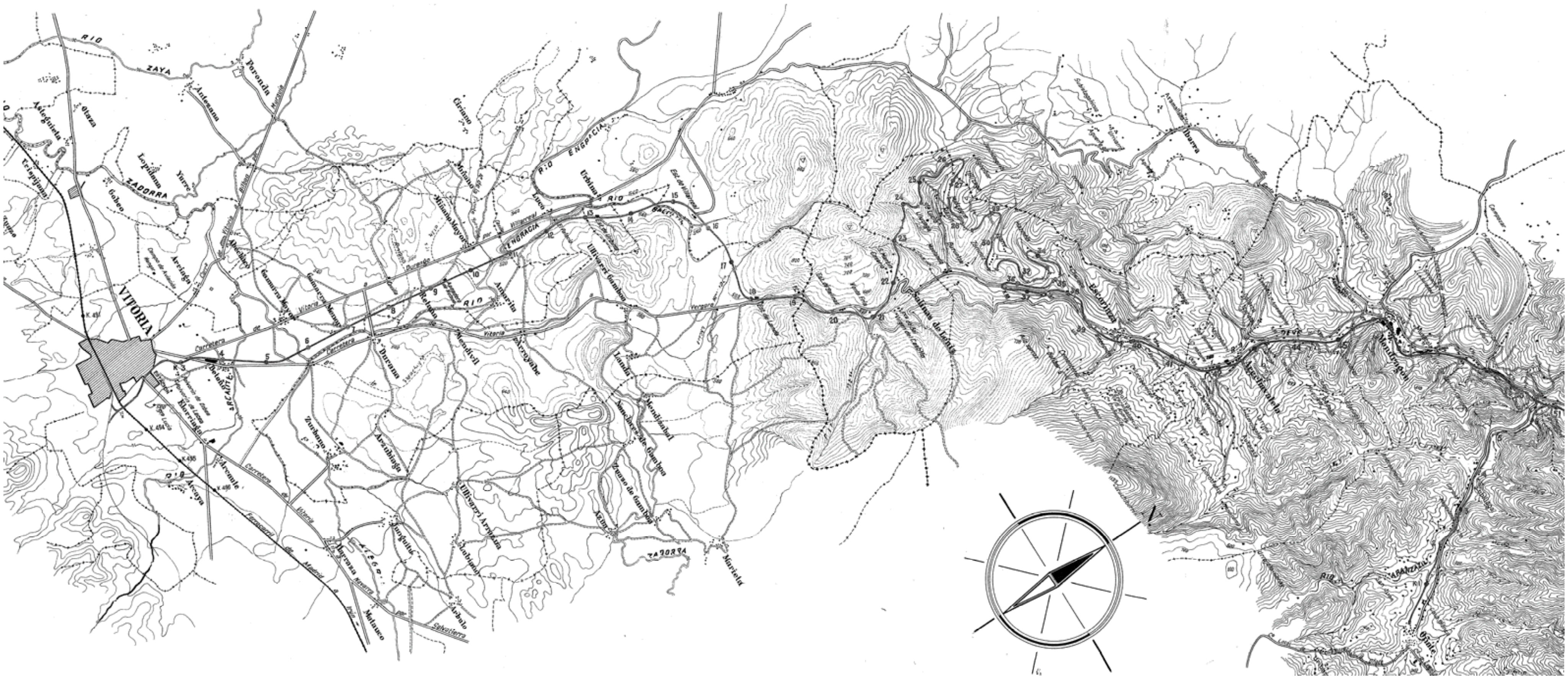


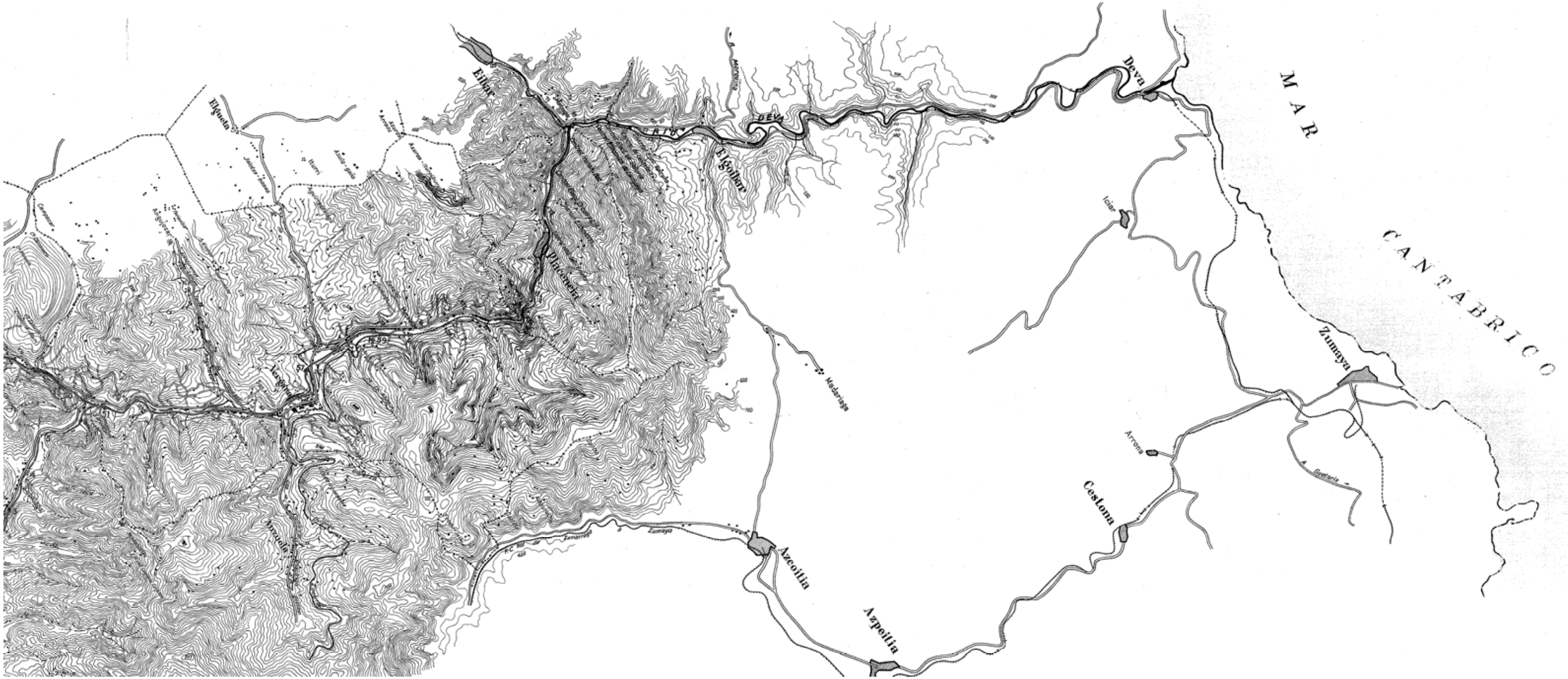
ANNEX 2 (CHAPTER 4)

2.1. <u>Historical state of the elements</u>

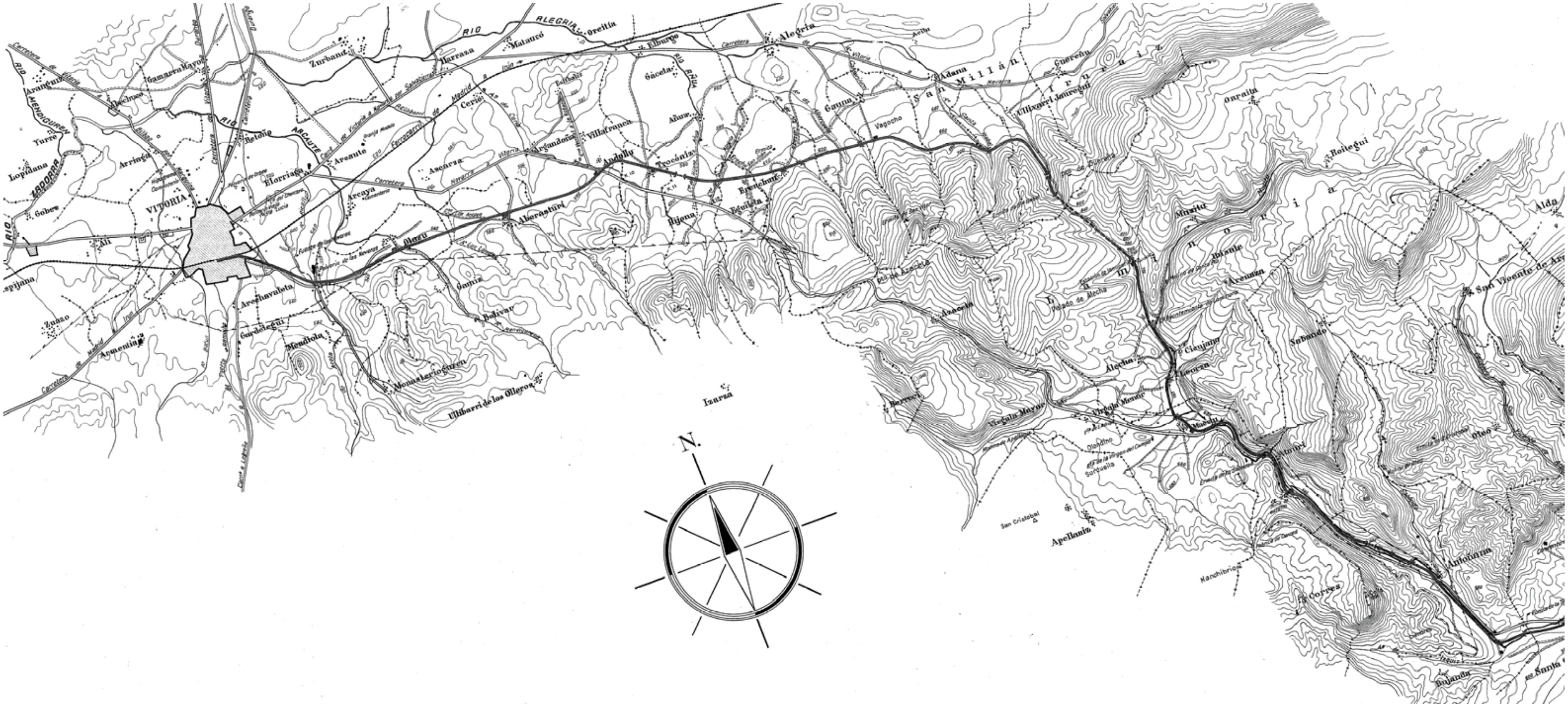
2.1.1. General plans

NORTHERN SECTION. Collection of the Narrow Gauge Railways (FEVE) in the Railway Museum of Asturias (RMA)




MAR
CANTÁBRICO
Deva
Eibar
Elgoibar
Placencia
Vergara
Zumaya
Cestona
Azcoitia
Azpeitia
Icíar
Arrona
Madariaga
Elgueta
RIO DEVA

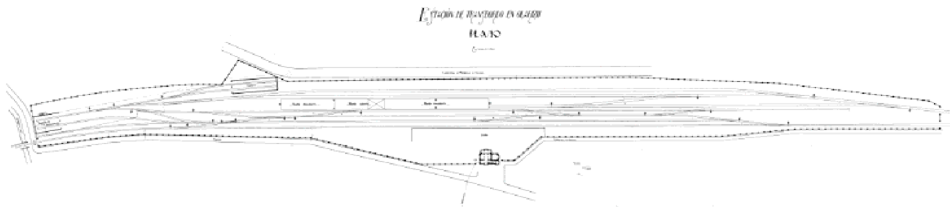
SOUTHERN SECTION. FEVE´s Collection in RMA

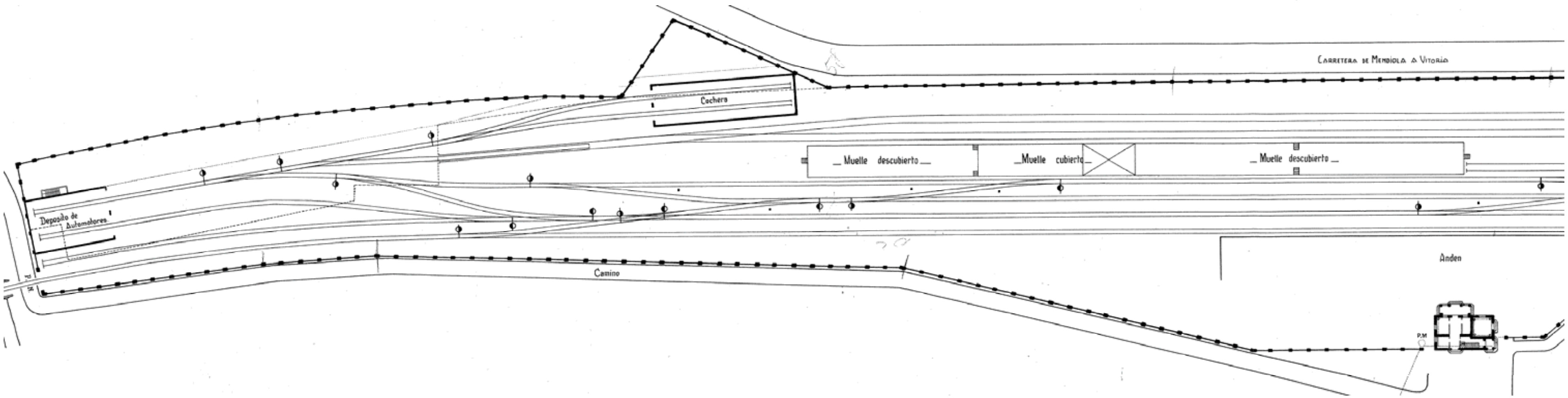



Contrasta
Alda
Zúñiga
Orbiso
Santa Cruz de Campezo
Nazar
Acedo
Ancín
Mendaza
SIERRA DE DOS HERMANAS
Piedramillera
Sorlada
Learza
Murieta
Oco
Olejua
Abáigar
Labeaga
Villamayor de Monjardín
Luquin
Barbarin
Arroniz
Dicastillo
Arellano
Allo
Ayegui
ESTELLA
Zubielqui
Amillano
Lacar
Lorca
Murillo
Villatuerta
Morentin
Metauten
Galbarra
Vitoria
RIO EGA

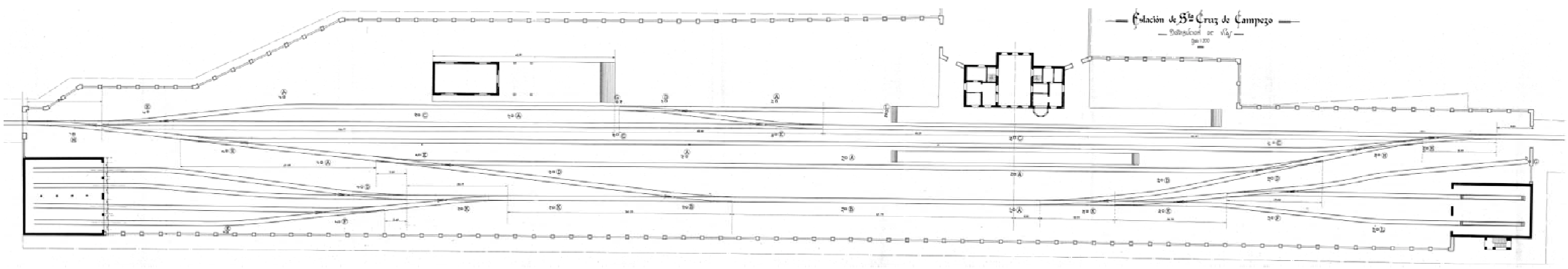
2.1.2. Railway station areas

RAILWAY STATION AREA OF OLARIZU.
Alejandro Mendizábal FEVE´s Collection in RMA



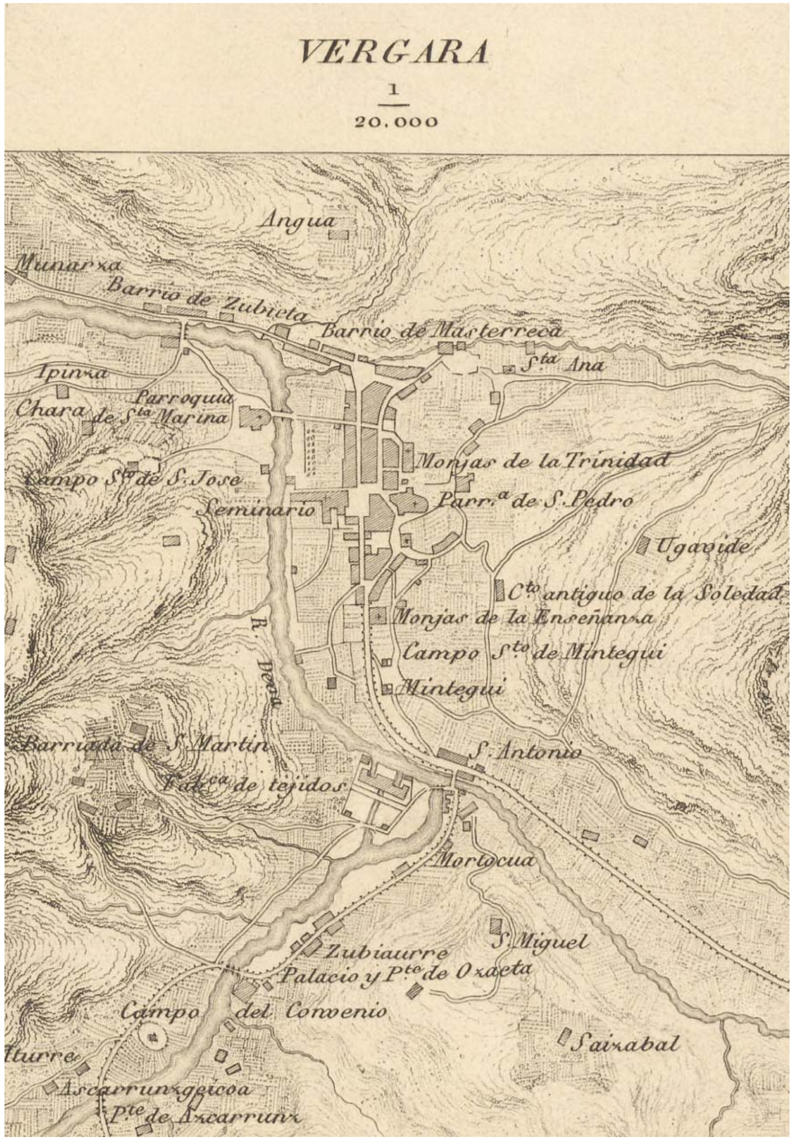


RAILWAY STATION AREA OF KANPEZU. Alejandro Mendizábal, FEVE´s Collection in RMA

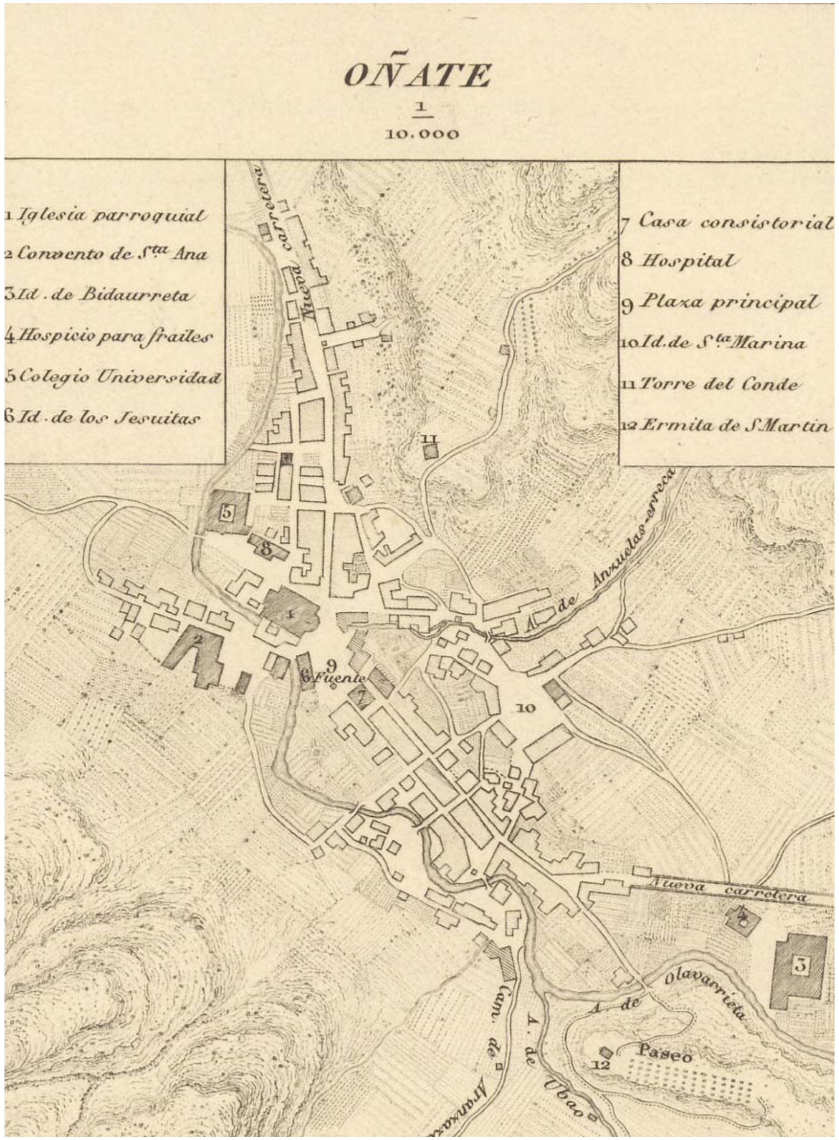


2.1.3. Surrounding territory

BERGARA. Francisco Coello, 1848

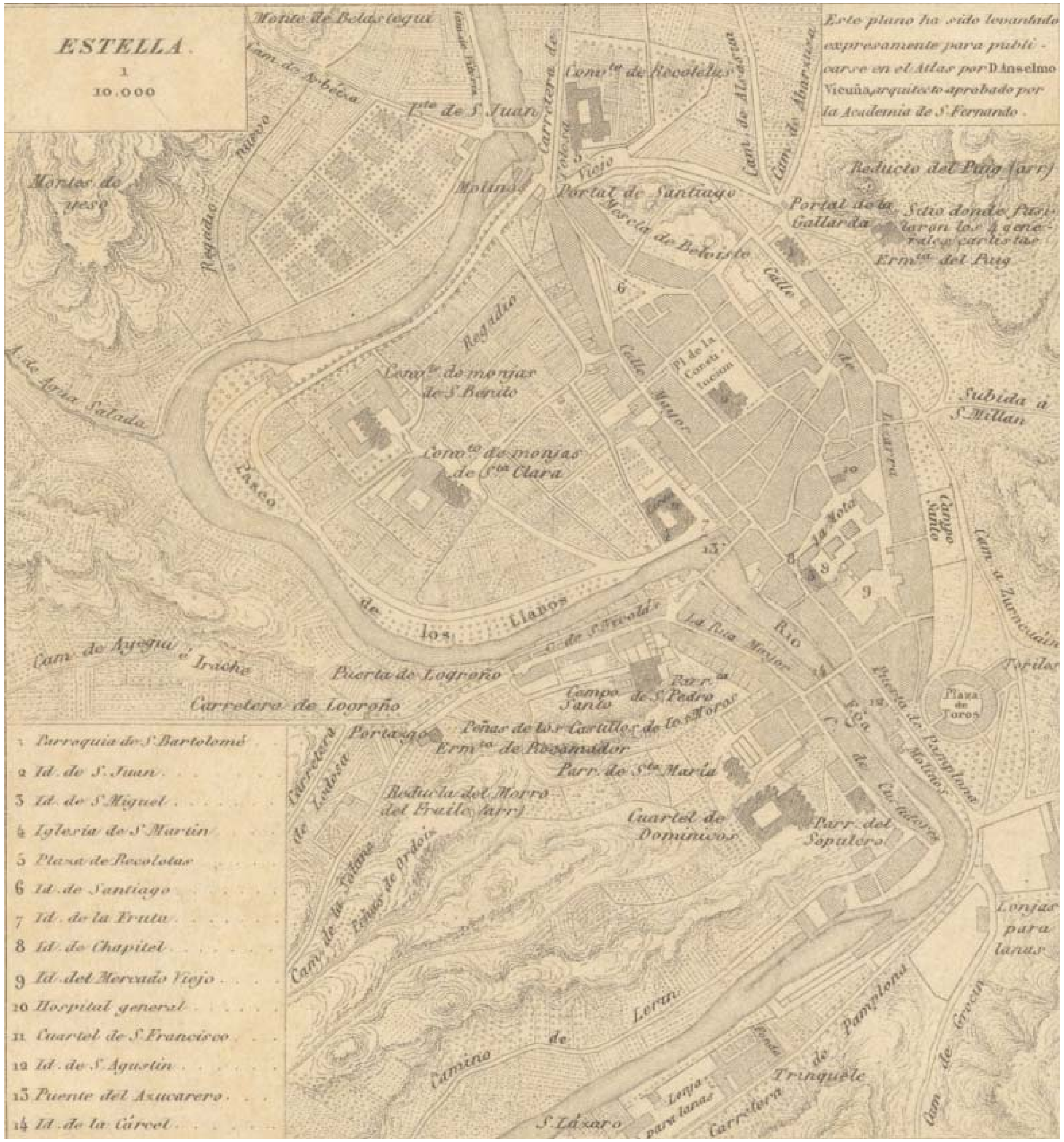


OÑATI. Francisco Coello, 1848

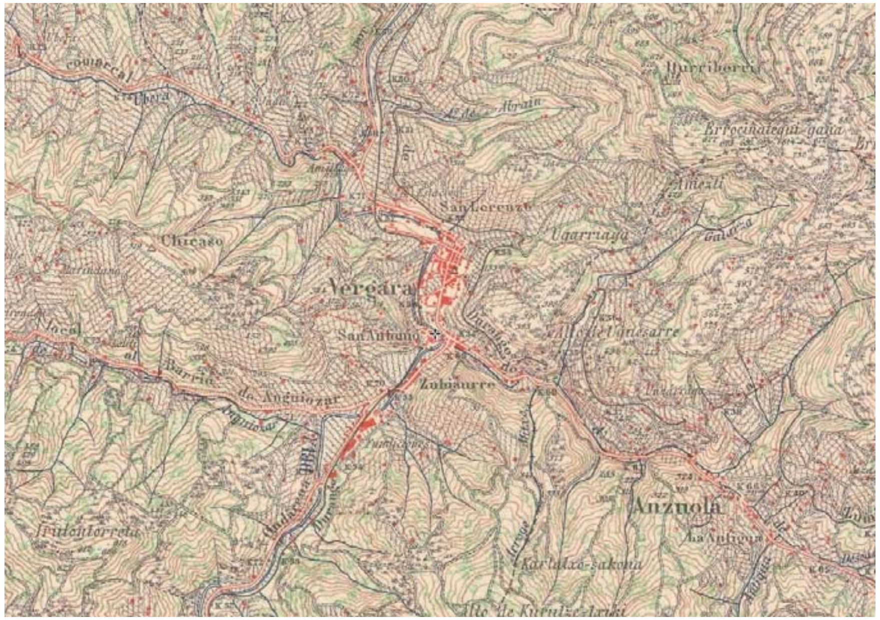


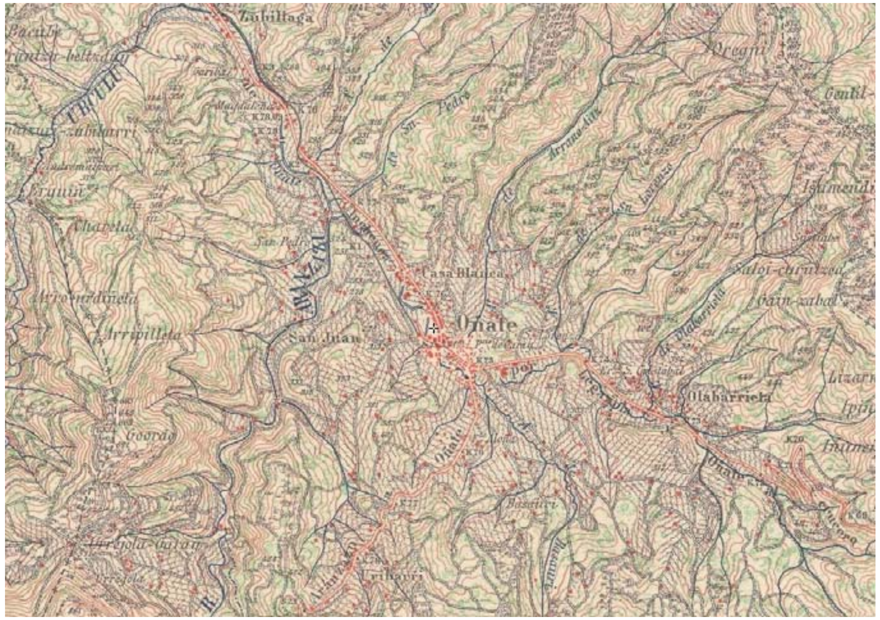
VITORIA-GASTEIZ. Francisco Coello, 1948

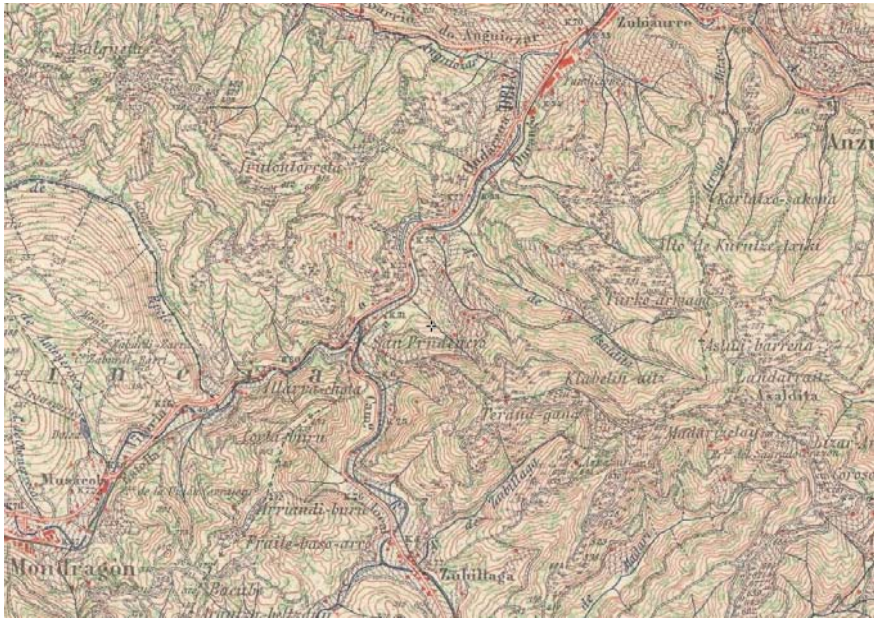
LIZARRA. Francisco Coello, 1861



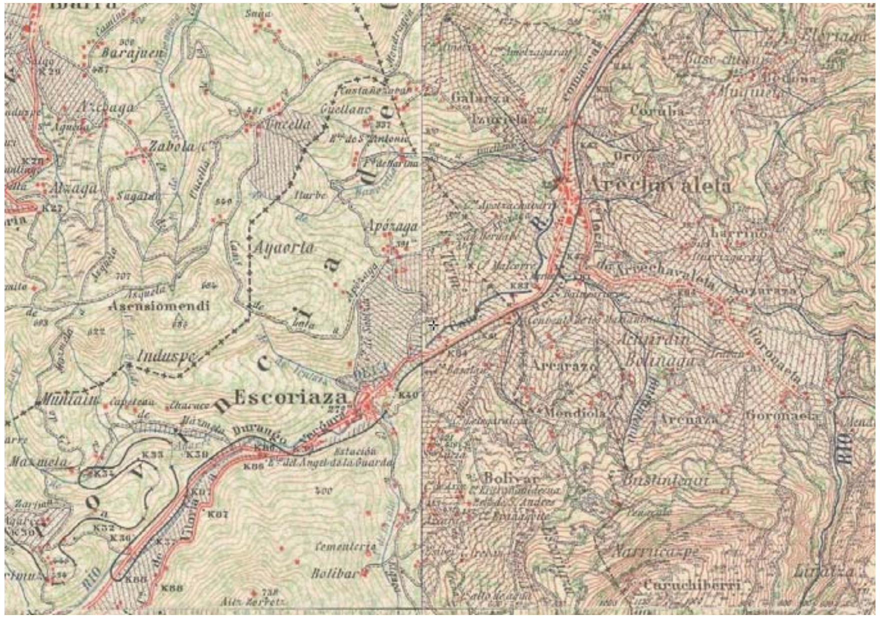
TERRITORY ALL AROUND THE VASCO-NAVARRO RAILWAY
National Topographic Map, (MTN 50 1st edition, 1929-1944) IGN

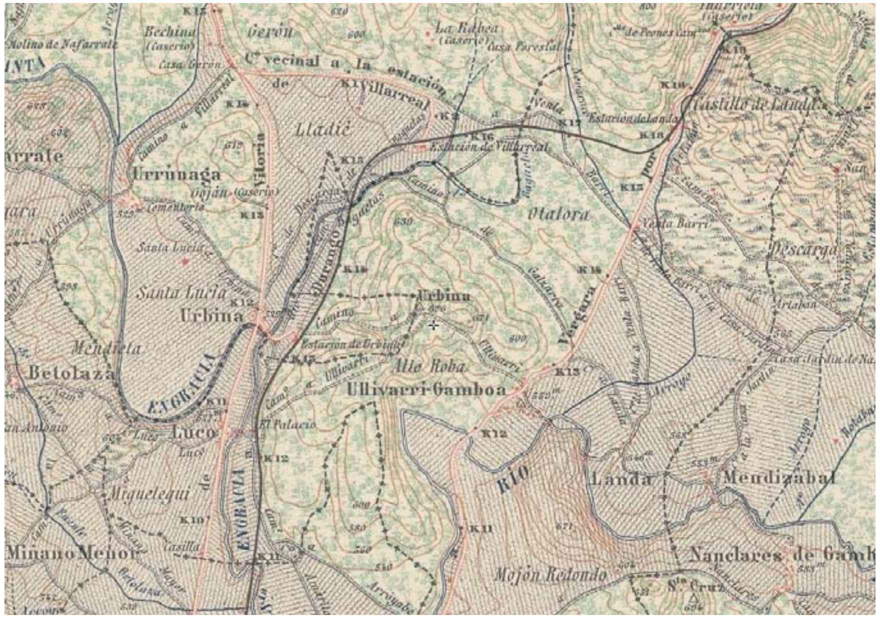

Vergara
San Lorenzo
Chicaso
Zubiaurre
Anzuola


Zubillaga
Casa Blanca
Oñate
San Juan
Olabarrieta

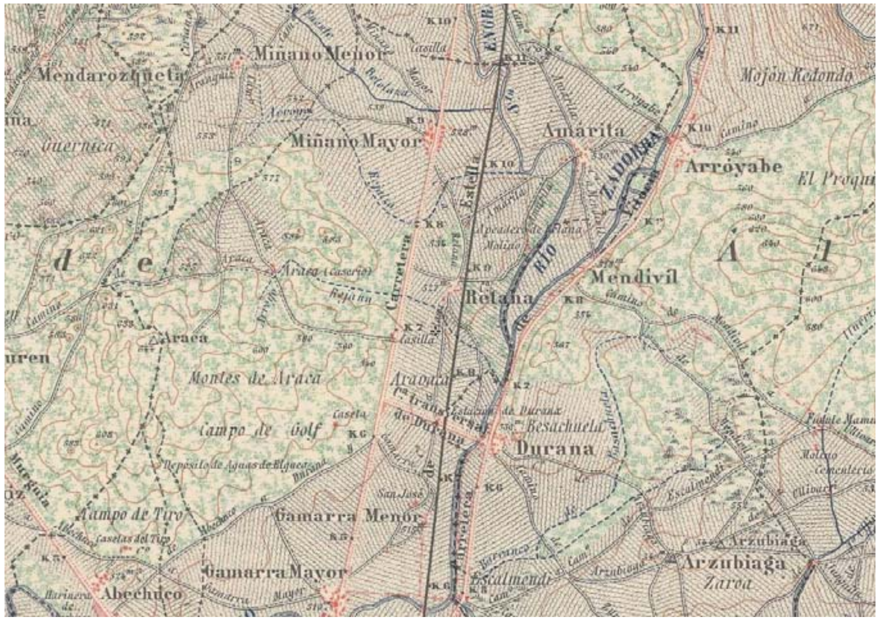

Zubiaurre
San Prudencio
Mondragon
Zubillaga

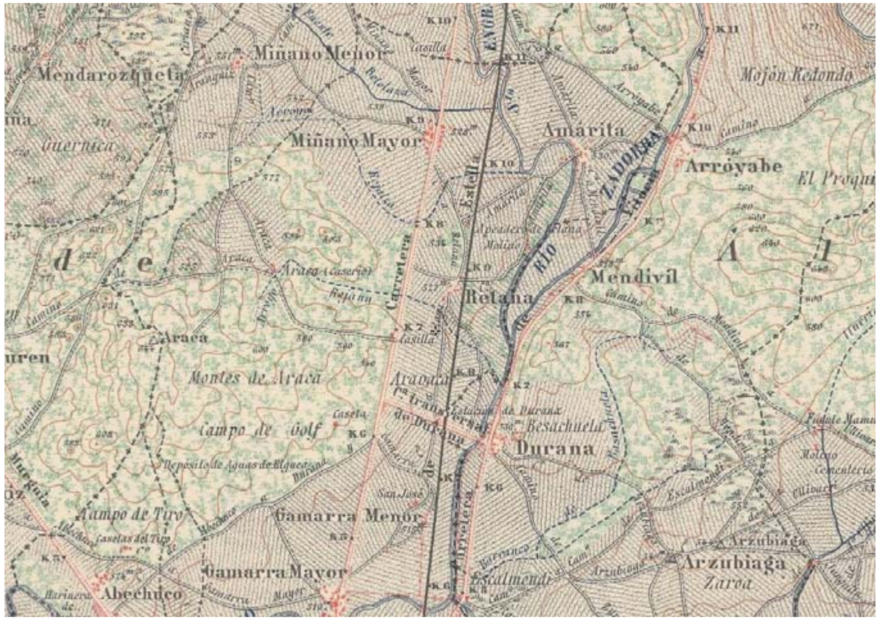
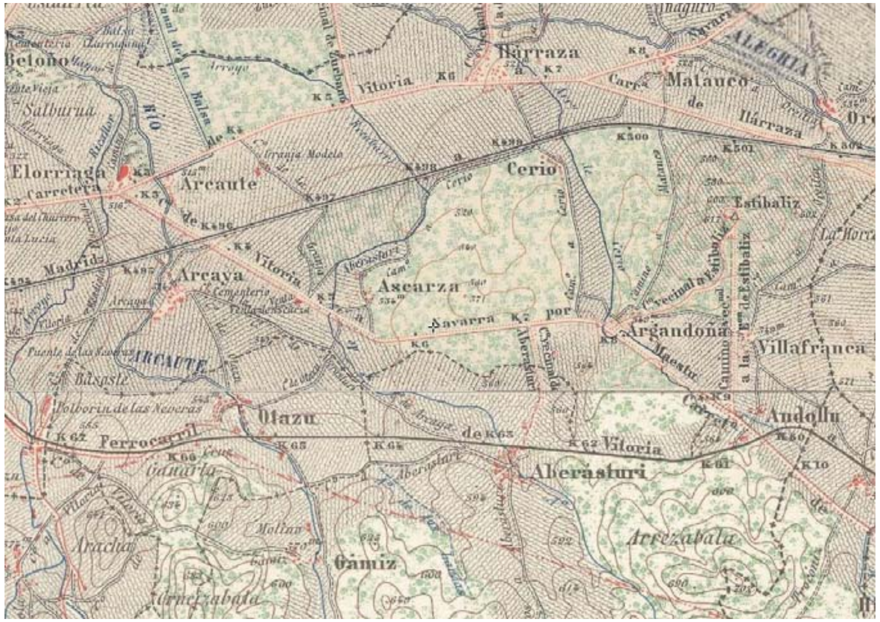
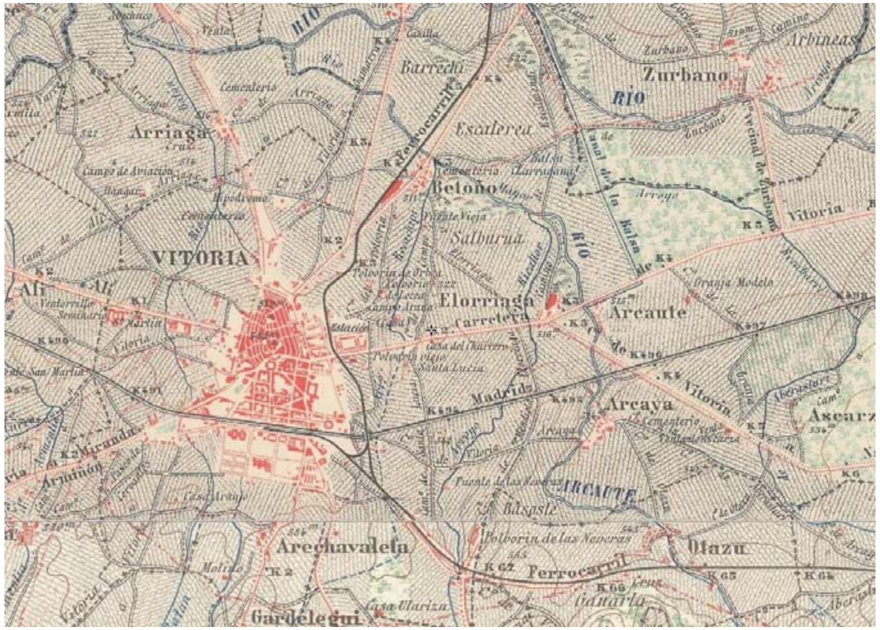

Udalaitz
Udala
Musacola
Mondragon
San Prudencio
Zubillaga


Arechavaleta
Escoriaza
Asensiomendi
Ayaorto
Zabola
Induspe
Maxmela
Bolivar
Mendiola
Galarza
Arenaza
Goronaeta
Curuchiberri
Cementerio
Apózaga
Aozaga

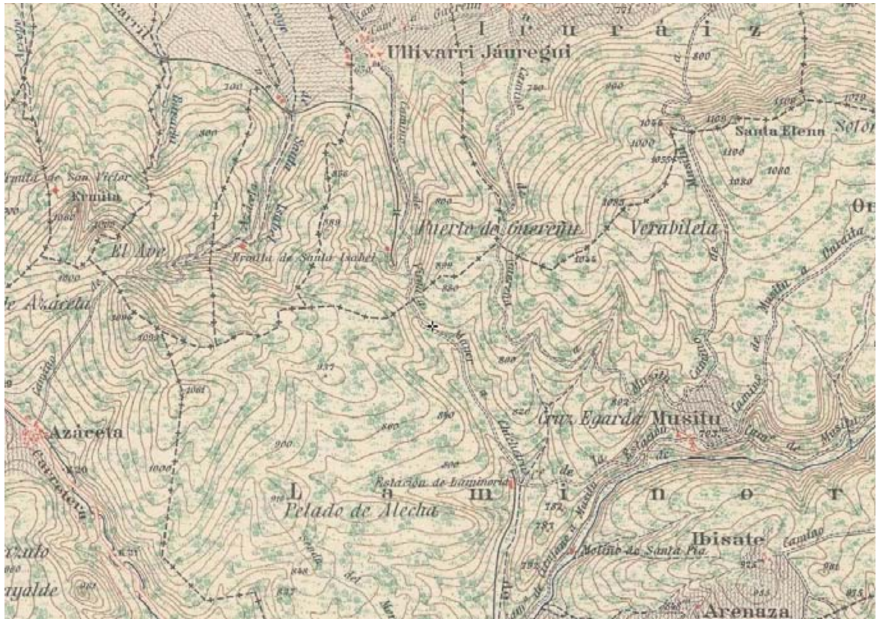
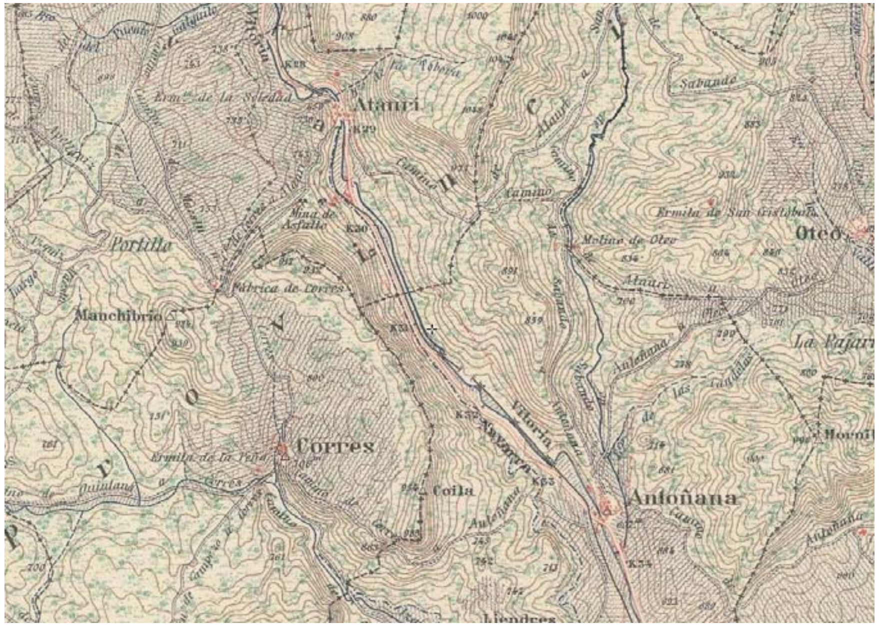

Urbina
Betolaza
Urrúnaga
Santa Lucía
Ullivarri-Gamboa
Alto Roba
Luco
Mendiola
Miguelegui
Miñano Menor
Landa
Mendizabal
Nanclares de Gamb
Mojón Redondo
Otalora
Descarga
Castillo de Landa
Estación de Villarreal
C.º vecinal a la estación de Villarreal
Lladié
Bechina
Gerón
Río Zadorra

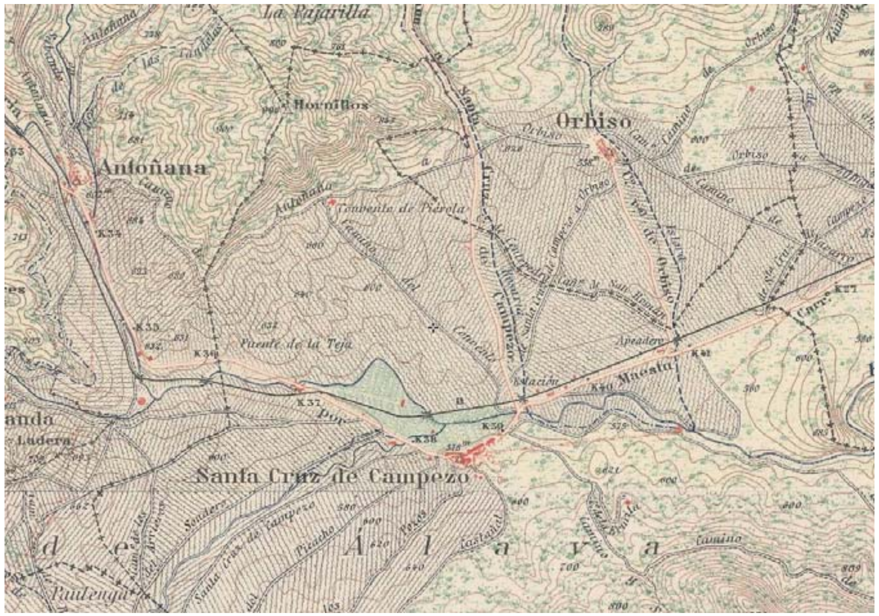

Escoriaza
Induspe
Jarindogoiti
Albina-goya
Subero
Jarinto
Uruburu
Zarimuz
Marolobaso
Maroto
Neveraco Arrúe
Salinas de Leniz
Bostoro
Iliazabal
Bolibar
Cementerio
Maxmela
Loper
Arrupe
Manlanda (Caserío)
Estación de Salinas
Provincia de Guipuzcoa

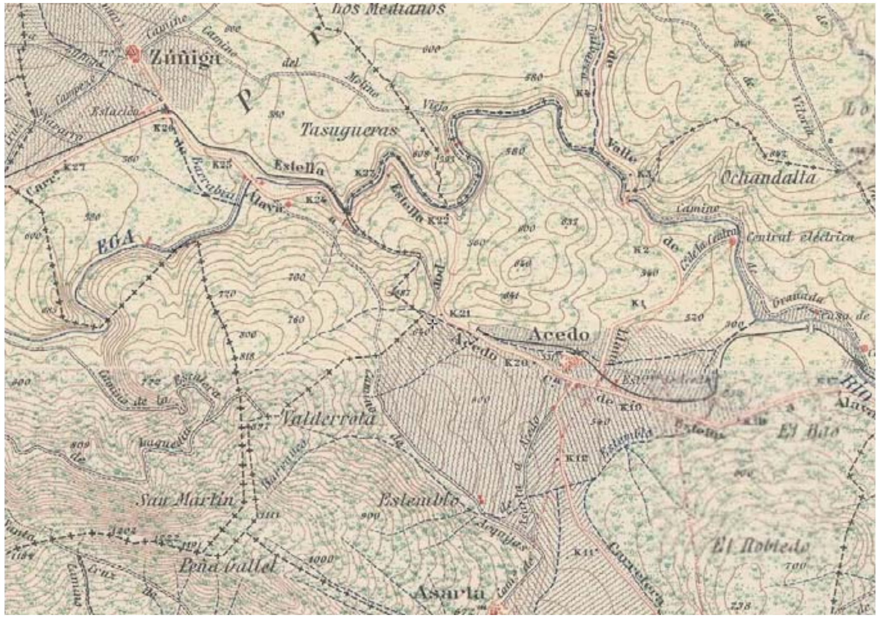
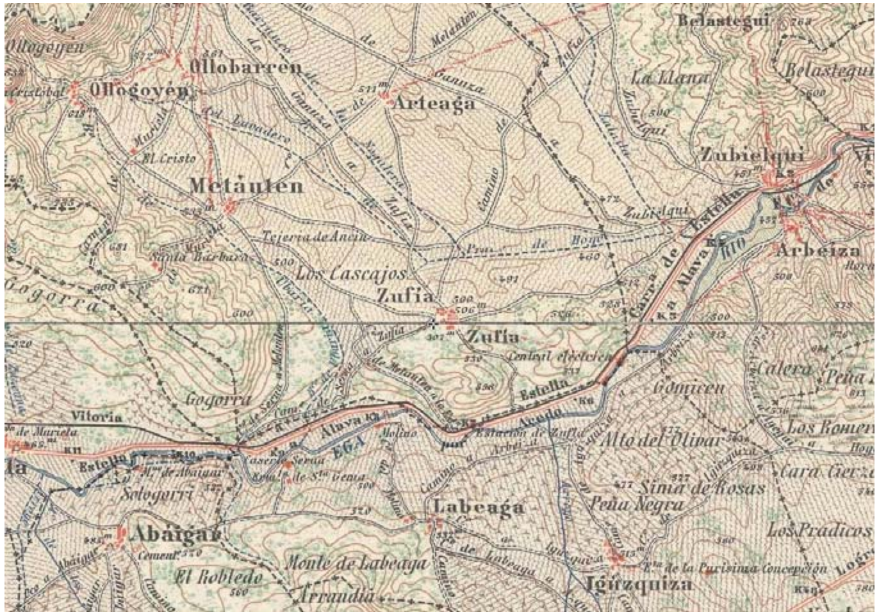
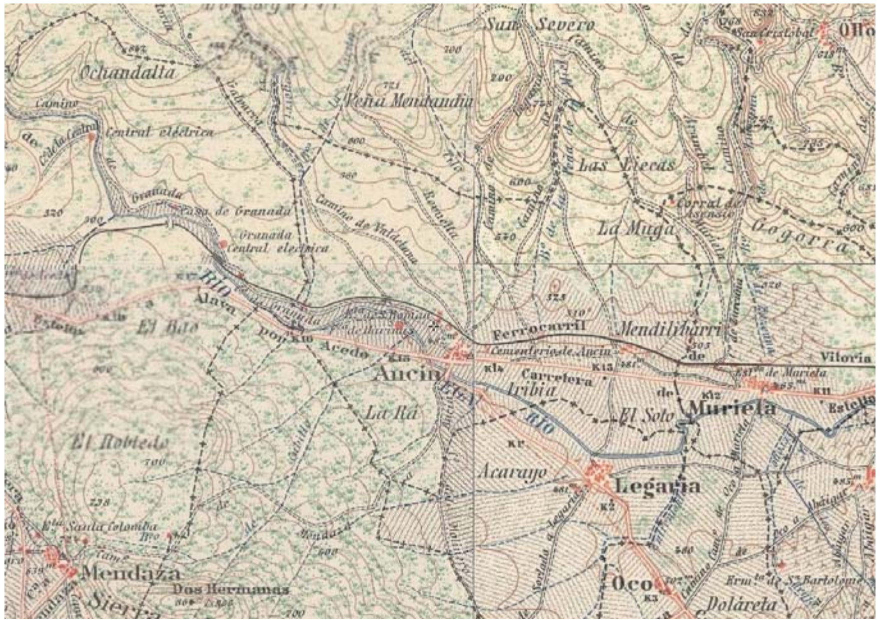
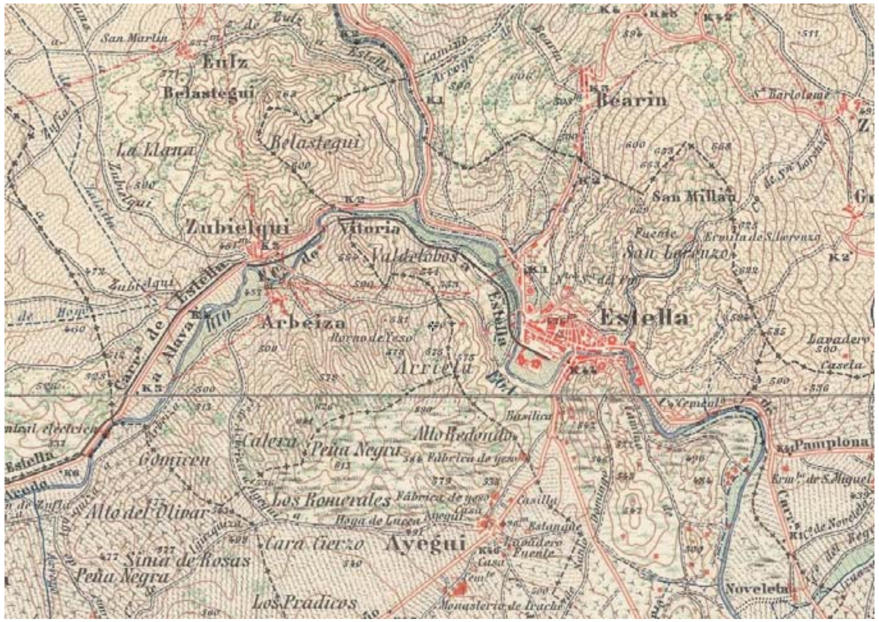

Miñano Menor
Miñano Mayor
Mendarozqueta
Amarita
Arroyabe
El Proqui
Mendivil
Retana
Araca
Montes de Araca
Campo de Golf
Durana
Gamarra Menor
Gamarra Mayor
Campo de Tiro
Abechuco
Arzubiaga
Escalmendi
Mojón Redondo
Carretera
Río Zadorra


Miñano Menor
Mendarozqueta
Mojón Redondo
Miñano Mayor
Amarita
Arróyabe
Retana
Mendivil
Montes de Araca
Campo de Golf
Durana
Gamarra Menor
Gamarra Mayor
Arzubiaga
Abechuco

Betoño
Ilarraza
Matauco
Elorriaga
Arcaute
Cerio
Estibaliz
Arcaya
Ascarza
Argandoña
Villafranca
Otazu
Ferrocarril
Aberasturi
Andollu
Gamiz

Barrechi
Zurbano
Arriaga
Escalerea
Betoño
VITORIA
Elorriaga
Arcaute
Arcaya
Arechavaleta
Otazu
Ferrocarril
Gardelegui

Alegria
Villafranca
Añua
Andollu
Trocóniz
Gauna
Vagocho
Ferrocarril
Erenchun
Hijona
Eguileta
Auburrey


Ullivarri Jáuregui
Puerto de Guereñu
Verabileta
Santa Elena
El Aor
Azáceta
Cruz Egarda
Musitu
Estación de Laminoria
Pelado de Alecha
Ibisate
Molino de Santa Pía
Arenaza

Atauri
Portilla
Manchibrio
Fábrica de Corres
Corres
Ermita de la Peña
Coila
Antoñana
Molino de Oteo
Ermita de San Cristóbal
Oteo
La Pajarilla

Estación de Laminoria
Pelado de Alecha
Molino de Santa Pía
Ibisate
Arenaza
Pozu
Alecha
Cicujano
Virgala Mayor
Virgala Menor
Leorza
Sabando
Olandino
Surdueila
Maestu
Apellaniz
Atauri

La Pajarilla
Hornillos
Orbiso
Antoñana
Convento de Piérola
Fuente de la Teja
Apeadero
Estación
Maestu
Ladera
Santa Cruz de Campezo


Zúñiga
Tasugueras
Ochandalta
Central eléctrica
EGA
Acedo
Valderrota
San Martín
Estemblo
El Robledo
Peña Gallet
Asarta

Ollobarren
Ollogoyen
Arteaga
Metauten
Belastegui
La Llana
Zubielqui
Arbeiza
Los Cascajos
Zufía
Gogorra
Vitoria
Labeaga
Alto del Olivar
Sima de Rosas
Peña Negra
Abaigar
El Robledo
Monte de Labeaga
Igúzquiza
Los Prádicos

San Severo
Ochandalta
Central eléctrica
Peña Menitandia
Las Lecas
La Muga
Gogorra
El Bao
Ferrocarril
Mendilibarri
Ancín
Carretera
El Soto
Murieta
La Ra
El Robledo
Acarayo
Legaria
Mendaza
Dos Hermanas
Oco
Doláreta

Eulz
Belastegui
Bearin
La Llana
Zubielqui
Vitoria
Valdelobos
San Millán
San Lorenzo
Arbeiza
Estella
Alto Redondo
Calera
Peña Negra
Gomicen
Los Romerales
Alto del Olivar
Cara Cierzo
Ayegui
Sima de Rosas
Peña Negra
Los Prádicos
Monasterio de Irache
Pamplona
Noveleta

2.2 Current state of the elements

2.2.1. Current description of the linear infrastructure and its elements

Source: Inventory of Industrial Landscapes within the Autonomous Community of the Basque Country. The Landscape of the Vasco-Navarro Railway (Herreras 2011-2012)

DESCRIPCIÓN ACTUAL DEL TRAZADO

"El Ferrocarril Vasco Navarro comienza su explanación en el barrio bergarés de Mekolalde, a dos kilómetros del núcleo urbano en el punto X-547836 / Y-4777136. En la actualidad, la estación ha desaparecido y la antigua explanación ha sido sustituida por un bidegorri, si bien, parte del camino primitivo ha sido enterrado por las fábricas de nueva construcción desde el punto X-5477565 / Y-4777016 al punto X-547577 / Y-4776721.

Después de este punto la explanación se recupera como camino de servicio para algunas de las huertas que hay junto al río. En esta zona encontramos una alcantarilla (X-547361,0 / Y-4776426,0) que se conserva original, mientras que el resto que había en la zona se han reformado sustituyéndolas por hormigón.

El trazado resulta impracticable a la altura del caserío Etxebarrieta Azpikoa (X-547189 / Y-4776233), hasta el punto X-547145 / Y-4776023, junto al puente Zubizaharra y al puente Zubiberri, aunque antes encontramos los restos de un muro de contención (X-547269,5 / Y-4775728,1) de unos 150 metros sobre el que pasaba el trazado.

Así alcanzamos el núcleo de Bergara, donde el trazado se pierde al pasar entre fábricas y nuevas urbanizaciones, desde el punto X-547203 / Y-4775425 hasta llegar al barrio de San Lorenzo, en el punto X-547182 / Y-4775184, donde el ferrocarril cruzaba el río Deba mediante un largo puente (X-546794,5 / Y-4774920,6), en origen de cinco tramos y en la actualidad cegado en uno de los laterales. Salvado el río, el tren tomaba una amplia curva, con un ángulo de casi 90º, para encarrilar hacia el este, de manera paralela al cementerio, en dirección a la iglesia parroquial.

Allí giraba de nuevo adentrándose en la montaña mediante un pequeño túnel, el nº 17, cuya boca salía cerca de las casas de Katabia. Sin embargo, en la actualidad ambos accesos (X-5467580 / Y-4774459; X-547617 / Y-4774306) se encuentran cegados, lo que nos impide recorrer el trayecto, de unos 150 metros, y debemos rodear el montículo, para lo cual continuamos por el bidegorri.

El trazado continúa paralelo al río Deba, el cual vuelve a cruzar por el puente de Bergara (X-547445 / Y-4773899; X-547449 / Y-4773803) de tres tramos, para llegar al lugar en el que se encontraba la estación de Bergara, hoy en día desaparecida bajo nuevos edificios de viviendas. Una vez dejada atrás la zona en la que se levantaba el edificio de la estación de Bergara, el camino del ferrocarril supera de nuevo el río Deba por el puente de Torrekua (X-547459 / Y-4773553; X-547461 / Y-4773507), un puente que enlaza con el túnel nº 16 (X-547543,4 / Y-4773851,3).

Este pasadizo fue reformado al llevar a cabo la variante de Bergara, por lo que hoy en día es más largo que en origen, sin embargo, se ha conservado la parte antigua, con su bóveda en roca viva y restos de catenaria en la parte más alta.

La salida del túnel nº16 ha sido relativamente modificada para salvar la variante, de manera que el trazado original se pierde entre los puntos X-547562 / Y-4773453; X-547550 / Y-47743425, hasta llegar a la fábrica de Unión Cerrajera y las viviendas obreras de dicha empresa, donde la explanación primitiva, convertida en carril bici, desfila entre los pabellones y las casas. Más adelante, el trazado cruza por cuarta vez el río Deba por el puente de Unión Cerrajera (X-546954 / Y-4772657; X-546935 / Y-4772625). Esta pasarela destaca porque a su lado había otra de similares características que pertenecía a la vía privada de Unión Cerrajera, y de la cual sólo queda una zapata en el centro del río.

Cuando por fin se dejan atrás las instalaciones de la cerrajera, el trazado, que continúa convertido en bidegorri, se corta para pasar bajo la rotonda de acceso al sur de Bergara (X-546676 / Y-4772272) y llega hasta una zona (X-546653 / Y-4772144) en la que la explanación ha dejado de ser bidegorri, pero que se encuentra en un estado de conservación aceptable gracias a su uso como paseo por los vecinos del municipio. Desde este punto hasta San Prudencio, el trazado sigue su línea original, pero las alcantarillas y los pequeños puentes sobre arroyos o torrenteras han sido modificados para dar mejor servicio a la autopista que une Bergara con Vitoria – Gasteiz.

Así, al llegar a San Prudencio, el trazado del ferrocarril se pierde bajo la depuradora y las fábricas (X-545420 / Y-4770405; X-545140 / Y-4770156), mientras que la estación ha sido derribada para poder ubicar el parking y la garita del guarda. Desde este punto (X-545140 / Y-4770156) parte el ramal hacia Oñati, en dirección sureste, mientras que el ferrocarril vasco navarro cruza el río Oñati por el puente de San Prudencio (X-545502/ Y-4770171) para dirigirse a Arrasate.

El ramal de Oñati parte desde San Prudencio (X-545302/ Y-4770430) y el trazado hasta el barrio de La Fandería es practicable, gracias a que el Ayuntamiento de Oñati está convirtiendo el *itinerario del ferrocarril en bidegorri. Así, casi desde el barrio de San Prudencio la explanación ha sido cementado, lo que también ha provocado que desaparezcan alcantarillas propias del trazado. A pesar de ello, aún se conservan restos de muros de contención (X-545351,3 / Y-4769899,7) y una tajea en arco de medio punto (X-545537 / Y-4770459).*

El recorrido pasa por la zona denominada de La Fandería (X-545202/ Y-4769159), aunque en este tramo se ha perdido parte del trazado primitivo como consecuencia de la construcción de diferentes pabellones industriales. Sí se ha mantenido el puente de la Fandería (X-544647,7 / Y-4769070,9), que permite cruzar el río Oñati y dirigir el camino hacia el barrio de Zubillaga.

Sin embargo, el trazado del ramal a Oñati se encuentra perdido en su gran mayoría, sobre todo entre la Fandería y Oñati, debido a la nueva construcción de naves de fábricas, las cuales se instalaron sobre el explanación, por lo que la mayor parte del camino debe realizarse por el arcén de la carretera.

La explanación ha desaparecido en toda esta zona, permaneciendo únicamente algunos elementos significativos del ferrocarril. Por ejemplo, en Zubillaga, en Oñati, donde el trazado del ferrocarril cruzaba el núcleo de población, aún se conservan un puente sobre arroyo (X-545682,4 / Y-4768054,4), un paso en arco rebajado (X-545668,5 / Y-4768087,6) y el puente de Zubillaga (X-545463,7 / Y-4768129,4) sobre el río Oñati, adintelado con un único pilar y que todavía conserva restos metálicos y un raíl original. Y en el núcleo de La Magdalena, el ferrocarril superaba el río Oñati por el puente de la Magdalena (X-546317,2 / Y 4767208,3), aún hoy en pie.

Otro hito conservado se halla a la altura de la fábrica ULMA y del caserío Mikeleskoa, el trazado del ferrocarril cruzaba el camino por un túnel (X-546377,2 / Y-4766934,9) que, en el presente, pertenece a la fábrica y es utilizado como almacén. La explanación continuaba por las actuales instalaciones de ULMA y pasaba por delante del caserío Kastillokoa, donde salvaba un arroyo mediante un pequeño puente (X-546527,1 / Y-4766532,8) tras el cual se construyó un muro de contención (X-546529,5 / Y-4766691,5), ambos en pie en la actualidad, aunque la explanación haya desaparecido..

Pasados estos elementos, es posible retomar el trazado en el punto X-546907 / Y-4766119, en mal estado de conservación, hasta las fábricas "Construcciones Metálicas Santa Cruz" y "Cartonajes Arregui" (X-547081 / Y-4765899), bajo la cual pasaba la explanación, para desaparecer de nuevo a continuación debido a la construcción de la variante de Oñati y las fábricas de nueva construcción.

En este tramo se localizan el apeadero de San Pedro o de Torreauzo (X-546904,8 / Y-4766142,5), al cual resulta imposible acceder, dado que se encuentra dentro de un terreno vallado. Al que sí se puede llegar es al puente de San Pedro o de Torreauzo (X-546832,9 / Y-4766188,6), un paso junto al apeadero que hoy en día utiliza una fábrica anexa.

El trazado se introduce en el núcleo de Oñati (X-547422 / Y-4765242) dejando la carretera pero tomando una calle que pasa por un antiguo hangar de la estación (X-547422 / Y-4765248), hoy en día totalmente remodelado, y finaliza en la estación de Oñati (X-547714,3 / Y-4764888), ubicada junto a la Universidad y al Cuartel de la Guardia Civil. Esta estación contó en su día con edificios de aseos, almacén de mercancías y una cochera, así como con una plataforma circular para dar la vuelta a las máquinas. Estas estructuras y construcciones han desaparecido actualmente, quedando en pie únicamente el edificio principal de la estación y el pequeño hangar, ya citado, que se utiliza como almacén.

Se retoma el trazado original del Ferrocarril Vasco Navarro donde lo habíamos dejado antes de coger el ramal de Oñati, en el barrio San Prudencio. Este barrio se encuentra en el punto de unión de tres municipios; Oñati, Bergara y Arrasate/ Mondragón. Desde aquí, el trazado continúa por el puente de San Prudencio, punto que acercaba la explanación hacia Arrasate con el ramal a Oñati.

Actualmente resulta complicado retomar el camino hacia Arrasate dado que sobre el trazado primitivo se ha construido la carretera y una rotonda, por lo que es necesario cruzar de manera peligrosa (X-545032 / Y-4770053). El trazado, paralelo al río Deba en todo momento, sigue por la explanación primitivo, cruza el túnel de San Prudencio (X-544783,5 / Y-4770082), que como su propio nombre indica, parte de ese núcleo de población, cruce de caminos entre Arrasate, Bergara y Oñati y, tras el mismo aún quedan restos de muros de contención (X-544683,0 / Y-4770032; X-544529,4 / Y-4769926).

El camino continúa por el trazado original, y unos metros más adelante (X-544469,8 / Y-4769837), nos encontramos con una construcción de piedra que bien parece un muro de contención, sin embargo sabemos, por la documentación del ferrocarril, que se trata de un descargadero de balasto, el material empleado para la solera del explanación.

El camino sigue, y antes de entrar en el túnel del molino de Barrenazahar, una galería de planta curva, vemos en su boca una alcantarilla (X-544489,1 / Y-4769817) protegida por un muro combado a modo de pozo, quizás para evitar el encharcamiento del túnel. A la salida de este nos espera el puente del molino de Barrenazahar (X-544459,1 / Y-4769835), ubicado como su propio nombre indica junto a dicho molino.

Desde este lugar, el trazado, en su mayor parte, ha sido cubierto, aprovechando la explanación original para construir sobre ella un tramo de bidegorri. En este tramo el cauce del río ha sido ensanchado para evitar inundaciones, y no se ha podido determinar exactamente cuánto ha afectado esta modificación del cauce del río a la explanación original del ferrocarril.

Así continúa sobre el carril bici hasta el punto X-543537 / Y-4769361, donde la explanación cruzaba el río Deba por un puente actualmente derribado, posicionándose en la orilla este. Y desde este lugar se retoma el camino original del ferrocarril hasta la rotonda de acceso a Arrasate desde la AP-1, en el punto X-543164 / Y-4769148, donde de nuevo se pierde la explanación.

Así, el trazado del ferrocarril se adentra en Arrasate completamente desaparecido, hasta la estación de Arrasate (X-542828,4 / Y-4768503), hoy en día convertida en oficina de empleo, y en buen estado de conservación. De los tres elementos que conformaban el conjunto de edificios ferroviarios, tan sólo queda la estación, habiendo desaparecido ya los almacenes y la subestación.

Mientras recorremos longitudinalmente el municipio entre las calles que en la actualidad ocupan la antigua explanación del ferrocarril, apreciamos que la explanación cruzaba entre las instalaciones de la Unión Cerrajera e incluso contaba con una vía que se adentraba en la fábrica.

A la salida del núcleo de población, como consecuencia de la construcción de pabellones empresariales sobre el trazado original, los restos que se conservan del ferrocarril son escasos. Hay que desviarse del trazado marcado por el bidegorri para acceder a un puente sobre el Deba (X-541206,8 / Y-4767894) y unos metros después de pasar el recinto fabril de Fagor, integrado en sus instalaciones encontramos un paso que en la actualidad está cegado y es empleado como almacén de la fábrica. Cuando se abandona el polígono industrial, saliendo ya del municipio de Arrasate en dirección a Aretxabaleta, el bidegorri retoma el camino original del ferrocarril, paralelo al río Deba, muy bien habilitado en esta ocasión.

Ya en Aretxabaleta el camino ferroviario continúa por el interior del núcleo de población por una zona ajardinada en la que se han conservado restos de catenaria (X-541398 / Y-4767634). Entonces, el trazado original desaparece (X-540236 / Y-4764141) debido a la construcción de las escuelas y varias viviendas sobre el mismo. No es seguro, pero da la sensación de que el muro del bolatoki del colegio es un muro de contención del ferrocarril (X-540460,8 / Y-4765372), dado que se encuentra alineado con el trazado original.

A continuación, el antiguo explanación se adentra en una zona industrial convertido en bidegorri.

Pocos restos quedan en el municipio de Aretxabaleta, si bien aún se aprecian frente a la histórica fábrica AZBE los plataneros que daban sombra a la estación de Aretxabaleta, hoy en día desaparecida.

Una vez dejadas atrás las fábricas, el trazado original del ferrocarril es fácilmente reconocible porque, además de estar aprovechado por el carril bici, cuenta con un largo muro de contención (X-540687,9 / Y-4764305) en uno de sus laterales. El bidegorri continúa sobre la explanación original del ferrocarril hasta el cruce con la variante de Eskoriatza, donde de nuevo se pierde el trazado en el punto X-540204 / Y-4764093, poco antes de pasar por delante de la fábrica de Fagor.

En la actualidad, la variante de Eskoriatza ha aprovechado el trazado primitivo del ferrocarril vasco navarro. De esta manera el bidegorri discurre paralelo a la variante de Eskoriatza y, por ende, a la explanación. Tras dos kilómetros sobre el bidegorri, una fuerte pendiente con trazado en "S" que evidencia la pérdida del camino original, lleva hasta el túnel de Olazar o nº 13 (X-538934,7 / Y-4763119). Reabierto en 2011 cuando se habilitó el carril bici, cuenta con 160 metros y pasa por debajo del cementerio de Eskoriatza, realizando un trazado en curva.

Tras éste, el trazado obliga a cruzar bajo el paso de Dorleta (X-539295,1 / Y-4763226), realizado en arco de medio punto y sobre el cual pasa una carretera. Desde este punto se llega a la estación de Eskoriatza, la cual se encuentra integrada en el polígono industrial y reconvertida en almacén municipal y en la que termina o comienza el bidegorri que siguiendo el camino del tren une esta localidad con la vecina de Arrasate.

A la salida de Eskoriatza, el trazado reaparece (X-537750 / Y-4762430) paralelo a la carretera GI-3310 hasta el cruce con la carretera GI-3342 (X-537297 / Y-4762455) para volver a ser impracticable hasta poco antes de llegar al núcleo de población de Gaztañadui (X-536814 / Y-4762637). En este tramo ubicado a la entrada de en el barrio de Gaztañadui sólo queda un pequeño puente sobre torrentera (X-536698,6 / Y-4761950) que ha visto sustituido su tablero original por otro de moderna rejilla metálica. Pasado el puente, el trazado iba paralelo a la carretera pero se ha perdido completamente en unos metros a causa de la maleza, aunque luego vuelve a aparecer.

El camino del ferrocarril nos adentra en el núcleo donde el tren pasaba sobre el puente de Castañares (X-536770,7 / Y-4761908). Ubicado en el centro del barrio, ha perdido su tablero adintelado bajo el que pasa el río, y los terrenos por los que cruza el trazado con posterioridad son privados y por tanto, se encuentran cerrados al paso. Apenas 300 metros que han sido tragados por las zarzas y demás maleza y que hacen impracticable el camino.

Esto nos lleva a retomar el camino en el viaducto de Gaztañadui (X-536369 / Y-4761396), que cruza la carretera para de nuevo ponerse casi paralela a la misma, pero esta vez ya en dirección a Mazmela. Tras cruzarlo, la explanación no se encuentra en muy buen estado de conservación, aunque es practicable. El trazado corre paralelo a la carretera GI-627, de nuevo anegado de maleza y agua.

De esta forma nos acercamos al apeadero de Gaztañadui (X-536368 / Y-4761645) el cual ha sido notablemente modificado, pero aún mantiene tanto el andén como la rejería original que lo delimitaba. Tras este apeadero, sendos puentes, el primero (X-536851 / Y-4761526) de mayor tamaño que el segundo (X-536575 / Y-4761952), pero ambos con el tablero roto y, por tanto, impracticables. Desde este punto, la explanación sube desde el núcleo de población de Gaztañadui hasta el de Mazmela, camino en el cual nos hay un muro de contención con aliviaderos (X-536515,8 / Y-4761775) y alguna alcantarilla, que permiten que se encuentre en buen estado de conservación el trazado.

Seguimos el trazado del ferrocarril, que nos conduce perfectamente hasta la boca sur del túnel nº 12 (X-537251 / Y-4762682). Este acceso al pasadizo, aparte de encontrarse inundado, convertido en ciénaga, está en buen estado de conservación. No así el trazado, que se ha alterado justo antes de la boca del túnel, debido al relleno de la zona con materiales procedentes de las extracciones llevadas a cabo para vaciar los túneles del tren de alta velocidad.

Tras cruzar el túnel nº 12, cuya galería está bien conservada por el interior, el trazado se adentra en la montaña entre una trinchera al natural para pasar bajo el gran viaducto de la autopista.

El camino del ferrocarril conduce hasta Mazmela, tras llevar a cabo las curvas y contracurvas que el escarpado trazado se ve obligado a realizar para poder ascender desde el valle del Deba hasta la Meseta.

El trazado curvo de la explanación, que pasa por delante de la iglesia del término, se pierde al llegar al túnel nº 11 (X-535960 / Y-4762449), en la actualidad cegado en sus dos bocas. El trazado se encuentra desaparecido a lo largo de 300 metros, integrado en un terreno privado y cercado para evitar el paso al mismo. Además, la explanación se halla anegado de zarzas, hierbas y ramas de árboles que hacen complicado su recorrido hasta el punto X-536055 / Y-4762282.

Así se llega directamente hasta el apeadero de Mazmela (X-536391 / Y-4762663), cerca del cual un muro de contención (X-536316,2 / Y-4762550) soporta la presión del terreno bajo la explanación. Llama la atención que este tramo de salida de Mazmela, se encuentra paralelo al que nos introducía en el barrio, aunque a mayor cota.

Desde el apeadero de Mazmela (X-536380 / Y-4762523), el trazado se ve modificado por la aparición de viaducto de la autopista entre Vitoria – Gasteiz y Arrasate. Las zapatas y rellenos del puente han obligado a cerrar el paso natural del ferrocarril, perdiéndose este por completo, aunque sí han mantenido un paso bajo la autopista que permite enlazar con el camino ferroviario original en el punto X-536055 / Y-4762282.

Tras dos kilómetros, el trazado entra en el túnel nº 10 (X-536673 / Y-4762480), todo ello oculto por la vegetación. A pesar de ello, el túnel es fácil de cruzar y llegar a su vez al próximo túnel nº 9 (X-536960,4 / Y-4762097), dado que el terreno aún permanece explanado y las bocas de la galería están limpias de maleza. La explanación sigue su trazado dejando a su paso alcantarillas y muros de contención (X-536298 / Y-4762094), bien soportando la ladera por el lateral de la trinchera, bien aguantando la explanación por el lateral de caída, hasta llegar al barrio de Zarimutz dentro del municipio de Eskoriatza.

Lo primero que se aprecia en el trazado al llegar al barrio es la casa de obreros de Zarimutz (X-535745 / Y-4761800). Esta es un edificio a pie de vía, que en la actualidad ha sido reutilizado como vivienda de fin de semana, lo que ha permitido que se encuentre en buen estado de conservación. Tras la misma, y antes de llegar a los túneles, el trazado realiza una contracurva en la que se alternan una alcantarilla y un paso sobre arroyo (X-535838 / Y-4761831) a gran profundidad.

De esta forma el camino del ferrocarril llega al barrio de Zarimutz en Eskoriatza y, en lugar de atravesar el núcleo de población, lo rodea, si bien son necesarios dos túneles para llevar a cabo este recorrido. El primero de ellos, el túnel nº 8 (X-536157 / Y-4761545) se ubica a escasos metros del túnel nº 7 (X-535780 / Y-4761301), el cual se abre bajo una carretera que parte de la iglesia de Zarimutz, estando ambos prácticamente bajo el barrio. Los dos túneles tienen planta curva y restos de catenaria en su interior, siendo el número 8 de mayor envergadura, ya que además cuenta con un hueco de seguridad en el centro del mismo.

Una vez bordeado el núcleo de población de Zarimutz, el trazado continúa su recorrido rodeando las actuales obras del TAV, entre trincheras al natural (X-534684 / Y-4762526), a veces reforzadas con sillería irregular en las partes más bajas. Lo escarpado del terreno obliga a llevar a cabo pasos sobre arroyos (X-535043 / Y-4762253) en lo más profundo de las vaguadas del explanación, que en la actualidad bien se encuentran en mal estado de conservación, bien han desaparecido reventados por la presión del terreno.

El trazado es en todo momento en curva para rodear el valle de Zarimutz y salvar la pendiente que conduce hasta el siguiente barrio: Marín dentro del municipio de Eskoriatza. A nuestro paso localizamos restos del ferrocarril como muros de contención (X-534764,7 / Y-4761763) que soportan la explanación en el lateral que cae hacia el valle y otros que sirven para contener los terrenos que caen hacia el explanación. Todos ellos con aliviaderos y aparejados en sillería irregular.

El paso de los camiones para las obras del tren de alta velocidad, las cuales no se pierden de vista en ningún momento de este tramo, ha dado lugar al derrumbamiento de un paso que originalmente fue de arco de medio punto y que en la actualidad se encuentra semi-cegado por la maleza. Con todo, continúa el camino del ferrocarril hasta localizar una prácticamente inapreciable boca del túnel nº 6 (X-534734 / Y-4761483).

Aunque la boca de salida del túnel se encuentra prácticamente cegada por un derrumbamiento, el trazado es practicable. Tras este, dos muros de contención (X-534458 / Y-4761467; X-534462 / Y-4761427) de gran amplitud refuerzan el terreno, el cual es transitable pero con cuidado, ya que, como hemos dicho antes, las zarzas, los charcos y las ramas de los árboles se han apoderado de la explanación. Así nos acercamos a la boca norte del túnel nº 5 (X-534315 / Y-4761363), el cual se encuentra inundado en su parte inicial y ha sufrido numerosos derrumbamientos en el interior, por lo que resulta muy complicado, casi imposible cruzarlo.

Una vez atravesado el túnel, la explanación se une a la carretera, compartiendo trazado hasta llegar casi a la estación de Marín (X-534150 / Y-4761375). Esta se encuentra en un lamentable estado de conservación, si bien aún conserva los rasgos principales de este tipo de construcciones. El terreno aquí es blando, prueba de lo cual son los dos muros de contención (X-534125 / Y-4761421; X-533890 / Y-4761519) que refuerzan los laterales de la explanación tras la estación.

El recorrido, prácticamente en curva en todo momento para rodear el valle de Marín y para salvar la pendiente existente, nos conduce hasta el túnel nº 4 (X-533803 / Y-4761534). El acceso al mismo se encuentra cerrado en ambas bocas por verjas, fácilmente sorteables, colocadas en el lugar por algún aldeano para evitar que los animales entren en el interior. Este pasadizo continúa con el trazado en curva y pasa por debajo del cementerio de Marín, desembocando directamente en la parte alta del núcleo.

Queda claro que el terreno aquí es tendente a derrumbes y desprendimientos a juzgar por la gran cantidad de muros de contención que vamos encontrando a lo largo del recorrido. Llama la atención que, en apenas dos kilómetros, aparecen tres largos muros (X-533595 / Y-4761824) y una trinchera reforzada con murete, además de un interesante puente sobre arroyo (X-533527 / Y-4761799), a unos 15 metros por debajo del nivel del explanación. Este paso cuenta con un ojo en arco de medio punto peraltado y con desagües sobre el mismo, así como con muros ataludados para reforzar el terreno a sus lados. A ellos debemos añadir los drenajes y las alcantarillas que ayudan a que la tierra permanezca en su lugar al encauzar las aguas de los diferentes arroyos naturales que surgen en la montaña.

De esta manera, continuamos el trazado del ferrocarril en este punto hasta llegar al término municipal de Aramaio ya en Alava. La explanación resulta bastante compleja debido a los numerosos hundimientos del terreno que se han producido a lo largo de los últimos años en la zona. A pesar de ello, aún quedan restos como un muro de contención de mampostería al este de la explanación de unos diez metros de largo, o algunos drenajes en arco de medio punto, alguno de los cuales se encuentra enclavado en territorio de Aramaio.

También pertenece a esta localidad una larga trinchera (X-533494 / Y-4762163) de 1,5 metros de alto y unos 70 metros de largo, apareja en piedra y adaptada al terreno que se curva en esta zona. Un derrumbe de tierra (X-533241 / Y-4761604) ha provocado que la explanación no tenga continuación hacia Leintz Gatzaga en un tramo de 100 m.

Retomamos el trazado en (X-533255 / Y-4761522). El caminante se encuentra con un paso sobre un arroyo (X-533035 / Y-4761879), reforzado con muros en talud de sillarejo, y drenajes, unos adintelados y otros en arco de medio punto, además de restos de catenaria. Una vez dejados atrás estos elementos, se cruza sobre nosotros un nuevo paso en arco de medio punto (X-533255 / Y-4761000). A los lados, el paso se refuerza con una trinchera natural y un muro de sillería ataludado.

Tras caminar un kilómetro, el trazado nos conduce hasta una nueva boca de túnel, la del túnel nº 3 (X-533726 / Y-4760563). Al cruzarlo se observa a la perfección su planta en curva así como su correcto estado de conservación. A la entrada del mismo, un gran muro de contención de unos 100 metros de largo y 40 metros de caída soporta el terreno sobre el que se asienta la explanación por su lado este. El camino continúa desde el túnel nº 3, por lo que queda del explanación, con algunos tramos mejor conservados que otros pero a fin de cuentas transitables, hasta la boca norte del túnel nº 2 (X-533992 / Y-4760164). Debido a que se halla derrumbado en su interior, resulta casi imposible cruzarlo.

Se llega al túnel nº 1 (X-534334 / Y-4759951). Se trata de un túnel en curva, con restos de catenaria, pero con derrumbes interiores, lo que ha provocado que la boca norte se encuentre prácticamente cegada. Seguimos pues nuestro trayecto hacia Arlaban desde la boca sur del túnel *nº 1. En este punto (X-534522 / Y-4759532), la explanación abandonada y sin acondicionar pasa junto a un caserío. También aparecen restos de la catenaria y una alcantarilla de arco de medio punto bajo la explanación. A partir de este lugar la explanación continúa accesible para vehículos a motor llegando así hasta el pequeño núcleo de San Martín Goikoa.*

Nada más llegar al núcleo de casas, aunque sin apenas entrar en el mismo, un paso en arco rebajado (X-535041 / Y-4759448), con trinchera reforzada, permite que una carretera salve la explanación que continúa su trazado hasta el puente de San Martín (X-535009 / Y-4759306). Este cuenta en su cara sur con una trinchera al natural que en su parte final se junta con un gran muro de contención labrado en mampostería.

Llama la atención que, en toda esta parte del trayecto, se aprecian restos de cable para el sistema morse y para el teléfono, posteriores a la ejecución del ferrocarril. Dejando atrás este puente, el trazado nos conduce hasta el antiguo apeadero de San Martín (X-535056 / Y-4759265). Este consiste en una simple tejavana de uralita que en la actualidad es utilizada como caseta de los trastos de una vivienda aneja.

Desde este apeadero el camino del Vasco Navarro supera la carretera GI-3681, que une Arlaban con Leintz Gatzaga, mediante un puente de tabla recta de hormigón y un solo ojo (X-535102 / Y-4759183). En este punto la explanación ha sido convertida en camino vecinal con paso apto para vehículos a motor. A los lados del mismo aún se conservan un paso sobre torrentera (X-535199 / Y-4759072) de sillería en arco de medio punto, en la actualidad prácticamente cegado por la maleza y dos alcantarillas originales.

Tras este tramo, el trazado del ferrocarril llega a la carretera N-240, la cual cruzaba originalmente. Es en este cruce donde primitivamente se encontraba un guardabarreras (X-535129 / Y-4758222), en la actualidad desaparecido, para controlar el paso a nivel. Hoy en día, a partir de este punto la explanación se encuentra intransitable hasta el Alto de Arlabán.

En ese lugar debió alzarse la estación de Leintz Gatzaga o un cambio de vías, a juzgar por la explanada que se conserva. La explanación transcurre a una cota superior, a un metro sobre el nivel de la carretera, y cuenta con un prolongado muro de sillería regular (X-534757 / Y-4758171), a modo de contención, de unos 67 metros de largo, roto tan solo con una escalinata de seis peldaños en el centro. A 900 m del Alto de Arlabán (619 metros de altitud) se encuentra la muga entre los dos territorios Gipuzkoa y Álava, a 14 kilómetros de la capital alavesa.

A partir de este punto el trazado irá descendiendo lentamente hasta llegar al corazón de Vitoria, que se encuentra a 525 metros sobre el nivel del mar. El trazado desciende de manera acentuada pero continua por el valle del arroyo Arlabán, sumergido en el bosque mixto de hayas, robles y alisos que encierran en su seno los montes Isuskitza y Usokoaitzu, en plena Sierra de Elgea. La orografía del valle permite al trazado realizar el descenso sin grandes obras de ingeniería como los grandes muros de contención, túneles y puentes que hemos encontrado en la zona guipuzcoana que acabamos de dejar atrás.

El primer cambio visible que se aprecia en el cambio de provincia es que al entrar en Álava el trazado ha sido adecuado como Vía Verde en todo el territorio. En su mayor parte hasta llegar a la ciudad de Vitoria el trazado histórico del ferrocarril va a coincidir con el espacio habilitado como Vía Verde, por lo que los elementos estructurales originales del ferrocarril se van a mantener en buen estado o han sido restaurados para esta nueva función, pero se han perdido en las zonas en las que no coincide el nuevo trazado con el histórico, debido a las obras realizadas en algunos tramos, lo que se refleja convenientemente en los planos.

La entrada en el municipio de Arrazua Ubarrundia se realiza por una zona, que debido a la existencia de pequeñas regatas tuvieron que construirse puentes de pequeño tamaño y drenajes para dar paso al agua bajo la explanación. El primero de estos puentes (nº 140. X-533801,4 / Y-4757204,8) de pequeño tamaño lo encontramos a pocos metros de la frontera con Gipuzkoa. Se trata de un puente de arco de medio punto, que se conserva bien sin apenas alteraciones, y unos 500 metros más adelante encontramos otro de similares características, pero en este caso adintelado, y con menos luz, ya que el agua a la que tiene que dejar paso es de un volumen inferior.

Siguiendo el trazado, que en este punto va completamente recto, llegamos al tercer puente del municipio de Arrazua Ubarrundia, que se encuentra muy cubierto por la vegetación que tapa tanto el pequeño arroyo que salva como el arco del mismo. Este puente (nº 142. X-534000,4 Y-4757552,4) está más transformado que los dos anteriores, ya que el tablero del mismo y los antepechos han sido sustituidos por hormigón y una barandilla metálica.

Apenas a 150 metros de este tercer puente encontramos una alineación de postes de hormigón que unían una antigua cantera con las ruinas de un cargadero que nunca llegó a utilizarse, pero que fue construido con la idea de transportar la piedra desde la cercana cantera hasta el ferrocarril. Esta estructura de carga está oculta entre la maleza, y en estado de ruina, por lo que únicamente es visible desde la explanación gracias a la pista que aportan los restos de los postes de hormigón.

De nuevo aparece otro puente (nº 145. X-533603,8 / Y-4756844,9), de pequeño tamaño para salvar una regata con apenas agua. En este caso de se trata de un puente en arco de medio *punto, sobre el que se han realizado pocas intervenciones. En esa zona encontramos algunos restos de la infraestructura del ferrocarril, como restos metálicos con perfil en "H", incrustados en el cemento, que quedaron después del desmantelamiento de la vía. Después de estos restos el trazado se encuentra interrumpido por una carretera asfaltada que hay que atravesar para llegar a la antigua estación de Landa (nº 146 – BRS 66. X-533579,1 / Y-4756710,5).*

Esta estación se encuentra restaurada ya que actualmente es utilizada por la junta de Landa como sede social. Junto a ella se encuentra el edificio del antiguo almacén (Nº 150 – BRS 87) que está sin uso y permanece tapiado. En este espacio se han perdido algunos de los elementos originales del ferrocarril como el andén, pero se conservan las antiguas escaleras, hoy tapadas por la hierba, que daban acceso a la estación desde la zona baja.

A partir de este punto, el trazado abandona la dirección Norte-Sur para girar suavemente hacia el Oeste nada más abandonar la estación. A unos 400 metros de la estación la explanación pasa por encima de un camino vecinal, por lo que nos encontramos con un puente (nº 151 – BRS 86. X-533435,1 / Y-4756560,8), de mayor tamaño que el resto de los del municipio que habíamos encontrado hasta el momento, ya que su luz permite el paso de vehículos a motor. El antepecho del puente no se conserva y ha sido sustituido por unas barandillas metálicas que guardan la misma estética en toda la vía verde. Sin embargo la estructura del puente es la original y sin apenas cambios o transformaciones, de sillar y dos muros en talud en los extremos.

Nada más cruzar este puente, a pocos metros de él, aparece una trinchera (nº 152. X-533348,9 / Y-4756288,0) de unos 70 metros de longitud. Se encuentra excavada en la roca, y forrada con bloques irregulares de caliza en su parte baja. Las paredes de la misma son muy verticales. Nada más salir de la trinchera el trazado cambia de dirección en una amplia curva. Tomando claramente una dirección Este – Oeste.

En la nueva recta encontramos otro puente adintelado, de pequeñas dimensiones, para el paso de un pequeño arroyo, que casi podría ser considerado drenaje si no fuera porque el agua fluye continuamente bajo él. No posee antepecho y parece ser que no lo tuvo en ningún momento. Unos metros más adelante, en la misma recta, encontramos un puente de mayor entidad (nº 154. X-532897,6 / Y-4756533,9), ya que posee más luz, y es en arco de medio punto, donde el posible antepecho original ha sido sustituido por las habituales vallas metálicas. En ambos casos el tablero ha sido sustituido por hormigón.

A unos 200 metros del segundo de estos puentes, encontramos un paso sobre la vía (nº 155 – BRS 85. X-533435,1 / Y-4756560,8) para dar servicio a un camino vecinal. Se trata de un paso habitual en la línea, de sillar y arco escarzano, con trinchera escavado al natural a ambos lados.

Pasando por debajo de este camino vecinal nos acercamos al municipio de Legutiano, pero a unos 200 metros antes de entrar en él encontramos un pequeño drenaje bajo la explanación. Es adintelado, y de poca luz, que solo lleva agua bajo él en algunos momentos puntuales.

El trazado entra en el municipio de Legutiano. En este término apenas lo roza por el extremo sureste del mismo. En este recorrido de apenas 3 kilómetros antes de entrar de nuevo en Arrazua –Ubarrundia pasa junto a una estructura formada por cuatro machones de sección cuadrangular y hormigón armado que es posible que tuvieran relación con el antiguo ferrocarril, y junto a esta estructura, de la que únicamente quedan restos, encontramos un pequeño puente sobre un arroyo estacional, pero que apenas es visible por la vegetación que lo cubre por completo en los laterales, mermando considerablemente su capacidad hidráulica.

Antes de llegar al pequeño núcleo donde está la estación de Villarreal tendremos que pasar por debajo de un túnel de nueva factura, que se ha construido para que sobre él vaya una carretera. Este túnel es artificial, formado a base de cubos de prefabricado de hormigón. Después de él, a unos 200 metros encontramos de nuevo un pequeño puentecillo o alcantarilla, sobre una regata casi seca en verano y que en invierno llevará mayor caudal.

Entrando en un pequeño barrio, situado a 400 metros en dirección este desde la fábrica de Condesa S.A., encontramos el conjunto de edificios de la estación de Villarreal, entre los que destaca la estación (nº 162 – BRS 44. X-531301,7 / Y-4756581,3), el edificio de automotores (nº 163 – BRS 58. X-531116,4 / Y-4756556,1) y el muelle de mercancías.

Todos estos elementos se encuentran en mal estado, abandonados desde que la línea del Vasco – Navarro dejó de estar operativa. Eso ha provocado que los edificios se encuentren casi en estado de ruina, ya que no se han reaprovechado para ninguna otra función como muchas de las antiguas estaciones en otros puntos del trazado.

Poco después de abandonar el conjunto de la estación de Villareal, prácticamente frente a la fábrica de Condesa S.A. el trazado desaparece (X-530766,5 / Y-4756502,4) debido a las obras de la autopista y del tren de alta velocidad. Aunque el trazado que se ha propuesto para que se siga por la Vía Verde no es el definitivo, el trazado histórico no se podrá recuperar en esa parte ya que ha quedado completamente alterado por las obras realizadas en esa zona, que corresponde de nuevo al término municipal de Arrazua – Ubarrundia.

La explanación original se puede retomar poco después de atravesar de nuevo en Legutiano y estar en Arrazua - Ubarrundia, unos metros más delante del edificio que albergó la estación – apeadero de Urbina, perteneciente al término municipal de Legutiano, en el punto X-529845,4 /

Y-4754603,2. Este edificio se encuentra en las afueras del barrio de Urbina, al este del mismo. Es un edificio sencillo en comparación con las demás estaciones de la línea. Actualmente está restaurada y pertenece a la Junta Administrativa de Urbina.

Antes de salir de Legutiano, justo en la frontera con Arrazua - Ubarrundia, unos 300 metros después de la estación –apeadero de Urbina y apenas un metro antes de que la Vía Verde retome el trazado histórico del ferrocarril encontramos un pequeño paso inferior bajo la vía (nº 166 – BRS 84. X-529776,3 / Y-4754459,7), en arco de medio punto recercado de ladrillo.

En el tramo que discurre frente al barrio de Luko, donde el trazado vuelve a tomar dirección norte – sur, encontramos dos pasos bajo la vía. El primero parece ser una simple alcantarilla en arco, cubierta por la vegetación y el segundo un paso sobre un pequeño sendero, en el que se ha optado por un tablero liso de hormigón. Cruza después la zona de presunción arqueológica correspondiente al Poblado de Arzamendi. Nada más abandonarlo, dos pasos superiores cruzan el trazado separados apenas unos 100 metros el uno del otro. Son modernos, correspondientes a la AP-1.

En la misma frontera entre Arrazua - Ubarrundia y Vitoria – Gasteiz, tras dejar atrás Luko, discurre el río Santa Engracia, que es atravesado por un puente de tablero adintelado, en dos tramos, que apoya en un pilar central de sección ovalada, construido en mampuesto, mientras que el material empleado en el firme es de hormigón armado. Una vez cruzado el río, ya en el término municipal de la capital alavesa, entre las poblaciones de Miñano Mayor y Amarita, en apenas 150 metros encontramos dos pequeños puentes sobre arroyos secos, del estilo de las alcantarillas, que apenas son visibles debido a la vegetación que los cubre, y que sólo se adivinan gracias a las vallas de protección de los laterales.

A la altura de Miñano Mayor, al este del núcleo urbano encontramos otro de estos pequeños puentes o alcantarillas, que posee las mismas características que los anteriores, y que, al igual que los anteriores, apenas es visible debido a la gran cantidad de vegetación que lo cubre, lo que entre otras cosas, merma considerablemente su capacidad hidráulica.

Continuando en dirección sur, llegamos al conjunto de la estación de Retana, compuesto por el edificio de la antigua estación y el muelle de mercancías. Ambos se encuentran unos 600 metros al norte del núcleo del barrio al que daban servicio. Actualmente se han restaurado ambos edificios como vivienda particular manteniendo sus características arquitectónicas originales.

A partir de este punto el firme pasa a estar asfaltado. Una vez que hemos dejado atrás el núcleo urbano de Retana, a unos 600 metros del mismo, siguiendo en línea recta en dirección Norte – Sur, encontramos otra alcantarilla. De nuevo la vegetación la oculta casi totalmente de la vista. Siguiendo el trazado, y cada vez más cerca de la ciudad de Vitoria, a 200 metros de la alcantarilla encontramos un paso sobre la vía de un camino rural (nº 179 – BRS 1204. X-529359,4 / Y-4751099,6). Es en arco de medio punto, y la fábrica es de mampuesto.

Nada más entrar en el barrio de Durana, que pertenece al término municipal de Arrazua - Ubarrundia, encontramos un paso de agua bajo el trazado del ferrocarril. Se trata de un antiguo canal, puede que de riego o puede que para alimentar alguna turbina, y que actualmente se encuentra en muy mal estado, habiendo sido colonizado por la vegetación de la zona. Y prácticamente junto a él está la antigua estación del barrio. Esta estación de Durana (nº 182 – BRS 89. X-529099,1 / Y-4749233,0) ha sido convertida en vivienda lo que ha propiciado que se mantenga en buen estado, aunque también ha impedido que conserve su aspecto original.

A punto de abandonar el barrio de Durana para entrar de nuevo en Vitoria –Gasteiz, atravesamos una acequia de riego sobre un puente de un único tramo, de mampostería, y ya al otro lado de la muga apenas 20 metros más lejos de éste, encontramos otro paso, en este caso para un arroyo de cauce estacional, aunque apenas si se puede distinguir al estar cubierto de maleza. Un poco más adelante la explanación original ha desaparecido debido a las obras del TAV.

Se recupera el trazado histórico pocos metros después de un pequeño puente o alcantarilla con arco de medio punto recercado de ladrillo (nº184. X-529073,6 / Y-4749016,0). Avanzamos por el trazado hasta llegar al antiguo municipio de Gamarra Menor, hoy entidad de la capital alavesa.

Dejando atrás el núcleo de Gamarra Menor el trazado pasa por debajo de la N-1, a través de un paso de moderna factura realizado con grandes bloques huecos de prefabricado de hormigón. A 500 metros en dirección sur desde la población de Gamarra Menor encontramos un puente sobre el río, de tablero recto de hormigón que continúa un par de metros después en una moderna pasarela que salva una vaguada y que permite descender por un lateral. Esta nueva pasarela es de madera y hormigón armado.

Siguiendo en línea recta llegamos al último elemento antes de entrar en el núcleo urbano de Vitoria – Gasteiz. Se trata del puente de Eskalmendi (nº 192 – BRS 1201. X-528920,1 / Y-4747430,6), sobre el río Zadorra. Tiene cuatro tramos, uno de ellos en arco de medio punto y los demás adintelados. Era en origen metálico, habiendo sido sustituido este material por el hormigón después de la Guerra Civil Española. A partir de ese momento el trazado histórico desaparece ya que comienza en el barrio de Gamarra el centro urbano de la capital.

En Vitoria el trazado se ha conservado únicamente en algunos tramos como bidegorri, pero en muchos tramos se ha edificado sobre el mismo, y se ha modificado la trama urbana por lo que no se puede reproducir el trazado histórico. La desaparecida estación de Vitoria era la estación principal y sede de la compañía, en ella estaba sus oficinas. Era un edificio de dos pisos con una marquesina que cubría los andenes.

Entre 1920 y 1927 se construyen los 69 kilómetros de la línea de Vitoria a Estella que es la que comienza en este momento. Este tramo poco tiene que ver con la línea a Bergara ya que para su construcción el ingeniero encargado del proyecto, Alejandro Mendizabal Peña, realizó un nuevo estudio que modificó significativamente el inicial realizado por Joaquín Herrán y su tío Juan José.

En sus 69 km esta línea atraviesa dos comarcas alavesas, La Llanada y la Montaña, y una navarra, Tierra Estella. Hasta el Túnel de Laminoria, que posee la boca Oeste en el municipio de San Millán / Donemiliaga y la boca Este en el término de municipal de Arraia – Maestu. Esta dirección marcadamente Oeste – Este va a cambiar una vez que el tren penetra en la comarca de la Montaña Alavesa, pasando a tomar una dirección más marcadamente Norte – Sur.

Desde la estación de Vitoria, el antiguo Ferrocarril Vasco Navarro se dirigía a Estella atravesado la parte sur del casco urbano de la capital alavesa. Sin embargo, el crecimiento urbano ha condenado al antiguo trazado y ha postergado el comienzo del tramo habilitado como Vía Verde de Vitoria - Gasteiz a Estella al kilómetro 2,7 de la carretera al cementerio El Salvador y Otazu.

El trazado histórico se recupera en los límites de Vitoria – Gasteiz en el barrio de Oreitiasolo. Es una zona industrial en la que se ubican restos del antiguo ferrocarril junto a otros elementos del patrimonio industrial de Vitoria. En este punto encontramos el depósito de automotores de Olarizu (nº 132 – BRS 511. X-528619,7 / Y-4742103,4), que es el único elemento que se conserva del recinto de la desaparecida estación de Olarizu. Pasado este punto llegado a un pequeño puente sobre un arroyo, en arco escarzano de mampostería y unos metros más adelante un paso sobre la vía de características similares.

En todo este tramo se conservan algunos tramos de la explanación, pero en muy malas condiciones, ya que en esta zona no se ha habilitado como vía verde. Algunos tramos, los más cercanos a la ciudad aparecen en una zona de descampados, mientras que según nos alejamos del centro urbano, y antes de enlazar con el tramo habilitado como vía verde el trazado histórico ha sido asfaltado y convertido en carretera. Nada más comenzar la vía verde sobre el trazado del ferrocarril en el barrio de Otazu en el municipio de Vitoria - Gasteiz, encontramos un puente de tablero liso de hormigón, dejando un paso bajo él.

Una vez comenzado el recorrido por el trazado ya adaptado como vía verde, y siguiendo la dirección Oeste – Este, encontramos a las afueras de Otazu, a unos escasos 300 metros del núcleo urbano un pequeño puente sobre un arroyo que hoy en día está anulado. Para cruzar esta regata y la carretera que va paralela a él hay una nueva pasarela, de moderna factura que se encuentra situada sobre el pequeño puente del trazado original. Al cruzar nos encontramos con la estación de Otazu (nº 126 – BRS 512. X-530803,6 / Y-4742161,1), construida originalmente como apeadero y que hoy está rehabilitada como albergue.

Siguiendo el trazado, entre las poblaciones de Otazu y Aberasturi, 1,2 kilómetros al este de la primera encontramos el Pontón de Otazu, que servía a la vez de paso inferior y puente sobre un pequeño arroyo. Se trata de un sencillo puente de medio arco con refuerzos laterales, y el intradós reforzado con hormigón en masa. Y llegando ya al barrio de Aberasturi de la capital alavesa, antes de entrar en el núcleo del mismo encontramos otro pontón, sobre el arroyo Aberasturi (nº 124 – BRS 1197. X-533025,2 / Y-4742088,6), de características similares, pero sin muros de refuerzo en este caso.

Ya en el núcleo de Aberasturi, aunque a las afueras del mismo, encontramos la antigua estación de ferrocarril (nº122 – BRS 513. X-533247,0 / Y-4742064,4) del mismo, rehabilitada como vivienda particular y que ha sido restaurada siguiendo sus características arquitectónicas originales. También se conserva en este punto el andén correspondiente a esta estación, pasando la explanación entre ambos elementos.

Una gran trinchera taja las laderas del monte Arrezabala, en una de las implacables rectas que caracterizan a este tramo del ferrocarril por La Llanada. A la salida de la trinchera, sobre un alto terraplén, se ve el santuario de Estíbaliz.

Cruzado el alto terraplén la vía se interna en un frondoso quejigal. Entre el barrio de Aberasturi y el de Andollu apenas hay elementos originales del trazado, yendo la explanación recta únicamente encontramos un sencillo puente de mampostería y arco escarzano sobre un arroyo a medio camino entre ambos barrios.

A las afueras del barrio de Andollu, en el cruce con la carretera Vitoria - Estella se alza la antigua estación (nº 119 – BRS 515. X-535329,8 / Y-4742224,7). Antes de la construcción del ramal de la vía que llega hasta el santuario de Nuestra Señora de Estíbaliz, esta estación se conocía como la estación de Andollu, pasando a denominarse posteriormente estación de Estíbaliz.

Junto a la estación encontramos un paso subterráneo para cruzar la carretera. Este paso subterráneo es moderno, ya que el ferrocarril cruzaba a nivel estando protegido este punto con *barreras de pértiga, pero no se conserva ningún resto de este elemento.*

Al otro lado de la carretera encontramos el puente sobre el arroyo de Zerio (nº 117 – BRS. 1196. X-535551,9 / Y-4742290,7), sobre el arroyo de Marinaldea, en arco de medio punto. Justo después de este puente encontramos la bifurcación del trazado. El ramal principal que continúa hacia Estella, siguiendo dirección Sureste, mientras que el ramal que se dirige al Santuario de Estíbaliz lo hace en dirección Norte. Ambos ramales se encuentran separados en punto de la bifurcación por un muro de contención que marca el desnivel entre ambas explanaciones.

El ramal de Estíbaliz realiza una gran curva para realizar el ascenso de manera suave. Destacamos tres elementos; a 200 metros de la población de Andollu encontramos un pequeño puente en arco, que se encuentra cubierto por la vegetación. A dos kilómetros del comienzo del ramal encontramos un paso superior de tablero recto (nº 115 – BRS 1195. X-535657,1 / Y-4743818,9), con dos pilares centrales de sección rectangular y sillares regulares.

El término del ramal a Estíbaliz fue concebido como un simple apeadero (nº 113 –BRS 514. X-535200,7 / Y-4744087,5) en fondo de saco, en el que llama poderosamente la atención la elegante arquería que, al tiempo de servir de soporte al talud, daba cobijo a los viajeros que esperaban los trenes. Una corta escalera conecta los andenes de la estación con el gran aparcamiento del santuario, donde otra escalera, bastante más larga, nos acerca a la entrada de la iglesia.

El ramal principal, sale del término municipal de Vitoria Gasteiz y entra en el municipio de Iruraiz – Gauna. Al sur de la entidad de Trokoniz, en el municipio de Iruraiz – Gauna, al pie de la vía verde y dentro del casco urbano encontramos la antigua estación (nº 108 – BRS 25. X-536564,3 - Y-4741834,3) que es actualmente una vivienda, y la explanación original del ferrocarril entre el punto X-539000/ Y-4740783,0 y el punto X-539043,0 – Y-4740792,0 se ha destinado a jardín, por lo que existe un camino alternativo, paralelo al original situado unos 10 metros al norte.

Salimos de la entidad de Trokoniz y a 600 metros de él, ya en el municipio de Elburgo/Burgelu llegamos al túnel de Trokoniz (nº 110 – BRS 43. X-537019,8 / Y-4741514,5), que ha sido restaurado recientemente. Es un túnel abierto en un terreno de poca consistencia por lo que necesitó bóveda de hormigón y estribos de mampostería, y se encuentra entre dos tramos de trinchera. Pasando los 159 metros de túnel continuamos el camino y entre las poblaciones de Tronkoniz y Erentxun, a dos kilómetros de la primera, está el paso de San Juan (nº 111 –BRS 44. X-537634,7 / Y-4741112,0), en arco de medio punto y con un fuerte estribo en el lateral.

Siguiendo en dirección a Erentxun, 1,3 kilómetros antes de llegar allí, ya en el término municipal de Alegria – Dulantzi, el trazado pasa por encima del camino de Egileta, para lo que posee un paso (nº 107 – BRS 63. X-537847,0 / Y-4741053,8) en arco de medio punto que se ha restaurado recientemente, y que no se parece al original que era en arco escarzano.

Nuevamente en el término municipal de Iruraiz – Gauna, poco antes de llegar al barrio de Erentxun, pasamos por una trinchera de unos 50 metros de larga que se encuentra forrada con grandes bloques de mampostería. En el casco de Erentxun se conservan el muelle de mercancías (nº 103- BRS 24. X-539180,1 / Y-4740819,6) y la antigua estación (nº 104 – BRS 23. X-539180,1 / Y-4740819,6), ambos en estado de ruina.

Salimos de Erentxun en dirección Este y a 700 metros encontramos un paso sobre la vía, en arco escarzano, de mampostería reforzado con hormigón que ancla en tierra. Siguiendo el camino y en territorio de Alegría – Dulantzi, a 1,2 kilómetros del núcleo de Erentxun encontramos otro paso de un camino rural, en este caso bajo la vía, en arco de medio punto, e inmediatamente después volvemos a entrar en Iruraiz – Gauna.

Poco después del barrio de Gauna, a 1 kilómetro de donde se encontraba una estación hoy en día desaparecida, ya que fue derribada poco después de cerrarse la línea, encontramos un paso sobre la vía, después el trazado gira en dirección sureste y a unos 3 kilómetros de distancia hay otro paso superior de similares características. Siguiendo en esta dirección sureste, a 200 metros de este último paso sobre la vía pasamos sobre un arroyo estacional con un puente de arco de medio punto y sillar.

Unos metros más adelante una balsa ha invadido el trazado original, y ofreciendo un camino alternativo apenas 10 metros más al norte. La explanación original desaparece bajo las aguas de la balsa de riego desde el punto X-542090,0 / Y-4740266,0 hasta el punto X-542198,0 / Y-4740146,0.

El paisaje se va haciendo cada vez más boscoso, y encontramos una zona de trincheras excavadas al natural en toda esta zona. Y a 3,5 kilómetros de Erentxun en el término municipal de San Millán/Donemiliaga, 300 metros más adelante del último puente, en un espacio con una fuerte trinchera, nos encontramos con otro paso superior (nº 97 – BRS 149. X-542605,1 / Y-4740008,7) de mampostería, el Paso de Adana, que ancla sobre las laderas de la trinchera.

Volvemos a entrar en el municipio de Iruraiz – Gauna, un kilómetro al noroeste de los núcleos de Jauregi y Ullibarri – Jauregi el conjunto de la estación de Ullibarri – Jauregi, de la que únicamente se conserva el andén (nº 95. X-543447,3 / Y-4739626,3) y la subestación de transformación de Rotalde (nº 94 – BRS 59. X-543447,3 / Y-4739626,5), que está vacante.

Antes de abandonar definitivamente el municipio de Iruraiz – Gauna, a 5 kilómetros de distancia de la población de Erentxun en dirección sureste, a la altura de Ulibarri – Jauregi, pasamos bajo el paso del camino de Txintxetru (nº 93 – BRS 71. X-543816,3 / Y-4739592,2), construido para el paso del ganado. Y cruzando la muga y entrar de nuevo en término municipal de San Millán / Donemiliaga, tras pasar la población de Ullibarri – Jauregi, cruzamos sobre el camino de Santa Isabel (nº 92 –BRS 148. X-544256,3 / Y-4739590,0), que más que un paso, bien podría constituir un túnel, ya que alcanza grandes dimensiones, al comprender el cauce del río y la calzada del camino carretero que conducía a las antiguas canteras de caliza.

Después del paso inferior del camino de Santa Isabel la explanación en el camino gira hacia el sur, y a menos de 100 metros de éste encontramos un gran muro de contención, de unos 50 metros de largo, y otro un poco más corto unos metros más adelante. A 200 metros de comenzar la subida hacia el túnel de Laminoria hay otro paso sobre la vía, y 100 metros después, cercano a una balsa de riego agrícola, está el túnel de Huecomadura (nº 85 – BRS 146. X-544587,9 / Y-4738579,8), que es un túnel artificial de 73 metros y medio, y nada más salir del túnel encontramos un muro de contención y algunos restos de soporte de la catenaria. 30 metros después, siguiendo en la misma dirección Sur, pasamos sobre el camino del puerto de Gereñu.

Ya en la zona del túnel de Laminoria, en el lado de San Millán / Donemiliaga, están las ruinas de la casa del túnel (nº 83 –BRS 144. X-544529,1 / Y-4738255,8) que fue utilizada durante las obras del túnel como oficina de dirección y alojamiento de empleados y más adelante se habilitó como edificio de brigadas. Unos metros más adelante, precedido por una trinchera encontramos la entrada del túnel de Laminoria.

El túnel de Laminoria es sin duda, con sus 2.250 m de longitud, la obra más emblemática del Ferrocarril Vasco Navarro. Pasa bajo el puerto de Ullibarri, collado que separa los Montes de Vitoria de los Montes de Iturrieta, conectando la Llanada Alavesa con el valle de Laminoria y la cabecera del Ega, territorio inscrito en la comarca de La Montaña Alavesa.

El túnel se encuentra cerrado debido a los derrumbes que ha sufrido a causa de las balsas de la cantera de Laminoria y al hecho de que utilizara como tubería en los años 80 y principios de los 90, haya sufrido varios derrumbes. En el año 1998 se realizó por encargo del Departamento de Medio Ambiente de la Diputación Foral de Álava un estudio para rehabilitarlo y abrirlo al paso, opción que se desestimó por su elevado coste. Ya en el año 2008 se intentó de nuevo pasar a través del túnel, pero en esta ocasión los derrumbes habían sido mayores y ya no se pudo.

*Por ello, para cruzar al otro lado hay habilitada una ruta alternativa, que permite retomar el trazado el ferrocarril ya en la comarca de Montaña Alavesa. La alternativa es un camino montañero que, unos 600 metros antes del túnel de Laminoria se desvía del trazado del ferrocarril y sobrepasa el puerto de Gereñu para entrar en el municipio de Arraia – Maeztu por la carretera de Musitu hasta **la** ermita de Santo Toribio, sita en el kilómetro 28,6 de la carretera Maeztu-Musitu**,** donde una rampa nos permite acceder de nuevo al trazado original del ferrocarril a 1,4 km más allá de la boca sur del túnel de Laminoria.*

Desde la boca sur del túnel de Laminoria, hasta el punto en el que comienza la vía verde, junto a la ermita de Santo Toribio, hay dos pasos superiores, correspondientes a dos caminos rurales. Ambos en arco escarzano y que anclan en tierra, situados a 500 y 100 metros respectivamente del punto de enlace de la vía verde con el trazado histórico. Este tramo se encuentra en buenas condiciones, pero al no ser transitado, la vegetación tiende a cubrir la explanación.

A partir de este punto hay una gran tubería que corre paralela al camino, y que corresponde a un trasvase de aguas del río Ega al río Zadorra durante la sequía del otoño de 1990 y que actualmente es un elemento degradante sin ninguna utilidad. La tubería llegaba hasta la boca sur del túnel, que se inundaba completamente, saliendo el agua por la boca norte para abastecer al ayuntamiento de Alegria – Dulantzi en un primer momento y para trasvasar el agua al río Zadorra posteriormente.

A tan solo 60 metros del cruce del camino con la carretera de Alecha, encontramos otro paso superior similar a los anteriores. En este caso se trata del correspondiente al camino de Cicujano (nº 14 – BRS 145. X-545737,6 / Y-4733993,3), que se encuentra entre dos tramos de trinchera al natural. En esta trinchera, en el lado derecho hay un tramo forrado con sillarejo irregular, con las piedras muy bien trabadas, y en el lado izquierdo es posible que existiera un muro de contención similar, pero ha sido desmochado.

Hay en esta zona, así mismo, algunos restos de los postes de la catenaria y dos drenajes, con un desagüe de un metro aproximadamente en su punto más alto y 1,10 metros de largo que en el interior poseen un muro en talud. Estos drenajes que cruzan bajo la explanación son de mampostería.

Llegamos después a la Estación de Cicujano (nº 17 –BRS 144. X-545778,3 / Y-4733728,5), situada frente a la población del mismo nombre. Se trata de un antiguo apeadero que se encuentra en excelente estado de conservación. El edificio fue comprado en su momento a FEVE por el ayuntamiento de Arraia – Maeztu y posteriormente vendido a particulares bajo el compromiso de mantener sus características arquitectónicas. A 100 m al sur de esta construcción se encuentra el túnel de Leorza (nº 19 – BRS 143. X-545752,3 / Y-4733667,1), precedido de una trinchera reforzada con sillar. Es un túnel de 336,30 metros que ha sido parcialmente restaurado *para ser transitado en la actualidad.*

Siguiendo en dirección sur pasamos sobre el paso inferior de Aletxa, que se encuentra en el cruce entre el trazado del ferrocarril con la carretera A-4145 que lleva a Aletxa, frente a la población de Leortza. Es un paso corriente, realizado en sillarejo, con una luz de 4 metros.

Una pasarela sobre la carretera a Cicujano y un pontón sobre el río Berrón permiten la entrada a ***Maeztu*** *en el punto kilométrico 27,6 del Ferrocarril desde Vitoria - Gasteiz. Esta pasarela moderna es la que sustituye el tramo desaparecido del Paso del Molino de Maestu. Originalmente tenía tres arcos, de los que únicamente queda uno en el extremo más cercano al núcleo de Maestu. Los otros dos arcos desaparecieron con la construcción de la carretera A-3114 sobre la que pasa.*

El trazado del ferrocarril perfila el casco urbano por su costado izquierdo, y pasa sobre el Pontón de Maestu (nº 24 – BRS 140. X-545348,8 / Y-4732467,3) que cruza sobre el arroyo Berrón en el interior de la población. Al poco el firme de tierra da paso al asfalto y un carril bici se prolonga hasta la gran estación de Maeztu (nº 25 – BRS 41. X-545609,9 / Y-4732146,3), hoy convertida en Casa Consistorial.

Saliendo de Maestu en dirección a Atauri el carril bici da paso de nuevo a un firme de tierra que, otra vez acompañado del tubo metálico y emparejado a la carretera, atraviesa el puente de Peñasalada (nº 26 – BRS 139. X-546119,4 / Y-4732052,1) sobre el curso del Berrón-Ega y otro segundo puente sobre el canal de las Ferrerías (nº 27 – BRS 138. X-546200,3 / Y-4732072,8). El primero de ellos adintelados, de dos tramos con un apoyo central en un pilar de sección ovalada, y el segundo en arco escarzano.

*En este punto la antigua vía del ferrocarril se curva a la derecha, posicionándose al pie de la Peña las Cinco***,** *sita en el imponente monte Arboro***.** *Una profunda trinchera taja la falda de esta quebrada, abriéndose al otro extremo la zona recreativa de Zumalde, en el punto kilométrico 29,1 desde Vitoria – Gasteiz. Poco antes de las piscinas de Maestu se encuentra el paso superior del camino de Sabando (nº 28 –BRS 137. X-546395,8 / Y-4732020,8), flanqueado por una profunda trinchera reforzada con sillar bien escuadrado y a 500 metros de él, llegamos al cruce de la Vía Verde con la A-132.*

Tras el área recreativa de Zumalde la traza original del ferrocarril fue ocupada por la remodelada carretera Vitoria – Estella en el punto X-546405,0 / Y-4731658,0. La ruta se ha visto obligada a desligarse del ferrocarril y a buscar una alternativa.

El trazado original desaparece bajo el asfalto de la carretera general, mientras que para continuar a pie existe una pasarela que cruza la carretera y el río, de modo que se continúa más o menos en paralelo al trazado original, pero al otro lado de la carretera y del río Berrón. En todo este tramo, los momentos en que el trazado original no se ha convertido en parte de la carretera nacional, discurre por la ladera de la montaña, pero impracticable por la maleza y los derrumbes del terreno.

El trazado histórico se recupera a 400 metros en dirección noroeste desde Atauri, en el punto X-546753,0 / Y-4731101,0, en el viaducto que servía de paso sobre el río Ega-Berrón y la carretera general. Este viaducto de Atauri (nº 32 - BRS 77. X-546792,8 / Y-4731023,6) se encuentra en el punto kilométrico 30,2 desde Vitoria – Gasteiz. Ha perdido el tramo que cruzaba sobre la carretera, pero sobre el río está en buenas condiciones y se ha habilitado como zona de descanso.

Para llegar a la explanación desde la ruta alternativa hay que subir por una rampa los 8,5 metros que la separan del nivel del río. Junto al viaducto está una de las dos presas que abastecen de agua a la Central Hidroeléctrica de Antoñana, y desde ese punto comienza un canal que acompañará al trazado en un buen tramo.

A 50 metros del viaducto de Atauri, se encuentra el túnel de Atauri (nº 33 – BRS 136. X-546823,2 / Y-4731061,1), que atraviesa por debajo parte del barrio. Es un túnel de 362,20 metros de longitud con unas estibaciones robustas y gran espesor en los estribos y la bóveda para impedir desprendimientos. Se ha restaurado en 2011 para que se pueda utilizar en el itinerario de la vía verde. Siguiendo en dirección Estella cruzamos el canal de la C.H. de Antoñana a unos 200 metros de la población de Atauri, sobre un pequeño puente de arco (nº34 – BRS 135. X-547011,0 - Y-4730683,7).

A un kilómetro de distancia en dirección sur de la localidad de Atauri, a 100 metros del cruce de recorrido del ferrocarril con la A-132, encontramos la Estación de Atauri (nº 36 – BRS 43. X-547065,5 – Y-4730053,5). Se trata de un edificio en estado de ruina, para el que existe un plan de rehabilitación. Junto a la estación y a una cota superior, se encuentra la Fábrica de Asfaltos de Atauri (BRS 49).

Desde la estación la carretera invade nuevamente la traza de ferrocarril, por eso la ruta vuelve a tomar una alternativa. Continuamos en dirección sur y en el punto kilométrico 33,3 desde Vitoria – Gasteiz reaparece el trazado histórico, una vez atravesada la carretera sobre una pasarela metálica. De modo que la explanación original ha desaparecido entre el punto X-547107,0 / Y-4730027,0 en término municipal de Arraia – Maeztu Y-el punto X-547632,0 / Y-4729140,0 en *término municipal de Campezo / Kanpezu.*

Tras 700 metros, más adelante del punto de unión entre la explanación original y la actual Vía Verde, encontramos el Puente de San Saturnino (nº 40 – BRS 99. X-547969,7 / Y-4728604,2), a 3,2 kilómetros de Atauri, sobre las aguas del río Berrón. Es un puente de tablero recto, de dos tramos de 8 metros sobre el río, con un pilar central de sillar, y los estribos construidos con cajones de hormigón armado. Inmediatamente después llegamos al túnel de la Fuenfría (nº 42 – BRS 98. X-548207,4 / Y-4728460,3), *una pequeña galería artificial construida para evitar los derrumbes de la inestable ladera y que se encuentra precedida por una trinchera reforzada con sillar.*

A la salida del túnel encaramos una recta de 2 km, en la que pasaremos sobre el camino de Corres a 1,2 kilómetros al noroeste de Antoñana, sobre el pontón de la acequia del molino a 800 metros al noroeste de Antoñana y junto a este el puente del río Berrón – Antoñana. Todos ellos de arco de medio punto y sillar bien trabajado. Esta larga recta finaliza a los pies de las murallas de Antoñana, en el punto kilométrico 36 desde Vitoria – Gasteiz.

Originalmente un paso a nivel cruzaba la A-132 en este punto, pero actualmente se ha levantado una gran pasarela que permite el cruce sin peligro hasta alcanzar los vagones de ferrocarril ahora reutilizados como punto de información de la vía verde del FC Vasco Navarro y la Montaña Alavesa, que se encuentra situados junto al muelle de mercancías de Antoñana (nº 50 – BRS 43-1. X-549397,0 / Y-4727045,2), al sudeste del núcleo. En este punto el tramo de explanación original que se ha perdido es el comprendido entre el punto al Oeste X-549363,0 / Y-4727189,0 y el punto al Este X-549378,0 / Y-4727111,0.

Unos metros más adelante se encuentran la estación de Antoñana (nº 49 – BRS 43. X-549408,6 / Y-4726990,8) y su subestación eléctrica (nº 51 – BRS 44. X-549408,6 / Y-4726990,8). Ambas reconvertidas en viviendas particulares. El trazado original pasaba entre ambas construcciones y después junto a la Fábrica de Asfaltos. Actualmente este tramo no está habilitado, y hay una ruta alternativa, pero aunque cubierta por la maleza, la explanación original continúa unos cuantos metros más antes de desaparecer por completo.

En este tramo de la explanación original, a 600 metros de la estación de Antoñana encontramos el paso superior del camino de Corres (nº 54 – BRS 93. X-549618,5 / Y-4726460,2), en arco escarzano que apoya sobre la trinchera que cruza. A partir de este punto el recorrido original del ferrocarril se pierde y hay que tomar el desvío alternativo. Recuperamos el trazado histórico poco antes de un pequeño puente (nº 56. X-549689,3 / Y-4726298,8) sobre un arroyo estacional que se ubica a 800 metros de la población de Antoñana en dirección sudeste.

Siguiendo en esta dirección, a 1,7 kilómetros de Antoñana, en un punto donde en recorrido atraviesa una profunda trinchera excavada al natural, el trazado es atravesado por un paso superior (nº 59 – BRS 92. X-550002,0 / Y-4725466,5) correspondiente al camino de Bujanda, localidad del municipio de Campezo / Kanpezu. Es un paso realizado mediante arco de hormigón en masa y sólidamente apoyado en sus arranques.

300 metros más adelante, en la misma dirección sudeste, llegamos hasta el Viaducto de Santa Cristina (nº 60 – BRS 91. X-550123,2 / Y-4725295,9), que cruza el río Ega. Es una gran obra de cinco arcos de 5,5 metros de luz, con una longitud total de 83,2 metros, y una distancia al lecho del río de 10,4 metros.

Continuando el camino sobre la explanación original, 200 metros después de haber atravesado el río por el viaducto de Santa Cristina, está el paso superior del camino de Bujanda (nº 61 – BRS 90. X-550244,8 / Y-4725237,8). A partir de este punto el trazado deja de llevar una dirección sudeste para ser ya claramente Este, hasta la frontera con Navarra; 400 metros más adelante la explanación pasa por encima de una regata seca con un pequeño y sencillo puente en arco de medio punto. Junto a él, unos metros más adelante llegamos al puente de Tarifa (nº 64 – BRS 89. X-550771,0 / Y-4725275,3), que atraviesa el río Ega, de dos tramos rectos con pilar central ochavado.

En este punto el río Ega posee una presa recta, ligeramente perpendicular al río, de talud recto al interior, de la que parte un canal y un desagüe que cruza por debajo del trazado. Se trata de una presa construida con posterioridad al ferrocarril y que sirve al sistema de riego de los campos cercanos.

Después de este punto el trazado cruza la carretera. Originalmente lo hacía a nivel, con un paso protegido por barreras de pértiga, pero en la actualidad hay una pasarela que permite a los peatones cruzar sin riesgo y llegar a las afueras de la población de Santa Cruz de Campezo, donde a unos 300 metros de la misma atravesamos el río Ega por el puente de Santa Cruz (nº 68 – BRS 88. X-552855,5 / Y-4724927,5), formado por dos tramos de 8 metros de hormigón armado y alcantarilla de 3 metros y cimentación india, y 50 metros más adelante se salva una vaguada con un puente de arco de mampostería con refuerzos de hormigón.

A partir de este punto se ha ampliado un campo de trigo sobre la explanación del ferrocarril y hay un camino alternativo junto él, y a unos 200 metros en dirección este desde el cruce entre la A-2128 Y-la A-132, al norte del núcleo urbano de Santa Cruz de Campezo, paralelo a la carretera por la que discurre el camino alternativo, y apenas visible hay un puente (nº 71. X-553760,5 / Y-4725115,1) de doble arco para salvar el arroyo de Rosalía.

A unos 50 metros de este arroyo está ubicado el Depósito de Automotores Eléctricos de Campezo (nº 72 – BRS 87. X-553919,6 / Y-4725181,6) rehabilitado como vivienda particular, que es el único edificio del gran complejo del FF.CC. Vasco – Navarro en Santa Cruz de Campezo, que estaba compuesto por el citado Depósito de Automotores, la estación, las cocheras y el muelle de mercancías.

En el espacio que ocupaban estos edificios se ha levantado una urbanización de chalets adosados, por lo que el trazado histórico ha desaparecido en ese tramo bajo las nuevas viviendas desde el Oeste en el punto X-554017,0 / Y-4725196,0 al punto al Este X-554252,0 / Y-4725291,0, pero se ha habilitado un camino lateral alternativo a apenas 10 metros de distancia del que recorría el ferrocarril, y que enlaza con el trazado original una vez pasada la nueva urbanización (X-554236,1 / Y-4725203,5).

Siguiendo en dirección Este, a 50 metros desde el cruce del ferrocarril con la carretera a Orbiso cruzamos por encima del cauce del arroyo de Orbiso (X-555143,7 / Y-4725663,5). Es un puente construido con un tramo de 8 metros en hormigón armado y estribos de mampuesto. Y un kilómetro más adelante llegamos al llamado Paso de la Muga (nº 77 –BRS 86. X-556098,4 / Y-4726062,2), ya que marca la frontera entre Álava y Navarra, y encima del cual discurre el camino de Horradicho a Orbiso, que ha sido conocido por los habitantes de la zona como "El Confín".

Este paso salva una trinchera fuertemente reforzada con mampuesto, y constituye el final del trazado del ferrocarril Vasco- Navarro dentro de Euskadi.

A partir de este punto, y ya dentro de la Comunidad Foral de Navarra, el tren llegaba hasta Estella, destino final de esta línea."

2.2.2. Information panels along the Vasco-Navarro Greenway. Provincial Council of Araba/Álava (María Larrañeta)

EXAMPLES OF SOME DISSAPEARED ELEMENTS

LP5

HEGO EUSKAL HERRIKO TRENA
FERROCARRIL VASCO-NAVARRO

Laminoriako Geltokia
Estación de Laminoria

Estación de Laminoria

Apeadero de Laminoria y boca de entrada del túnel. (De la divisoria). M.A.M.-26.[1]

Libro de Javier Aranguren sobre automotores.

Vista general de la estación de Laminoria. (M. G. de A. M. 1920-1931)[2].

LAMINORIAKO GELTOKIA

Maestu eta Ulibarri-Jauregi artean erdiguneko bidegurutze bat sortzea zuen helburu, elkarrengandik oso urruti baitzeuden, eta, bestalde, Laminoriako banalerroaren tunel handia eraikiko zuten langileak hartzea edo instalatzea. Eraikinak mendi-etxea zirudien: teilatu-isurki zabalak, inklinazio handia eta arkupe babesgarriak kasik etxe inguru guztian. Beheko solairuan, arduradunaren bulegoa zegoen, baita jendearentzako ataria, egongela dotorea eta bainugela ere. Atzealdean, hotzaren babesean, arkupe egoki bat zegoen geltokira urreratzen zirenen zaldiak gordetzeko. Eraikinak neurri bereko hiru etxebizitza zeuzkan: lehena, nasa baino altuxeago, eta, beste biak, goiko solairuan, sukalde, hiru logela eta bainugelarekin. Kanpoaldean, bi trenbide zeuden ohiko garraiorako, eta, hirugarrenak, bat egiten zuen nasarekin. Eraikuntza-lanak 40.615,59 pezeta kostatu ziren.

ESTACIÓN DE LAMINORIA

Su objetivo era el de ofrecer un punto de cruce intermedio entre Maestu y Ullívarri-Jáuregui, excesivamente distanciados, y la necesidad de instalar obreros que trabajarían en la construcción del gran túnel de la divisoria de Laminoria . El edificio contaba con gran sabor montañés; extensos faldones de tejado, mucha inclinación y porche en casi todo el alrededor de la casa que la arropaba. En la planta baja se encontraba el despacho del jefe, el vestíbulo para el público, una buena sala de espera y baño. En la parte posterior, al abrigo de los fríos existía un buen porche para guardar las caballerías de quienes acudían a la estación. Esta edificación contaba con tres viviendas de igual tamaño; una a pequeña altura de los andenes y dos en el piso alto que contaban con cocina, tres dormitorios y baño. En el exterior, dos vías se dedicaban a la circulación ordinaria y una tercera en fondo de saco conectaba con el muelle. El coste de la edificación fue de 40.615,59 pesetas.

Reproducción de planos originales

[1] Memoria Alejandro Mendizábal
[2] Memoria General de Alejandro Mendizábal

Reproducción de planos originales

Arabako Foru Aldundia
Ingurumen Saila
Diputación Foral de Alava
Departamento de Medio Ambiente

2.2.3. Data sheets of the heritage catalogues of the urban plans of Navarre

MUNICIPAL DEVELOPMENT PLAN OF MURIETA, 1996

CATALOGO DE EDIFICIOS DE INTERES

Departamento de Medio Ambiente, Ordenación del Territorio y Vivienda

2 4 MAYO 1996
VIGENTE DESDE
ESTA FECHA

LOCALIDAD - DIRECCION: MURIETA - Diseminado nº52
FICHA DE INVENTARIO - REFERENCIA CATASTRAL: 261 - M531/P334
INCLUIDA EN EL INVENTARIO URBANISTICO DE PRINCIPE DE VIANA: NO

GRUPO DE CATALOGACION
.: ESTRUCTURAL

ELEMENTOS DE INTERES
·: INTERES GENERAL DEL EDIFICIO, VOLUMEN, COMPOSICON Y ELEMENTOS DECORATIVOS EN FACHADAS

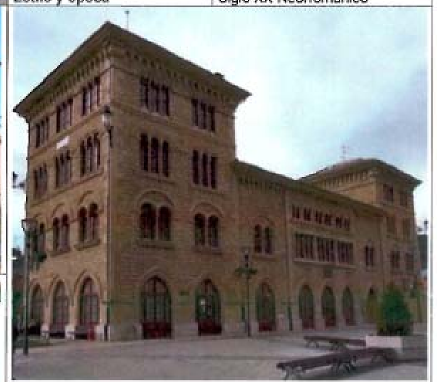
ELEMENTOS DISCORDANTES
,:

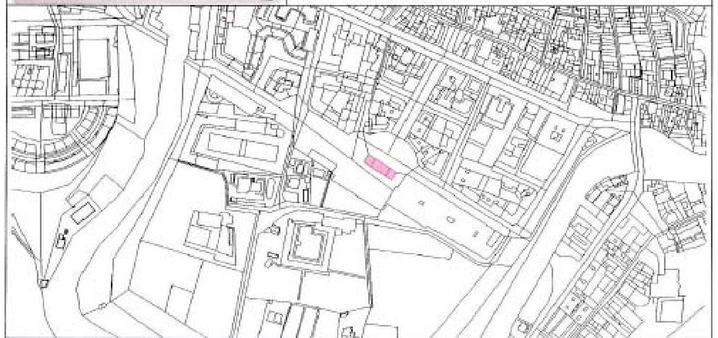
OBRAS NECESARIAS
;: REHABILITACION GENERAL

Plan Municipal de Ordenación de Murieta

MUNICIPAL DEVELOPMENT PLAN OF LIZARRA, 2015

CATÁLOGO DE PROTECCIÓN DE ESTELLA-LIZARRA		FICHA II-19
	Protección	Grado II: Protección estructural
Identificación del edificio	Nombre común de la edificación	Antigua Estación del Ferrocarril
	Dirección postal	Plaza de la Coronación, s/n
	Estilo y época	Siglo XX Neorrománico





Descripción	Edificio del XX. Edificio moderno, de la primera mitad del siglo XX, con función de estación de la antigua linea del Ferrocarril Vasco-Navarro. Diseñada por el ingeniero Alejandro Mendizabal, de estilo neorrománico, evoca al palacio de los Reyes de Navarra localizado en la ciudad. Consta de un cuerpo central y dos torres en sus extremos. Realizado con muros de silleria, cuenta con arcos y ventanas de medio punto, dobles y triples, en las plantas superiores, que alternan con otros ojivales en la planta baja. En la actualidad cumple la función de estación de autobuses.

Referencia: ....ESTACION (EDIFICIO2) - ZUBIELQUI

Denominaciones:	ESTACIÓN
Municipio:	ALLIN
CP + Localidad:	31241 ZUBIELQUI
Calle y Nº:	ESTACION (LA) 2
Polígono / parcela:	2 / 303
Localización:	Urbana

Grado de catalogación: 3

Información compl.:	Forma conjunto con el edificio nº 2 de la misma calle. Tienen la misma parcela en catastro.
Cronología:	Principal XIX
Estilo:	Regionalista
Tipo de inmueble:	Equipamiento: Estación ferrocarril
Ubicación:	Aislado
Elementos:	Alfiz, Balcón, Cadenas de esquina, Carpintería
Estructura perimetral:	Mampostería, Mampostería enlucida
Estructura interior:	Muros de fábrica, Pilares de hormigón
Estructura horizontal:	Forjado de hormigón
Cubierta;forma:	Cuatro aguas, Dos aguas, Un agua
Cubierta;armadura:	Forjados inclinados, Hormigón
Cubierta;cobertura:	Teja plana
Estado de conservación:	Completo en su estado original

Referencia: ....ESTACION (EDIFICIO1) - ZUBIELQUI

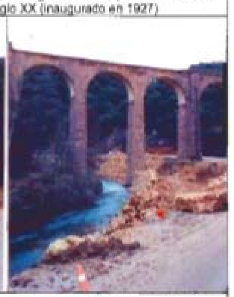
Denominaciones:	ESTACIÓN
Municipio:	ALLIN
CP + Localidad:	31241 ZUBIELQUI
Calle y Nº:	ESTACION (LA) 3
Polígono / parcela:	2 / 303
Localización:	Urbana

Grado de catalogación: 3

Información compl.:	Se encuentra en estado de abandono. Fue antigua estación de ferrocarril.
Cronología:	Principal XIX
Estilo:	Popular, Regionalista
Tipo de inmueble:	Equipamiento: Estación ferrocarril
Ubicación:	Aislado
Elementos:	Arco rebajado, Entramado, Reja
Estructura perimetral:	Entramado de madera, Ladrillo, Mampostería
Estructura interior:	Muros de fábrica
Estructura horizontal:	Forjado de madera, Forjado metálico
Cubierta;forma:	Dos aguas
Cubierta;armadura:	Forjados inclinados
Cubierta;cobertura:	Teja plana
Estado de conservación:	Ruinas

CATÁLOGO DE PROTECCIÓN — 7

MUNICIPIO DE ZÚÑIGA	PROTECCIÓN INTEGRAL	GRADO I
IDENTIFICACIÓN DEL EDIFICIO	Nombre común de la edificación	Viaducto de Argaijas
	Dirección postal	Carretera NA 132-A, en la muga entre Zúñiga y Metauten
	Parcela catastral	Situado sobre la carretera entre las parcelas nn.456 y 49
	Estilo y época	Obra de ingeniería de la primera mitad del siglo XX (inaugurado en 1927)



DESCRIPCIÓN	Se levanta en el trazado del antiguo ferrocarril Estella-Vitoria, sobre el río Ega y la carretera NA 132-A. El viaducto se dispone entre dos elevaciones del terreno, al sur entra en un tunel, y al norte, se prolonga a media ladera; en ese punto discurre a una cota de 542.95 m. (aproximadamente unos 22 m. por encima de carretera); se dispone sobre nueve altos arcos de medio punto de 11 m de luz, apoyados en esbeltas pilastras rectangulares (la más alta de 30 m.). El director de la obra fue el ingeniero Alejandro Mendizabal Peña; el puente fue inaugurado en 1927.	
	INTERÉS ARQUITECTÓNICO	Medio
	INTERÉS HISTÓRICO-AMBIENTAL	Alto
	INTERÉS FUNCIONAL	Alto
	ESTADO DE CONSERVACIÓN	Bueno
GRADO DE PROTECCIÓN		**OBRAS PERMITIDAS**
I: PROTECCIÓN INTEGRAL		Conservación y acondicionamiento.

PROTECCIÓN ESPECÍFICA

Resultaría recomendable reponer la barandilla de protección, permitiendo así un uso seguro del itinerario que proporciona el antiguo trazado del ferrocarril.

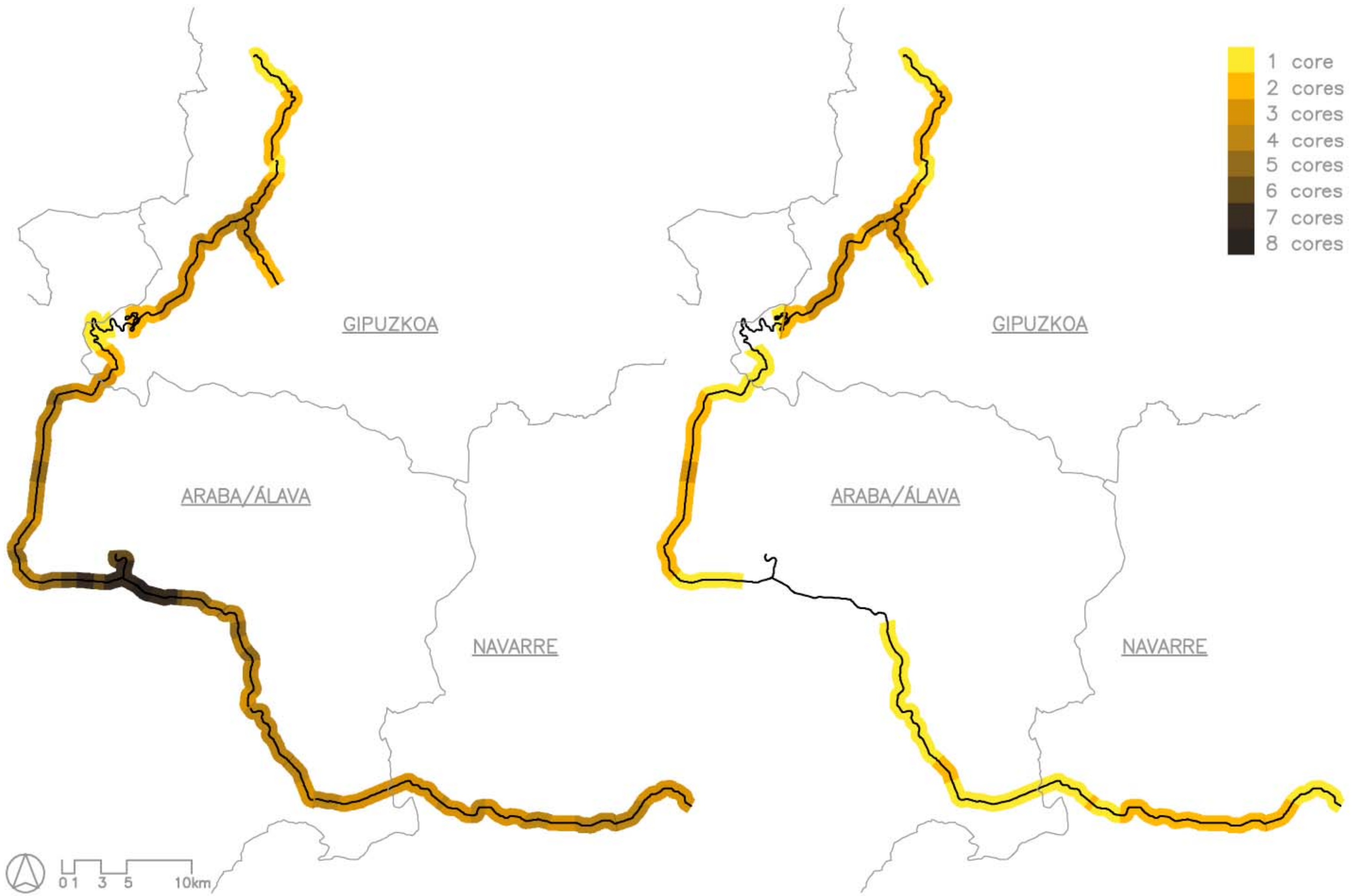
Departamento de Medio Ambiente
Ordenación del Territorio y Vivienda
BON de 30 MAYO 2003
VIGENTE DESDE ESTA FECHA

ANNEX 3 (CHAPTER 5)

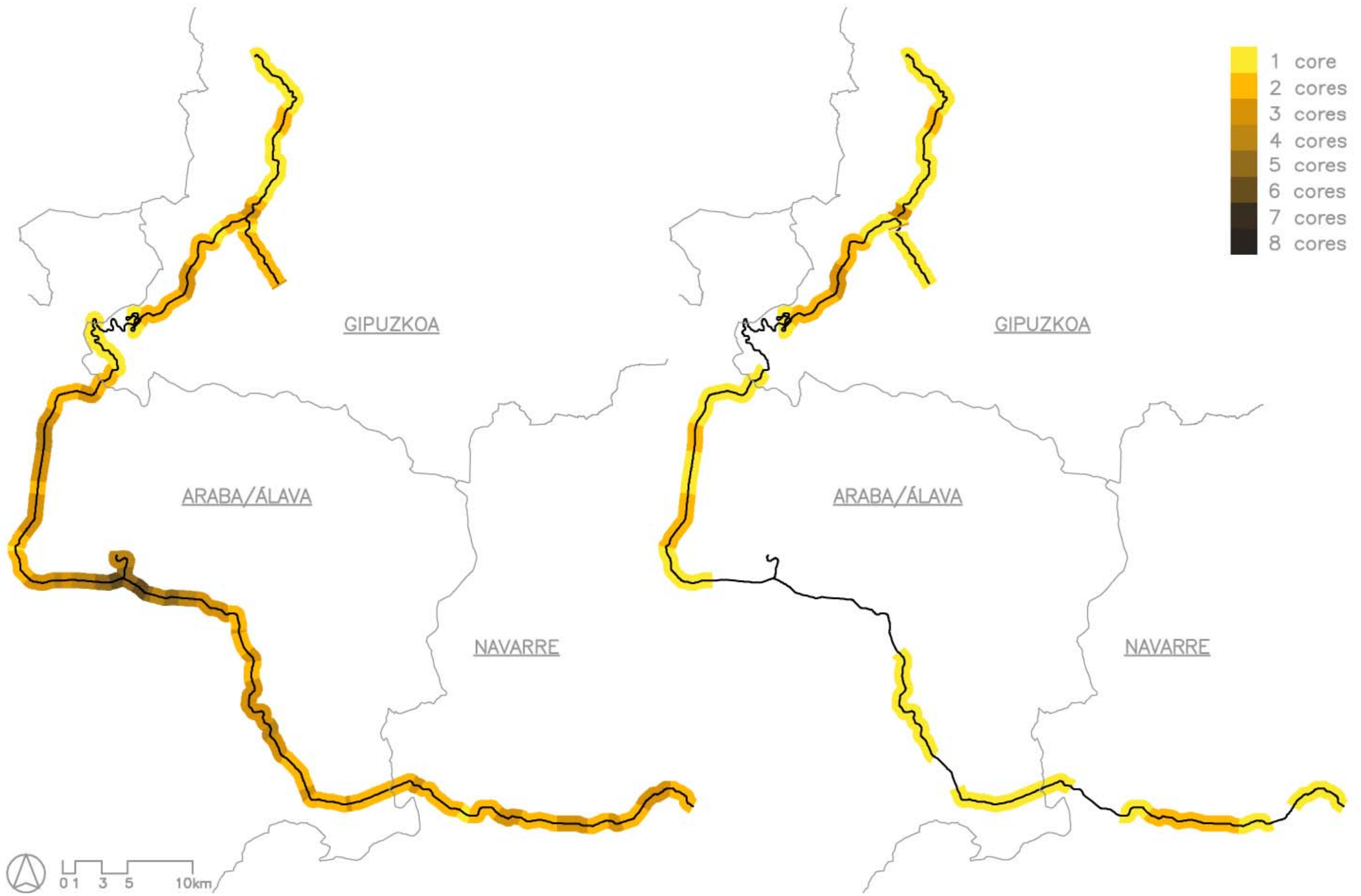
3.1. Interurban approach

3.1.1. Accessibility of the areas near the line

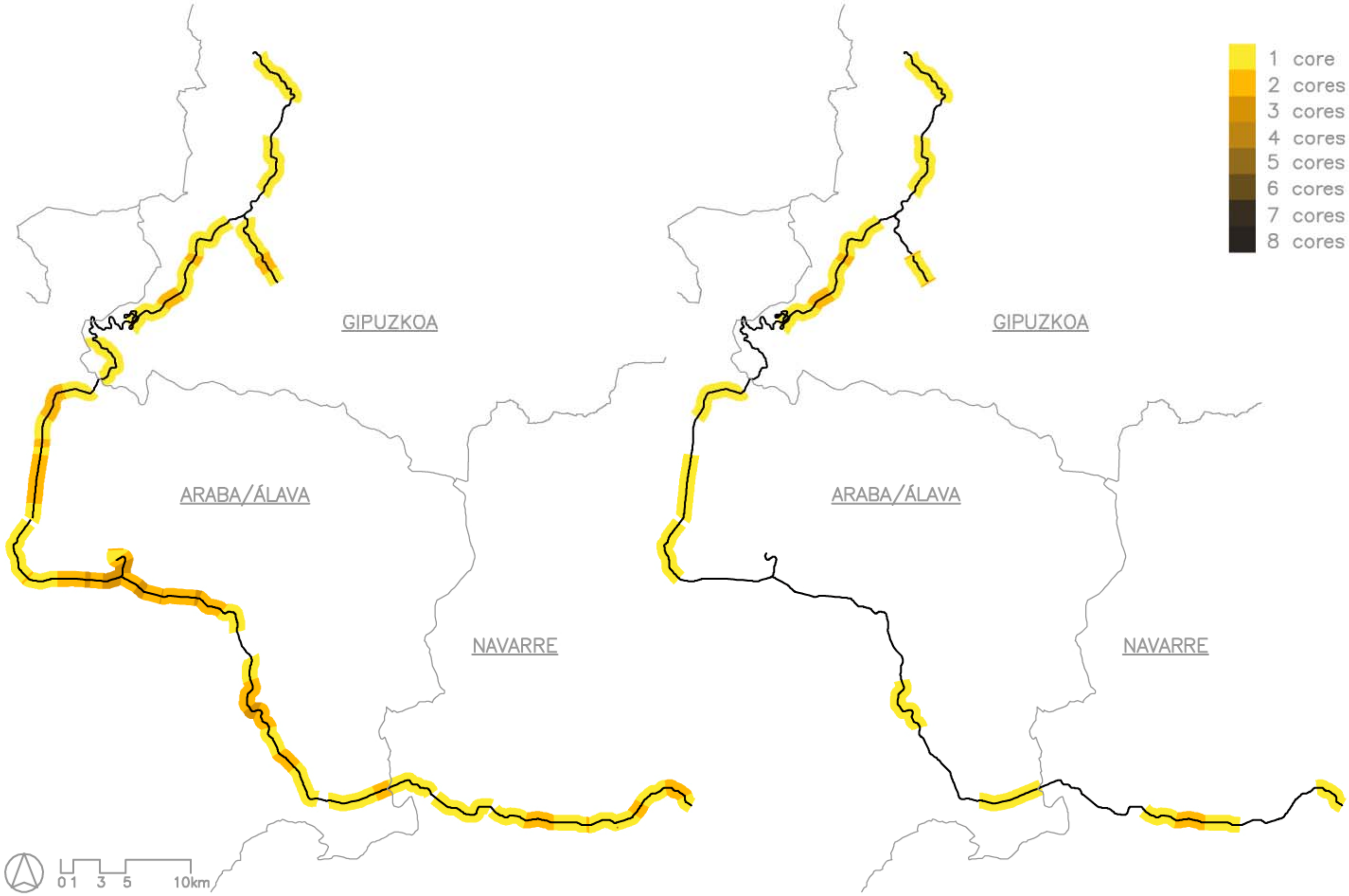
CYCLING ROUND-TRIPS. ALL CORES (LEFT) AND MAIN CITIES AND TOWNS (RIGHT)



CYCLING ROUND-TRIPS. ALL CORES (LEFT) AND MAIN CITIES AND TOWNS (RIGHT)



CYCLING ROUND-TRIPS. ALL CORES (LEFT) AND MAIN CITIES AND TOWNS (RIGHT)



3.2. Accessbility at different scales

	STRATEGIC AREAS RELATED TO ACCESSEBILITY AT DIFFERENT SCALES				
		AL1	AL2		AL3
	AREAS	ZONES	STRATEGIC AREAS: MAIN NODES	STRATEGIC AREAS: ALL NODES	TYPES
	MALTZAGA	1			-
	SORALUZE	1			2
	LOS MARTIRES	1			-
1	MEKOALDE	1	2 cores: running or long stay walking	2 cores: running or long stay walking	-
2	BERGARA	1			2
3	ALTOS HORNOS	1			-
4	SAN PRUDENCIO	1	3 cores: cycling (several companies)	5 cores: cycling	-
5	ZUBILLAGA	1			-
6	SAN PEDRO	1			-
7	OÑATI	1			2
8	ARRASATE	1	3 cores: cycling 3 cores: walking Railway stations at the ends of the section are preserved, so they can operate in common	3 cores	2
9	ULGOR	1		walking: short stay	-
10	ARETXABALETA	1		running: long stay	2
11	LANDETA-MARIANISTAS	1		walking: short stay	-
12	ESKORIATZA	1		3 cores	2
13	CASTAĐARES	1	2 cores: residential neighbourhood	2 cores: residential neighbourhood	-
14	MAZMELA	2			-
15	ZARIMUZ	2			-
16	MARIN	2			-
17	LEINTZ-GATZAGA	2			4
18	ARLABAN	2			-
19	LANDA	3			-
20	LEGUTIO	3			4
21	URBINA	3			3
22	ERRETANA	3	3 cores: cycling (longs stay)	5 cores: cycling (longs stay)	4
23	DURANA	3			3
24	VITORIA APEADERO	3			1
25	VITORIA-CIUDAD	3		5 cores: cycling	1
26	VITORIA-NORTE	3			-

	AREAS	AL1 ZONES	AL2 STRATEGIC AREAS: MAIN NODES	AL2 STRATEGIC AREAS: ALL NODES	AL3 TYPES
27	**OLARIZU**	3		it is accessible walking from Otazu	-
28	**OTAZU**	3			3
29	**ABERASTURI**	3		3 cores walking and 4 running	3
30	**ANDOLLU**	3		3 cores walking and 6 running	3
31	**ESTIBALIZ**	3			4
32	**TROKONIZ**	3			3
33	**ERENTXUN**	3			3
34	**GAUNA**	4		3 cores: walking	4
35	**URIBARRI-JAUREGUI**	4			4
36	**BRIGADA TUNEL**	4		5 cores: tunnel entrance	-
37	**LAMINORIA**	4		5 cores: tunnel exit	-
38	**ZEKUIANO**	4			4
39	**MAEZTU**	4		4 cores cycling and 3 walking	3
40	**ATAURI**	4		long stay	4
41	**ANTOÑANA**	4	2 cores: cycling (long stay)	4 cores: cycling	4
42	**FRESNEDO**	4		4 cores: cycling. Power plant+park	-
43	**KANPEZU**	4			4
44	**ORRADICHO**	4			-
45	**ZUÑIGA**	4			4
46	**ARQUITAS**	4	2 cores: cycling (long stay).Tunnel+camping	4 cores: cycling	-
47	**ACEDO**	4			3
48	**GRANADA**	4	2 cores: cycling, walking in the middle area. A railway station and hydroelectric plant are preserved at the ends of the section	short stay	-
49	**ANCIN**	5			3
50	**MURIETA**	5			3
51	**ZUFIA**	5	3 cores: cycling (long stay) Truffle interpretation centre	5 cores: cycling (long stay) Way of St.James	4
52	**ZUBIELQUI**	5			3
53	**LIZARRA**	5			2

ANNEX 4 (CHAPTER 6)

4.1. Indicators

4.1.1. Comparison

COMPARISON OF INDICATORS	Bertolini (1999)	Reusser et al. (2008)	Gonçalves & Portugal (2008)	Chorus and Bertolini (2011)	Zemp et al. (2011)	Ivan et al. (2012)	Moreno (2013)	Vale (2015)	Proposed indicators
Node-index: accessibility of the node									
(a) Accessibility by train									
Number of directions served	X	X	X	X				X	X
Daily frequency of services	X	X	X		X	X		X	
Number of stations within a certain area	X	X	X		X			X	X
Type of train connections		X		X			X		
Passenger frequency (per day)		X					X		
Staffing (present or not)		X							
(b) Accessibility by bus, tram, underground, etc.									
Number of directions served	X	X	X	X				X	
Daily frequency of services	X	X	n.a.		X	X		X	
Daily frequency of suburban buses						X			
Number of stops							X		X
Taxi stops							X		
(c) Accessibility by car									
Distance from the closest motorway access	X	X	n.a.				X	X	X
Distance from the closest secondary road									X
Car parking capacity	X	n.a.	n.a.			X		X	X
Traffic intensity (vehicles per day)							X		
(d) Accessibility by bicycle and foot									
Number of free-standing bicycle paths	X								
Bike path length within 2 km		X	n.a.						X
Bicycle parking capacity	X	n.a.	n.a.				X		
Interurban walking routes									X

	Bertolini (1999)	Reusser et al. (2008)	Gonçalves & Portugal (2008)	Chorus and Bertolini (2011)	Zemp et al. (2011)	Ivan et al. (2012)	Moreno (2013)	Vale (2015)	Proposed indicators
Place-index: intensity and diversity									
(a) Morphology of the area									
Proximity to the town centre		X		X			X		X
Core urban area x						X			
Housing density						X	X		X
Urban land-uses							X		X
Number of residents	X	X	X	X	X	X	X	X	X
Forest cover									X
Agricultural land-uses									X
Qualility of life							X		
(b) Activity									
Number of workers in retail/hotel and catering	X			X			X	X	
Number of workers in education/health/culture	X			X			X	X	
Number of workers in administration and services	X			X			X	X	
Number of workers in industry and distribution	X			X			X	X	
Number of workers in secondary sector		X	X			X			X
Number of workers in tertiary sector		X	X			X			X
Number of students									X
Number of jobs x					X		X		
Open areas									X
Protected natural areas									X
Linking corridors									X
Agricultural land									X
Elements of interest									X
Heritage elements									X
(c) Functional mix									
Degree of functional mix	X	X	X	X			X	X	X
(d) Other place-index variables									
Rate of unemployed with basic education						X			
Land prices x						X			

4.2. MCDA

4.2.1. Values of defined node areas

TOTAL VALUES OF DEFINED NODE AREAS

					N1						N2			N3			U1			U2	U3		C1					C2		C3			
					Rail		Bus		Tram		Car			Cycle	Walk interurban		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA		N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
				ha	nº	nº	nº	nº	nº	nº	1/km	1/km	nº	km	nº	nº	1/km	viv/ha	%	nº	%	% non	nº workers			ha	0-1	nº	nº	nº	nº	%	0-1
1		MALTZAGA	500	21.01	0	0	1	5	0	0			25	0.32	0	0		0.19	37.36	3	29.81	0.00	0	39	0	0.00	0.87	0	0	0	0	0.00	0
	-		1000	75.30	0	0	1	5	0	0	0.78	10.00	25	0.42	0	0	0.73	0.09	20.25	3	55.22	0.00	110	47	0	0.00	0.56	0	0	0	0	0.00	0
			2000	438.19	1	2	1	5	0	0			252	1.68	0	0		1.38	15.85	1299	52.72	0.00	433	1814	370	2.37	0.35	0	5	0	0	0.00	0
		SORALUZE-PLACENCIA DE LAS ARMAS	500	18.78	0	0	2	5	0	0			109	0.00	0	0		58.52	73.27	2074	0.77	0.00	27	246	541	0.16	0.56	6	2	0	0	0.00	0
	2		1000	46.66	0	0	3	5	0	0	0.23	1.02	237	0.34	0	0	10.00	37.12	57.18	3422	8.52	0.00	134	378	541	0.48	0.61	8	2	0	0	0.00	0
			2000	338.17	0	0	4	5	0	0			436	1.24	0	0		5.82	15.51	3876	43.90	0.36	663	460	541	1.07	0.52	10	2	0	0	0.20	0
		LOS MARTIRES	500	38.54	0	0	1	2	0	0			65	1.00	0	0		4.59	17.43	364	40.56	0.00	193	28	0	0.00	0.50	2	0	0	0	0.00	0
	-		1000	127.03	0	0	1	3	0	0	0.25	8.33	149	2.04	0	0	0.36	1.51	9.65	386	60.07	0.00	193	29	0	0.00	0.51	2	0	0	0	0.00	0
			2000	423.21	0	0	3	5	0	0			272	4.00	0	0		0.56	6.38	469	67.59	0.37	213	41	0	0.00	0.51	3	0	0	0	0.12	0
		MEKOALDE	500	31.66	0	0	1	3	0	0			109	0.86	0	0		0.73	32.98	35	29.09	2.16	82	0	0	0.00	0.58	0	0	0	0	1.53	0
	-		1000	126.93	0	0	2	3	0	0	0.39	7.14	109	1.25	0	0	0.41	0.28	14.29	55	53.19	6.15	86	0	0	0.00	0.52	0	0	0	0	2.88	0
			2000	383.63	0	0	4	5	0	0			348	2.35	0	0		0.33	11.26	246	50.98	3.64	474	74	0	0.00	0.46	3	0	0	0	1.79	0
		BERGARA	500	24.90	0	0	2	7	0	0			180	0.86	0	0		59.40	91.36	3275	2.54	0.00	49	934	2008	1.39	0.40	0	52	0	0	0.00	0
	2		1000	105.16	0	0	3	7	0	0	0.63	5.26	998	1.42	0	0	10.00	44.43	75.00	9936	12.68	0.26	273	1950	2694	7.77	0.50	2	186	0	0	0.22	0
			2000	487.71	0	0	4	7	0	0			2257	2.43	0	0		12.71	36.51	13255	28.00	1.20	1765	2663	3086	10.60	0.45	5	190	0	1	0.86	0
		ALTOS HORNOS	500	16.35	0	0	0	6	0	0			311	0.85	0	0		1.16	97.73	5	1.12	0.00	66	37	0	0.00	0.49	0	0	0	0	0.00	0
	-		1000	60.63	0	0	2	6	0	0	1.08	4.00	520	1.08	0	0	0.57	2.82	78.44	340	10.28	1.31	692	68	0	0.00	0.50	1	1	0	0	1.17	0
			2000	416.25	0	0	3	6	0	0			831	3.13	0	0		4.47	30.94	3871	36.80	1.13	972	306	930	1.07	0.46	2	7	0	0	0.71	0
		SAN PRUDENCIO	500	27.22	0	0	1	9	0	0			10	0.97	0	0		0.22	28.09	9	29.83	0.00	13	12	0	0.00	0.34	2	0	0	1	0.00	0
	-		1000	89.88	0	0	1	9	0	0	0.63	3.70	10	2.49	0	0	0.35	0.10	13.34	10	52.21	0.37	13	12	0	0.00	0.34	2	0	0	1	0.18	0
			2000	366.75	0	0	4	9	0	0			88	5.27	0	0		0.08	9.92	54	60.50	0.45	436	43	0	0.00	0.69	2	0	0	1	0.18	0
		ZUBILLAGA	500	18.52	0	0	2	5	0	0			115	0.80	0	0		5.62	54.82	208	6.98	0.00	505	37	0	0.00	0.53	1	0	0	0	0.00	0
	-		1000	124.61	0	0	3	5	0	0	0.23	0.34	364	1.87	0	0	0.29	0.98	24.31	242	35.19	2.26	957	130	0	0.00	0.56	1	0	0	0	1.46	0
			2000	458.71	0	0	6	5	0	0			490	3.43	0	0		0.34	13.91	311	41.29	0.83	1640	153	0	0.00	0.63	1	1	0	1	0.49	0
		SAN PEDRO	500	25.50	0	0	1	2	0	0			222	0.99	0	0		1.02	41.06	60	11.94	0.00	529	32	0	0.00	0.74	0	1	0	0	0.00	0
	-		1000	179.24	0	0	2	4	0	0	0.15	0.19	312	1.95	0	0	0.74	1.09	26.11	388	15.38	0.17	1244	161	0	4.12	0.54	1	1	0	0	0.14	0
			2000	619.58	0	0	5	6	0	0			816	4.22	0	0		2.99	20.21	3713	26.21	1.08	2694	1286	735	6.45	0.33	5	153	0	0	0.80	0
		OÑATI	500	25.34	0	0	1	6	0	0			201	0.15	0	0		33.82	88.74	1543	0.00	0.00	84	756	735	0.00	0.36	3	107	0	0	0.00	0
	2		1000	148.13	0	0	2	6	0	0	0.12	0.16	583	2.80	0	0	10.00	20.17	63.25	6154	9.04	0.00	976	1496	1755	1.59	0.41	5	171	0	0	0.00	0
			2000	624.08	0	0	5	6	0	0			1140	3.81	0	0		7.53	29.14	9929	18.25	0.08	2093	1832	2243	19.18	0.43	7	173	0	0	0.07	0

					N1						N2			N3				U1		U2	U3		C1					C2		C3			
					Rail		Bus		Tram		Car			Cycle	Walk interurban		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA		N11	N12	N13	N14	N15	N16	N21	N22	N23	N31	N32	N33	U11	U12	U13	U21	U31	U32	C11	C12	C13	C14	C15	C21	C22	C31	C32	C33	C34
				ha	nº	nº	nº	nº	nº	nº	1/km	1/km	nº	km	nº	nº	1/km	viv/ha	%	nº	%	% non	nº workers			ha	0-1	nº	nº	nº	nº	%	0-1
			500	22.13	0	0	5	8	0	0			383	0.64	0	0		56.80	98.38	2059	1.87	0.00	171	899	0	0.32	0.52	2	1	0	0	0.00	0
	2	**ARRASATE**	**1000**	72.39	0	0	10	10	0	0	0.40	1.69	711	0.84	0	0	10.00	56.36	85.14	7844	12.38	0.00	688	2584	2029	2.41	0.42	3	53	0	0	0.00	0
			2000	477.71	0	0	35	3	0	0			2321	5.24	0	0		20.78	51.12	20793	32.68	2.21	2407	5981	4204	21.13	0.44	6	55	0	0	1.49	0
			500	15.02	0	0	1	5	0	0			0	0.84	0	0		0.13	94.87	1	1.61	0.00	935	291	0	0.00	0.64	0	0	0	0	0.00	0
	-	**ULGOR**	**1000**	47.99	0	0	3	7	0	0	0.25	2.17	643	1.37	0	0	1.50	17.07	78.23	1690	1.69	0.00	984	1173	435	0.00	0.29	0	0	0	0	0.00	0
			2000	396.41	0	0	21	11	0	0			1335	5.07	0	0		18.32	45.14	14814	37.57	0.44	1657	5268	2609	10.51	0.43	5	56	0	0	0.27	0
			500	24.87	0	0	3	7	0	0			709	1.06	0	0		53.68	93.42	2943	5.85	0.00	162	641	992	0.04	0.45	1	2	0	0	0.00	0
	2	**ARETXABALETA**	**1000**	95.77	0	0	5	7	0	0	0.36	5.00	1150	1.97	0	0	10.00	28.00	67.98	5885	20.51	0.45	954	900	992	3.84	0.49	4	3	0	0	0.36	0
			2000	545.87	0	0	5	7	0	0			1474	4.18	0	0		5.48	26.13	6535	34.92	0.16	2112	1217	1257	11.72	0.41	6	4	0	0	0.10	0
			500	24.08	0	0	0	0	0	0			221	0.99	0	0		5.23	75.23	257	21.15	0.00	53	77	420	1.79	0.39	2	0	0	0	0.00	0
	-	**LANDETA-MARIANISTAS**	**1000**	90.84	0	0	2	6	0	0	0.59	100.00	780	1.94	0	0	2.35	9.73	61.75	2131	19.74	0.47	1944	529	817	3.68	0.32	3	0	0	0	0.37	0
			2000	375.24	0	0	7	7	0	0			1786	4.18	0	0		11.66	37.34	9397	24.03	0.75	2115	1554	2359	11.78	0.42	10	50	0	0	0.57	0
			500	12.86	0	0	1	4	0	0			124	1.00	0	0		15.01	89.94	442	6.56	1.17	254	93	0	0.00	0.43	0	1	0	0	1.10	0
	2	**ESKORIATZA**	**1000**	84.55	0	0	2	7	0	0	0.46	2.94	371	1.89	0	0	2.41	12.08	41.80	2116	38.20	4.65	308	245	210	1.23	0.56	2	47	0	0	2.88	0
			2000	428.22	0	0	4	7	0	0			629	3.25	0	0		4.12	19.07	3592	45.71	3.46	519	486	682	1.23	0.50	5	48	0	0	1.88	0
			500	11.52	0	0	1	2	0	0			0	0.00	0	0		0.95	6.15	17	41.84	6.81	1	0	0	0.00	0.90	0	0	0	0	3.96	0
	-	**CASTAÑARES**	**1000**	42.26	0	0	2	2	0	0	0.23	0.51	69	0.35	0	0	0.37	1.63	12.86	79	37.63	3.40	2	9	0	0.00	0.78	0	0	0	0	2.12	0
			2000	282.45	0	0	2	2	0	0			69	0.86	0	0		0.35	12.69	144	58.94	1.00	41	25	0	0.00	0.52	0	0	0	0	0.41	0
			500	21.79	0	0	0	0	0	0			0	0.00	0	0		0.09	17.96	0	58.72	0.00	0	0	0	0.00	-	0	0	0	0	0.00	0
	-	**MAZMELA**	**1000**	68.72	0	0	0	0	0	0	0.23	0.38	0	0.00	0	0	0.39	0.15	14.87	9	59.70	0.60	0	0	0	0.00	1.00	0	0	0	0	0.24	0
			2000	240.74	0	0	0	0	0	0			69	0.86	0	0		0.37	15.56	110	52.42	0.82	41	6	0	0.00	0.56	0	0	0	0	0.39	0
			500	22.99	0	0	0	0	0	0			0	0.00	0	0		0.30	28.78	9	21.10	0.00	0	0	0	0.00	1.00	0	0	0	0	0.00	0
	-	**ZARIMUZ**	**1000**	83.08	0	0	0	0	0	0	0.15	0.24	0	0.00	0	0	0.41	0.12	19.34	18	44.07	0.44	0	0	0	0.00	1.00	0	0	0	0	0.24	0
			2000	243.53	0	0	0	0	0	0			0	0.00	0	0		0.13	8.43	60	64.19	0.24	0	8	0	0.00	0.79	0	0	0	0	0.09	0
			500	22.21	0	0	1	2	0	0			0	0.00	0	0		0.18	33.54	5	62.31	1.45	0	0	0	0.00	1.00	0	0	0	0	0.55	0
	-	**MARIN**	**1000**	98.48	0	0	1	2	0	0	0.13	0.17	0	0.00	0	0	0.33	0.15	13.08	23	68.21	5.89	1	1	0	0.00	0.85	0	0	0	0	1.87	0
2			**2000**	277.86	0	0	1	2	0	0			0	0.00	0	0		0.09	5.79	54	72.03	2.77	2	1	0	0.77	0.90	0	0	0	0	0.77	0
			500	19.35	0	0	0	0	0	0			0	0.00	0	0		0.41	9.41	21	28.88	0.00	1	2	0	1.40	0.77	0	0	0	0	0.00	0
	4	**LEINTZ-GATZAGA**	**1000**	94.47	0	0	1	2	0	0	0.13	1.06	49	0.00	0	3	0.89	0.21	3.73	53	38.45	0.00	1	6	0	2.57	0.79	0	0	1	0	0.00	0
			2000	341.00	0	0	4	3	0	0			150	0.54	0	3		0.40	3.41	246	61.19	0.00	9	21	0	4.82	0.80	4	32	1	0	0.00	0
			500	18.43	0	0	1	3	0	0			81	0.45	0	3		0.27	10.67	7	61.62	0.00	0	0	0	1.40	1.00	1	0	1	0	0.00	0
	-	**ARLABAN**	**1000**	87.92	0	0	2	3	0	0	0.11	33.33	130	1.00	0	3	0.47	0.10	4.52	23	73.76	0.00	0	6	0	2.82	0.67	2	0	1	1	0.00	0.5
			2000	303.42	0	0	4	3	0	0			130	1.98	0	3		0.12	3.10	79	69.82	0.00	2	9	0	5.24	0.78	3	3	1	1	0.00	0.5
			500	18.46	0	0	1	2	0	0			110	0.98	0	1		0.43	22.77	14	62.77	0.00	0	5	0	0.80	0.61	0	0	0	1	0.00	0
	-	**LANDA**	**1000**	72.87	0	0	1	2	0	0	0.14	10.00	110	1.74	0	1	0.24	0.27	11.61	39	63.07	7.28	4	7	0	2.57	0.63	1	0	0	1	2.69	0
			2000	366.70	0	0	1	2	0	0			329	3.55	0	1		0.08	10.99	51	46.66	2.49	5	8	0	14.32	0.66	3	0	1	1	1.33	0.5

					N1						N2			N3			U1			U2	U3		C1					C2		C3			
					Rail		Bus		Tram		Car			Cycle	Walk interurban		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE		AREA	N11	N12	N13	N14	N15	N16	N21	N22	N23	N31	N32	N33	U11	U12	U13	U21	U31	U32	C11	C12	C13	C14	C15	C21	C22	C31	C32	C33	C34
				ha	nº	nº	nº	nº	nº	nº	1/km	1/km	nº	km	nº	nº	1/km	viv/ha	%	nº	%	% non	nº workers			ha	0-1	nº	nº	nº	nº	%	0-1
			500	3.87	0	0	0	0	0	0			0	0.51	0	1		0.26	16.32	4	0.00	0.00	0	0	0	0.16	1.00	0	0	0	0	0.00	0
	4	LEGUTIO	1000	39.82	0	0	0	0	0	0	0.23	8.33	0	1.72	0	1	0.25	0.08	31.57	9	8.86	4.45	0	0	0	2.10	1.00	0	0	0	1	4.05	0
			2000	384.68	0	0	0	0	0	0			0	3.61	0	1		0.02	28.87	13	28.17	6.83	68	1	0	3.37	0.71	2	0	0	1	4.91	0
			500	24.48	0	0	0	0	0	0			0	0.57	0	1		1.35	27.05	52	21.57	34.14	0	1	0	1.15	0.96	0	0	0	1	26.78	0.5
	3	URBINA	1000	85.66	0	0	2	2	0	0	0.48	0.87	28	1.49	0	1	2.44	0.83	19.93	122	28.83	55.17	36	5	0	1.75	0.61	0	2	0	1	39.26	0.5
			2000	266.40	0	0	4	2	0	0			45	3.64	0	1		0.36	37.33	181	20.40	32.58	494	47	0	4.21	0.54	0	4	0	1	25.93	0.5
			500	34.28	0	0	0	0	0	0			0	0.98	0	0		0.00	10.46	8	0.10	87.95	0	0	0	0.83	1.00	0	0	0	0	87.87	0
	4	ERRETANA	1000	178.32	0	0	1	2	0	0	0.34	3.70	0	2.04	0	0	1.68	0.12	23.85	53	3.70	79.89	1	5	0	1.80	0.81	0	0	0	1	76.94	0.5
			2000	519.30	0	0	2	2	0	0			0	3.93	0	1		0.15	29.99	140	4.80	78.57	380	187	0	3.47	0.40	0	1	0	1	74.79	0.5
			500	35.60	0	0	2	3	0	0			0	0.82	0	0		0.76	23.25	46	2.07	69.22	6	13	0	0.91	0.55	0	1	0	1	67.79	0.5
	3	DURANA	1000	125.67	0	0	2	3	0	0	0.44	2.00	25	1.89	0	0	2.04	1.03	27.00	296	5.62	68.65	8	220	1242	1.71	0.54	0	1	0	1	64.79	0.5
			2000	429.38	0	0	3	4	0	0			108	3.44	0	0		0.44	25.84	434	5.43	74.30	26	271	1242	5.95	0.46	0	1	0	1	70.27	0.5
			500	42.07	0	0	12	21	0	0			1146	2.05	0	0		94.44	100.0	9392	0.00	0.00	383	2349	1410	4.15	0.52	2	0	0	0	0.00	0
	1	VITORIA APEADERO	1000	195.00	0	0	30	31	0	0	0.36	1.37	4045	6.25	0	0	10.00	73.11	100.0	31871	0.00	0.00	1306	6493	6907	11.37	0.51	6	0	0	0	0.00	0
			2000	785.99	0	0	79	43	4	3			8131	18.42	0	0		67.53	100.0	109337	0.04	0.02	5512	31994	19168	58.79	0.49	24	206	1	0	0.02	0
			500	43.66	0	0	10	29	0	0			1255	0.00	0	0		129.16	100.0	11964	0.00	0.00	101	3233	2324	0.00	0.51	1	9	0	0	0.00	0
	1	VITORIA-CIUDAD	1000	194.11	0	0	31	35	1	3	0.27	1.61	3304	1.67	0	0	10.00	128.88	100.0	50438	0.00	0.00	606	12518	5847	14.14	0.57	10	205	0	0	0.00	0
			2000	811.69	1	3	102	43	6	3			10895	21.68	1	0		83.71	100.0	141124	0.00	0.10	3580	41291	27907	50.11	0.49	26	209	1	0	0.10	0
			500	27.41	0	0	0	0	0	0			86	0.60	1	0		0.29	95.78	15	2.85	24.40	172	271	0	1.50	0.49	1	1	0	0	23.70	0
3	-	OLARIZU	1000	123.57	0	0	4	10	0	0	0.17	0.41	343	2.13	1	0	1.43	6.91	76.02	1710	1.34	38.04	411	616	634	11.57	0.34	2	1	0	0	37.53	0
			2000	612.44	1	3	25	30	1	2			2670	8.84	1	1		25.33	65.10	31523	2.13	44.49	1330	6459	5145	74.84	0.54	7	1	0	0	43.55	0
			500	15.61	0	0	0	0	0	0			0	0.89	0	0		0.77	46.07	23	2.15	74.29	0	9	0	0.28	0.60	1	1	0	1	72.70	0.5
	3	OTAZU	1000	88.16	0	0	0	0	0	0	0.10	0.55	0	1.88	1	0	5.26	0.36	26.20	74	4.73	81.30	1	9	0	1.83	0.79	1	1	0	1	77.45	0.5
			2000	660.27	0	0	1	3	0	0			105	3.49	1	0		0.12	12.07	177	8.03	85.43	1	27	0	2.73	0.76	4	5	0	1	78.57	0.5
			500	31.04	0	0	0	0	0	0			0	0.93	0	0		1.35	37.00	91	1.35	72.48	0	1	0	0.96	0.98	0	0	0	1	71.50	0.5
	3	ABERASTURI	1000	84.29	0	0	0	0	0	0	0.11	0.81	0	1.88	0	0	6.67	0.72	25.46	133	4.69	82.83	0	1	0	1.66	0.99	1	0	0	1	78.94	0.5
			2000	502.26	0	0	1	3	0	0			0	3.70	1	1		0.13	5.98	139	10.44	93.51	0	1	0	3.38	0.99	1	0	1	1	83.75	1
			500	24.64	0	0	1	3	0	0			10	1.13	1	1		0.97	17.20	35	20.20	69.70	1	40	0	0.45	0.49	0	0	0	1	55.62	0.5
	3	ANDOLLU	1000	160.14	0	0	1	3	0	0	0.14	20.00	10	2.49	1	1	3.85	0.17	7.65	42	21.57	88.75	1	40	0	1.58	0.49	0	0	0	1	69.61	0.5
			2000	725.29	0	0	4	3	0	0			10	6.24	1	1		0.17	7.79	244	24.99	87.67	10	62	0	5.47	0.64	0	2	1	1	65.77	1
			500	16.13	0	0	0	0	0	0			317	0.51	0	1		0.19	32.79	24	8.15	76.16	0	0	0	0.65	1.00	1	1	0	1	69.95	0.5
	4	ESTIBALIZ	1000	71.96	0	0	0	0	0	0	0.21	0.56	317	1.08	0	1	2.50	0.58	30.91	127	9.48	63.62	1	14	0	1.80	0.81	1	1	0	1	57.59	0.5
			2000	329.13	1	3	2	3	0	0			317	2.20	1	1		0.33	16.81	254	8.91	81.79	6	54	0	3.60	0.68	1	3	1	1	74.50	1
			500	23.56	0	0	0	0	0	0			0	0.88	1	0		1.06	23.99	54	3.83	82.65	5	9	68	0.00	0.41	0	0	1	1	79.48	1
	3	TROKONIZ	1000	133.91	0	0	1	3	0	0	0.13	1.49	0	1.90	1	0	10.00	0.50	9.45	32	10.84	91.84	5	9	68	0.00	0.44	0	0	1	1	81.88	1
			2000	604.07	0	0	3	3	0	0			10	4.42	1	1		0.15	5.22	173	15.21	92.69	6	49	68	1.69	0.42	1	0	1	1	78.59	1

					N1						N2			N3			U1			U2	U3		C1					C2		C3			
					Rail		Bus		Tram		Car			Cycle	Walk interurban		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA		N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
				ha	nº	nº	nº	nº	nº	nº	1/km	1/km	nº	km	nº	nº	1/km	viv/ha	%	nº	%	% non	nº workers			ha	0-1	nº	nº	nº	nº	%	0-1
			500	24.56	0	0	0	0	0	0			0	0.52	0	0		1.47	53.24	77	0.00	69.29	4	3	0	0.00	0.84	1	0	0	0	69.29	0
	3	ERENTXUN	1000	145.53	0	0	0	0	0	0	0.13	0.59	0	1.56	0	1	10.00	0.29	10.96	94	1.23	93.90	5	3	0	0.12	0.85	1	0	0	1	92.75	0.5
			2000	710.65	0	0	1	3	0	0			0	3.72	0	1		0.13	5.42	209	6.39	96.09	6	5	0	1.38	0.90	2	0	0	1	89.95	0.5
			500	22.32	0	0	0	0	0	0			0	0.56	0	1		0.00	0.16	0	3.64	99.45	0	0	0	0.00	-	0	0	0	0	95.82	0
	4	GAUNA	1000	165.01	0	0	1	2	0	0	0.14	0.27	0	1.86	0	1	1.17	0.05	2.85	22	18.12	92.81	0	0	0	0.20	1.00	0	0	0	1	76.00	0.5
			2000	535.87	0	0	1	2	0	0			0	3.96	0	1		0.05	3.31	70	14.20	95.06	0	0	0	0.64	1.00	0	0	0	1	81.56	0.5
			500	23.31	0	0	0	0	0	0			0	0.97	0	1		0.04	4.34	4	54.15	77.35	0	0	0	0.00	1.00	1	0	0	1	35.47	0.5
	4	URIBARRI-JAUREGI	1000	109.24	0	0	0	0	0	0	0.13	0.16	0	1.78	0	1	0.87	0.01	2.81	4	63.45	83.44	0	0	0	0.00	1.00	1	0	0	1	30.50	0.5
			2000	560.94	0	0	1	2	0	0			0	3.93	0	1		0.08	3.02	91	52.33	89.05	1	0	0	1.27	0.98	2	0	0	1	42.45	0.5
			500	12.86	0	0	0	0	0	0			0	0.29	0	0		0.00	1.02	0	84.32	0.00	0	0	0	0.00	-	0	0	0	1	0.00	0
	-	BRIGADA TUNEL	1000	68.03	0	0	0	0	0	0	0.12	0.15	0	1.38	0	0	0.52	0.00	3.64	0	79.67	0.00	0	0	0	0.00	-	0	0	0	1	0.00	0
			2000	169.71	0	0	0	0	0	0			0	1.87	0	1		0.00	3.90	0	72.78	10.53	0	0	0	0.14	-	0	0	0	1	2.87	0
			500	15.26	0	0	0	0	0	0			0	0.00	0	0		0.00	0.00	0	6.09	0.00	0	0	0	0.00	-	0	0	0	0	0.00	0
	-	LAMINORIA	1000	120.30	0	0	0	0	0	0	0.00	0.24	0	0.15	0	0	0.43	0.00	1.79	0	41.81	0.00	0	0	0	0.00	-	0	0	0	1	0.00	0
			2000	352.31	0	0	0	0	0	0			0	1.15	0	0		0.00	2.61	0	48.77	9.62	0	0	0	0.00	-	0	0	0	1	4.93	0
			500	8.83	0	0	0	0	0	0			0	0.75	0	0		0.00	0.00	0	54.86	39.08	0	0	0	0.00	-	0	0	1	1	17.64	0.5
	4	ZEKUIANO	1000	63.89	0	0	0	0	0	0	0.00	0.54	0	1.51	0	0	1.57	0.53	10.59	25	38.87	64.90	0	2	0	0.00	0.86	2	0	1	1	39.67	1
			2000	419.53	0	0	0	0	0	0			38	3.37	0	0		0.66	6.96	366	32.89	61.15	4	43	78	0.39	0.59	3	0	1	1	41.04	1
			500	27.62	0	0	1	3	0	0			17	0.93	0	0		7.82	53.48	303	4.81	56.56	4	35	78	0.39	0.56	1	0	0	1	53.84	0.5
	3	MAEZTU	1000	127.42	0	0	1	3	0	0	0.00	9.09	38	1.84	0	0	10.00	1.84	27.59	332	17.84	68.76	29	42	78	1.52	0.51	2	0	2	1	56.49	1
			2000	542.98	0	0	1	3	0	0			122	4.45	0	0		0.47	9.23	349	41.18	73.19	29	44	78	3.56	0.52	4	0	2	1	43.05	1
			500	11.29	0	0	0	0	0	0			0	0.70	0	0		0.00	11.62	0	39.48	66.47	1	0	0	0.00	1.00	0	0	2	1	40.23	1
	4	ATAURI	1000	73.07	0	0	1	3	0	0	0.00	11.11	12	1.85	0	0	1.43	0.26	7.42	25	54.01	68.81	1	0	0	0.00	0.93	2	0	2	1	31.64	1
			2000	456.80	0	0	1	3	0	0			12	4.76	0	0		0.05	5.23	34	63.50	67.76	1	2	0	0.96	0.85	3	0	2	1	24.73	0.5
			500	11.57	0	0	1	3	0	0			13	0.51	1	2		0.35	7.77	13	7.76	88.20	0	0	0	0.28	1.00	2	0	0	1	81.35	0.5
4	4	ANTOÑANA	1000	68.99	0	0	1	3	0	0	0.00	11.11	22	1.27	1	2	4.65	1.12	14.86	92	23.34	85.17	1	3	0	1.39	0.92	3	1	1	1	65.29	1
			2000	355.66	0	0	1	3	0	0			22	3.31	1	2		0.30	8.75	137	46.22	78.91	1	4	0	3.74	0.93	3	1	2	1	42.44	1
			500	8.09	0	0	0	0	0	0			38	0.96	1	0		0.00	40.47	0	30.26	97.64	0	0	0	1.39	-	1	0	0	1	68.10	0.5
	-	FRESNEDO	1000	48.96	0	0	0	0	0	0	0.00	14.29	38	1.98	1	0	0.75	0.00	16.98	0	24.06	98.00	0	0	0	2.59	-	1	0	0	1	74.43	0.5
			2000	255.93	0	0	1	3	0	0			60	3.84	1	1		1.31	17.17	443	16.31	88.53	66	73	0	4.18	0.61	2	1	0	1	74.08	0.5
			500	15.87	0	0	0	0	0	0			31	0.41	1	1		1.64	28.15	53	6.82	79.10	2	8	0	0.41	0.72	0	0	0	1	73.70	0.5
	4	KANPEZU	1000	110.66	0	0	1	3	0	0	0.00	20.00	57	1.12	1	1	1.80	2.77	26.34	428	10.39	78.42	7	151	190	1.24	0.40	3	0	0	1	70.27	0.5
			2000	587.08	0	0	1	3	0	0			71	3.54	1	1		1.09	12.29	873	9.55	90.05	33	200	190	3.01	0.50	3	1	1	1	81.46	1
			500	6.80	0	0	0	0	0	0			0	0.75	0	0		0.00	17.44	0	3.15	89.07	0	0	0	0.53	-	0	0	0	0	86.26	0
	-	ORRADICHO	1000	89.93	0	0	0	0	0	0	0.00	20.00	0	1.84	0	0	0.62	0.00	4.10	0	2.03	96.68	0	0	0	1.19	-	0	0	0	0	94.72	0
			2000	511.73	0	0	1	3	0	0			0	3.07	1	1		0.26	4.43	162	11.06	100.0	3	104	190	2.84	0.35	4	0	1	1	89.03	1

					N1						N2			N3			U1			U2	U3		C1					C2		C3			
					Rail		Bus		Tram		Car			Cycle	Walk interurban		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA		N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
				ha	nº	nº	nº	nº	nº	nº	1/km	1/km	nº	km	nº	nº	1/km	viv/ha	%	nº	%	% non	nº workers			ha	0-1	nº	nº	nº	nº	%	0-1
	4	**ZUÑIGA**	**500**	15.61	0	0	1	4	0	0			0	1.00	0	0		0.00	39.65	0	1.96	85.91	0	0	0	0.00	-	1	0	0	0	84.23	0
			1000	95.27	0	0	2	4	0	0	0.00	20.00	0	1.93	0	0	1.23	0.46	25.15	50	20.05	84.62	2	1	0	0.13	0.89	2	0	0	0	67.66	0
			2000	439.09	0	0	2	4	0	0			8	3.90	0	0		0.22	12.71	109	33.30	96.87	2	1	0	0.64	0.95	3	1	1	1	64.61	1
	-	**ARQUITAS**	**500**	4.71	0	0	0	0	0	0			0	0.99	0	0		0.00	11.80	0	94.62	0.00	0	0	0	0.00	-	1	0	1	1	0.00	0.5
			1000	22.01	0	0	0	0	0	0	0.00	0.46	0	2.15	0	0	0.39	0.00	16.36	0	93.91	0.00	0	0	0	0.00	-	1	0	1	1	0.00	0.5
			2000	65.45	0	0	1	4	0	0			0	4.15	0	0		0.00	10.16	0	91.23	51.07	0	0	0	0.00	-	1	0	1	1	4.48	0.5
	3	**ACEDO**	**500**	21.72	0	0	1	4	0	0			0	0.76	0	0		2.44	33.38	82	0.00	69.29	2	3	0	0.32	0.89	3	0	0	0	69.29	0
			1000	127.40	0	0	1	4	0	0	0.00	16.67	0	2.29	0	0	3.64	0.83	19.26	163	6.54	82.49	4	6	0	0.32	0.89	4	0	0	0	77.09	0
			2000	492.12	0	0	1	4	0	0			50	4.16	0	0		0.22	7.57	163	40.16	90.87	4	36	0	0.32	0.68	5	0	0	1	54.38	0.5
	-	**GRANADA**	**500**	5.01	0	0	0	0	0	0			0	1.00	0	0		0.00	1.94	0	38.97	100.0	0	0	0	0.00	-	0	0	0	1	61.12	0.5
			1000	32.99	0	0	0	0	0	0	0.00	0.40	0	2.03	0	0	0.54	0.00	2.00	0	29.66	91.11	0	0	0	0.00	-	1	0	0	1	64.08	0.5
			2000	133.36	0	0	0	0	0	0			0	3.97	0	0		0.04	9.22	8	51.27	94.28	0	0	0	0.00	1.00	2	0	0	1	45.95	0.5
5	3	**ANCIN**	**500**	23.89	0	0	1	4	0	0			27	0.49	0	0		6.82	74.81	228	6.65	32.62	8	6	27	0.71	0.73	2	0	0	1	30.45	0.5
			1000	119.20	0	0	1	4	0	0	0.10	3.23	116	1.50	0	0	10.00	2.14	33.80	357	19.17	73.83	13	6	27	1.79	0.79	4	0	0	1	59.68	0.5
			2000	456.36	0	0	2	4	0	0			116	3.49	0	0		0.60	15.32	381	25.30	86.42	33	6	27	1.86	0.74	5	0	0	1	64.55	0.5
	3	**MURIETA**	**500**	8.39	0	0	0	0	0	0			21	0.78	0	0		1.55	43.92	17	2.04	79.06	0	5	0	0.10	0.65	0	0	0	0	77.45	0
			1000	101.84	0	0	1	4	0	0	0.11	4.00	21	1.74	0	0	10.00	2.55	26.51	349	4.39	80.06	9	30	0	0.81	0.82	2	0	0	1	76.54	0.5
			2000	506.96	0	0	2	4	0	0			86	3.62	0	0		0.55	14.12	383	2.39	88.18	564	30	0	0.88	0.49	4	0	0	1	86.07	0.5
	4	**ZUFIA**	**500**	26.32	0	0	1	4	0	0			0	0.00	0	0		0.04	48.10	0	60.35	88.84	0	0	0	0.00	-	0	0	0	1	35.23	0.5
			1000	172.31	0	0	1	4	0	0	0.23	10.00	0	0.00	0	0	0.87	0.05	35.35	0	44.35	83.68	0	0	0	0.00	-	0	0	0	1	46.57	0.5
			2000	803.30	0	0	2	4	0	0			0	0.00	0	0		0.09	26.84	112	37.03	87.42	3	2	0	0.00	0.92	1	0	0	1	55.04	0.5
	3	**ZUBIELQUI**	**500**	36.56	0	0	1	4	0	0			0	0.46	0	0		1.64	49.57	100	0.00	60.90	10	33	0	0.65	0.55	0	0	0	1	60.90	0.5
			1000	140.53	0	0	1	4	0	0	0.17	12.50	0	0.96	0	0	5.00	0.96	27.65	226	10.15	55.19	23	75	0	0.78	0.55	3	0	0	1	49.59	0.5
			2000	699.40	0	0	1	4	0	0			0	1.95	0	0		0.23	10.18	266	23.09	53.91	27	88	0	0.78	0.55	4	0	0	1	41.46	0.5
	2	**LIZARRA**	**500**	30.51	0	0	3	11	0	0			360	0.00	1	0		60.57	100.0	3367	12.82	4.37	621	701	741	3.91	0.43	4	2	0	0	3.81	0
			1000	132.71	0	0	8	11	0	0	0.40	1.49	1257	0.35	1	0	10.00	34.21	85.24	8312	14.77	5.31	1534	1730	2741	11.33	0.40	7	8	0	0	4.52	0
			2000	644.68	0	0	13	12	0	0			2574	1.35	1	0		10.51	49.38	12637	16.45	19.24	2332	2630	3213	15.47	0.42	8	8	0	1	16.07	0

% real data

RESCALED VALUES OF DEFINED NODE AREAS

				N1						N2			N3			U1			U2	U3		C1					C2		C3			
				Rail		Bus		Tram		Car			Cycle	Walk (interurban)		Town centr	Densit y	Land uses	Popul ation	Densit y	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
1			500	0.00	0.00	0.01	0.12	0.00	0.00			0.35	0.01	0.00	0.00		0.00	0.37	0.09	0.32	0.00	0.00	0.35	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00
	-	MALTZAGA	1000	0.00	0.00	0.01	0.12	0.00	0.00	0.72	0.10	0.35	0.02	0.00	0.00	0.05	0.00	0.20	0.09	0.58	0.00	0.55	0.36	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00
			2000	1.00	0.67	0.01	0.12	0.00	0.00			0.59	0.08	0.00	0.00		0.01	0.16	0.60	0.56	0.00	0.71	0.71	0.58	0.03	0.65	0.02	0.00	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.02	0.12	0.00	0.00			0.50	0.00	0.00	0.00		0.45	0.73	0.64	0.01	0.00	0.39	0.52	0.61	0.00	0.44	0.01	0.23	0.00	0.00	0.00	0.00
	2	SORALUZE-PLACENCIA DE LAS ARMAS	1000	0.00	0.00	0.03	0.12	0.00	0.00	0.21	0.01	0.59	0.02	0.00	0.00	1.00	0.29	0.57	0.69	0.09	0.00	0.57	0.56	0.61	0.01	0.39	0.01	0.31	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.04	0.12	0.00	0.00			0.65	0.06	0.00	0.00		0.05	0.16	0.70	0.46	0.00	0.75	0.58	0.61	0.01	0.48	0.01	0.38	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.01	0.05	0.00	0.00			0.45	0.05	0.00	0.00		0.04	0.17	0.50	0.43	0.00	0.61	0.32	0.00	0.00	0.50	0.00	0.08	0.00	0.00	0.00	0.00
	-	LOS MARTIRES	1000	0.00	0.00	0.01	0.07	0.00	0.00	0.23	0.08	0.54	0.09	0.00	0.00	0.01	0.01	0.10	0.50	0.63	0.00	0.61	0.32	0.00	0.00	0.49	0.00	0.08	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.03	0.12	0.00	0.00			0.60	0.18	0.00	0.00		0.00	0.06	0.52	0.71	0.00	0.62	0.35	0.00	0.00	0.49	0.00	0.12	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.01	0.07	0.00	0.00			0.50	0.04	0.00	0.00		0.01	0.33	0.30	0.31	0.02	0.51	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.02	0.00
	-	MEKOALDE	1000	0.00	0.00	0.02	0.07	0.00	0.00	0.36	0.07	0.50	0.06	0.00	0.00	0.02	0.00	0.14	0.34	0.56	0.06	0.52	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.03	0.00
			2000	0.00	0.00	0.04	0.12	0.00	0.00			0.63	0.11	0.00	0.00		0.00	0.11	0.46	0.54	0.04	0.72	0.41	0.00	0.00	0.54	0.00	0.12	0.00	0.00	0.02	0.00
			500	0.00	0.00	0.02	0.16	0.00	0.00			0.56	0.04	0.00	0.00		0.46	0.91	0.68	0.03	0.00	0.45	0.64	0.74	0.02	0.60	0.25	0.00	0.00	0.00	0.00	0.00
	2	BERGARA	1000	0.00	0.00	0.03	0.16	0.00	0.00	0.58	0.05	0.74	0.07	0.00	0.00	1.00	0.34	0.75	0.78	0.13	0.00	0.65	0.71	0.77	0.10	0.50	0.89	0.08	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.04	0.16	0.00	0.00			0.83	0.11	0.00	0.00		0.10	0.37	0.80	0.30	0.01	0.87	0.74	0.78	0.14	0.55	0.91	0.19	0.00	1.00	0.01	0.00
			500	0.00	0.00	0.00	0.14	0.00	0.00			0.62	0.04	0.00	0.00		0.01	0.98	0.14	0.01	0.00	0.49	0.34	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00
	-	ALTOS HORNOS	1000	0.00	0.00	0.02	0.14	0.00	0.00	1.00	0.04	0.67	0.05	0.00	0.00	0.03	0.02	0.78	0.49	0.11	0.01	0.76	0.40	0.00	0.00	0.50	0.00	0.04	0.00	0.00	0.01	0.00
			2000	0.00	0.00	0.03	0.14	0.00	0.00			0.72	0.14	0.00	0.00		0.03	0.31	0.70	0.39	0.01	0.80	0.54	0.67	0.01	0.54	0.03	0.08	0.00	0.00	0.01	0.00
			500	0.00	0.00	0.01	0.21	0.00	0.00			0.25	0.04	0.00	0.00		0.00	0.28	0.19	0.32	0.00	0.31	0.24	0.00	0.00	0.66	0.00	0.08	0.00	1.00	0.00	0.00
	-	SAN PRUDENCIO	1000	0.00	0.00	0.01	0.21	0.00	0.00	0.58	0.04	0.25	0.12	0.00	0.00	0.01	0.00	0.13	0.19	0.55	0.00	0.31	0.24	0.00	0.00	0.66	0.00	0.08	0.00	1.00	0.00	0.00
			2000	0.00	0.00	0.04	0.21	0.00	0.00			0.48	0.24	0.00	0.00		0.00	0.10	0.34	0.64	0.00	0.71	0.36	0.00	0.00	0.31	0.00	0.08	0.00	1.00	0.00	0.00
			500	0.00	0.00	0.02	0.12	0.00	0.00			0.51	0.04	0.00	0.00		0.04	0.55	0.45	0.07	0.00	0.72	0.34	0.00	0.00	0.47	0.00	0.04	0.00	0.00	0.00	0.00
	-	ZUBILLAGA	1000	0.00	0.00	0.03	0.12	0.00	0.00	0.21	0.00	0.63	0.09	0.00	0.00	0.00	0.01	0.24	0.46	0.37	0.02	0.80	0.46	0.00	0.00	0.44	0.00	0.04	0.00	0.00	0.02	0.00
			2000	0.00	0.00	0.06	0.12	0.00	0.00			0.67	0.16	0.00	0.00		0.00	0.14	0.48	0.44	0.01	0.86	0.47	0.00	0.00	0.37	0.00	0.04	0.00	1.00	0.01	0.00
			500	0.00	0.00	0.01	0.05	0.00	0.00			0.58	0.05	0.00	0.00		0.01	0.41	0.35	0.13	0.00	0.73	0.33	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.00
	-	SAN PEDRO	1000	0.00	0.00	0.02	0.09	0.00	0.00	0.14	0.00	0.62	0.09	0.00	0.00	0.05	0.01	0.26	0.50	0.16	0.00	0.83	0.48	0.00	0.06	0.46	0.00	0.04	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.05	0.14	0.00	0.00			0.72	0.19	0.00	0.00		0.02	0.20	0.69	0.28	0.01	0.92	0.67	0.64	0.09	0.67	0.73	0.19	0.00	0.00	0.01	0.00
			500	0.00	0.00	0.01	0.14	0.00	0.00			0.57	0.01	0.00	0.00		0.26	0.89	0.62	0.00	0.00	0.52	0.62	0.64	0.00	0.64	0.51	0.12	0.00	0.00	0.00	0.00
	2	OÑATI	1000	0.00	0.00	0.02	0.14	0.00	0.00	0.12	0.00	0.68	0.13	0.00	0.00	1.00	0.16	0.63	0.74	0.10	0.00	0.80	0.69	0.73	0.02	0.59	0.82	0.19	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.05	0.14	0.00	0.00			0.76	0.18	0.00	0.00		0.06	0.29	0.78	0.19	0.00	0.89	0.71	0.75	0.26	0.57	0.83	0.27	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.05	0.19	0.00	0.00			0.64	0.03	0.00	0.00		0.44	0.98	0.64	0.02	0.00	0.60	0.64	0.00	0.00	0.48	0.00	0.08	0.00	0.00	0.00	0.00
	2	ARRASATE	1000	0.00	0.00	0.10	0.23	0.00	0.00	0.37	0.02	0.71	0.04	0.00	0.00	1.00	0.44	0.85	0.76	0.13	0.00	0.76	0.74	0.74	0.03	0.58	0.25	0.12	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.34	0.07	0.00	0.00			0.83	0.24	0.00	0.00		0.16	0.51	0.84	0.35	0.02	0.90	0.82	0.81	0.28	0.56	0.26	0.23	0.00	0.00	0.02	0.00
			500	0.00	0.00	0.01	0.12	0.00	0.00			0.00	0.04	0.00	0.00		0.00	0.95	0.00	0.02	0.00	0.79	0.53	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00
	-	ULGOR	1000	0.00	0.00	0.03	0.16	0.00	0.00	0.23	0.02	0.70	0.06	0.00	0.00	0.13	0.13	0.78	0.63	0.02	0.00	0.80	0.66	0.59	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.21	0.26	0.00	0.00			0.77	0.23	0.00	0.00		0.14	0.45	0.81	0.40	0.00	0.86	0.81	0.77	0.14	0.57	0.27	0.19	0.00	0.00	0.00	0.00

				N1						N2			N3			U1			U2	U3		C1					C2		C3			
				Rail		Bus		Tram		Car			Cycle	Walk (interurban)		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
			500	0.00	0.00	0.03	0.16	0.00	0.00			0.71	0.05	0.00	0.00		0.42	0.93	0.67	0.06	0.00	0.59	0.61	0.67	0.00	0.55	0.01	0.04	0.00	0.00	0.00	0.00
	2	ARETXABALETA	1000	0.00	0.00	0.05	0.16	0.00	0.00	0.33	0.05	0.76	0.09	0.00	0.00	1.00	0.22	0.68	0.73	0.22	0.00	0.80	0.64	0.67	0.05	0.51	0.01	0.15	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.05	0.16	0.00	0.00			0.78	0.19	0.00	0.00		0.04	0.26	0.74	0.37	0.00	0.89	0.67	0.70	0.16	0.59	0.02	0.23	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.58	0.05	0.00	0.00		0.04	0.75	0.47	0.22	0.00	0.46	0.41	0.59	0.02	0.61	0.00	0.08	0.00	0.00	0.00	0.00
	-	LANDETA-MARIANISTAS	1000	0.00	0.00	0.02	0.14	0.00	0.00	0.54	1.00	0.72	0.09	0.00	0.00	0.22	0.08	0.62	0.65	0.21	0.00	0.88	0.59	0.65	0.05	0.68	0.00	0.12	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.07	0.16	0.00	0.00			0.80	0.19	0.00	0.00		0.09	0.37	0.77	0.25	0.01	0.89	0.69	0.76	0.16	0.58	0.24	0.38	0.00	0.00	0.01	0.00
			500	0.00	0.00	0.01	0.09	0.00	0.00			0.52	0.05	0.00	0.00		0.12	0.90	0.51	0.07	0.01	0.64	0.43	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.01	0.00
	2	ESKORIATZA	1000	0.00	0.00	0.02	0.16	0.00	0.00	0.42	0.03	0.64	0.09	0.00	0.00	0.22	0.09	0.42	0.65	0.40	0.05	0.67	0.52	0.52	0.02	0.44	0.22	0.08	0.00	0.00	0.03	0.00
			2000	0.00	0.00	0.04	0.16	0.00	0.00			0.69	0.15	0.00	0.00		0.03	0.19	0.69	0.48	0.03	0.73	0.58	0.64	0.02	0.50	0.23	0.19	0.00	0.00	0.02	0.00
			500	0.00	0.00	0.01	0.05	0.00	0.00			0.00	0.00	0.00	0.00		0.01	0.06	0.24	0.44	0.07	0.08	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.04	0.00
	-	CASTAÑARES	1000	0.00	0.00	0.02	0.05	0.00	0.00	0.21	0.00	0.46	0.02	0.00	0.00	0.01	0.01	0.13	0.37	0.40	0.03	0.13	0.22	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.02	0.00
			2000	0.00	0.00	0.02	0.05	0.00	0.00			0.46	0.04	0.00	0.00		0.00	0.13	0.42	0.62	0.01	0.43	0.31	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00
2			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.18	0.00	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-	MAZMELA	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.15	0.19	0.63	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.46	0.04	0.00	0.00		0.00	0.16	0.40	0.55	0.01	0.43	0.18	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.29	0.19	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-	ZARIMUZ	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.19	0.24	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.08	0.35	0.68	0.00	0.00	0.21	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00
			500	0.00	0.00	0.01	0.05	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.34	0.14	0.66	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	-	MARIN	1000	0.00	0.00	0.01	0.05	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.13	0.26	0.72	0.06	0.08	0.07	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.02	0.00
			2000	0.00	0.00	0.01	0.05	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.06	0.34	0.76	0.03	0.13	0.07	0.00	0.01	0.10	0.00	0.00	0.00	0.00	0.01	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.09	0.26	0.31	0.00	0.08	0.10	0.00	0.02	0.23	0.00	0.00	0.00	0.00	0.00	0.00
	4	LEINTZ-GATZAGA	1000	0.00	0.00	0.01	0.05	0.00	0.00	0.12	0.01	0.42	0.00	0.00	1.00	0.07	0.00	0.04	0.33	0.41	0.00	0.08	0.18	0.00	0.03	0.21	0.00	0.00	0.50	0.00	0.00	0.00
			2000	0.00	0.00	0.04	0.07	0.00	0.00			0.54	0.02	0.00	1.00		0.00	0.03	0.46	0.65	0.00	0.27	0.29	0.00	0.06	0.20	0.15	0.15	0.50	0.00	0.00	0.00
			500	0.00	0.00	0.01	0.07	0.00	0.00			0.47	0.02	0.00	1.00		0.00	0.11	0.16	0.65	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.04	0.50	0.00	0.00	0.00
	-	ARLABAN	1000	0.00	0.00	0.02	0.07	0.00	0.00	0.10	0.33	0.52	0.05	0.00	1.00	0.02	0.00	0.05	0.26	0.78	0.00	0.00	0.18	0.00	0.04	0.33	0.00	0.08	0.50	1.00	0.00	0.50
			2000	0.00	0.00	0.04	0.07	0.00	0.00			0.52	0.09	0.00	1.00		0.00	0.03	0.37	0.74	0.00	0.13	0.22	0.00	0.07	0.22	0.01	0.12	0.50	1.00	0.00	0.50
			500	0.00	0.00	0.01	0.05	0.00	0.00			0.51	0.04	0.00	0.33		0.00	0.23	0.22	0.66	0.00	0.00	0.17	0.00	0.01	0.39	0.00	0.00	0.00	1.00	0.00	0.00
	-	LANDA	1000	0.00	0.00	0.01	0.05	0.00	0.00	0.13	0.10	0.51	0.08	0.00	0.33	0.00	0.00	0.12	0.31	0.67	0.07	0.19	0.20	0.00	0.03	0.37	0.00	0.04	0.00	1.00	0.03	0.00
			2000	0.00	0.00	0.01	0.05	0.00	0.00			0.62	0.16	0.00	0.33		0.00	0.11	0.33	0.49	0.02	0.21	0.21	0.00	0.19	0.34	0.00	0.12	0.50	1.00	0.01	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.02	0.00	0.33		0.00	0.16	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4	LEGUTIO	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.08	0.00	0.33	0.00	0.00	0.32	0.19	0.09	0.04	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	1.00	0.04	0.00
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.17	0.00	0.33		0.00	0.29	0.22	0.30	0.07	0.49	0.07	0.00	0.04	0.29	0.00	0.08	0.00	1.00	0.05	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.03	0.00	0.33		0.01	0.27	0.33	0.23	0.34	0.00	0.07	0.00	0.02	0.04	0.00	0.00	0.00	1.00	0.28	0.50
	3	URBINA	1000	0.00	0.00	0.02	0.05	0.00	0.00	0.45	0.01	0.36	0.07	0.00	0.33	0.23	0.01	0.20	0.41	0.30	0.55	0.42	0.17	0.00	0.02	0.39	0.01	0.00	0.00	1.00	0.41	0.50
			2000	0.00	0.00	0.04	0.05	0.00	0.00			0.41	0.17	0.00	0.33		0.00	0.37	0.44	0.22	0.33	0.72	0.36	0.00	0.06	0.46	0.02	0.00	0.00	1.00	0.27	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.05	0.00	0.00		0.00	0.10	0.18	0.00	0.88	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.92	0.00
	4	ERRETANA	1000	0.00	0.00	0.01	0.05	0.00	0.00	0.32	0.04	0.00	0.09	0.00	0.00	0.15	0.00	0.24	0.33	0.04	0.80	0.08	0.17	0.00	0.02	0.19	0.00	0.00	0.00	1.00	0.80	0.50
			2000	0.00	0.00	0.02	0.05	0.00	0.00			0.00	0.18	0.00	0.33		0.00	0.30	0.42	0.05	0.79	0.69	0.49	0.00	0.05	0.60	0.00	0.00	0.00	1.00	0.78	0.50

				N1						N2			N3			U1			U2	U3		C1					C2		C3			
				Rail		Bus		Tram		Car			Cycle	Walk (interurban)		Town centr	Densit y	Land uses	Popul ation	Densit y	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
			500	0.00	0.00	0.02	0.07	0.00	0.00			0.00	0.04	0.00	0.00		0.01	0.23	0.32	0.02	0.69	0.23	0.25	0.00	0.01	0.45	0.00	0.00	0.00	1.00	0.71	0.50
	3	**DURANA**	**1000**	0.00	0.00	0.02	0.07	0.00	0.00	0.41	0.02	0.35	0.09	0.00	0.00	0.18	0.01	0.27	0.48	0.06	0.69	0.26	0.51	0.70	0.02	0.46	0.00	0.00	0.00	1.00	0.68	0.50
			2000	0.00	0.00	0.03	0.09	0.00	0.00			0.50	0.16	0.00	0.00		0.00	0.26	0.51	0.06	0.74	0.38	0.53	0.70	0.08	0.54	0.00	0.00	0.00	1.00	0.73	0.50
			500	0.00	0.00	0.12	0.49	0.00	0.00			0.76	0.09	0.00	0.00		0.73	1.00	0.77	0.00	0.00	0.69	0.73	0.71	0.06	0.48	0.00	0.08	0.00	0.00	0.00	0.00
	1	**VITORIA APEADERO**	**1000**	0.00	0.00	0.29	0.72	0.00	0.00	0.33	0.01	0.89	0.29	0.00	0.00	1.00	0.57	1.00	0.87	0.00	0.00	0.83	0.83	0.86	0.15	0.49	0.00	0.23	0.00	0.00	0.00	0.00
			2000	0.00	0.00	0.77	1.00	0.67	1.00			0.97	0.85	0.00	0.00		0.52	1.00	0.98	0.00	0.00	1.00	0.98	0.96	0.79	0.51	0.99	0.92	0.50	0.00	0.00	0.00
			500	0.00	0.00	0.10	0.67	0.00	0.00			0.77	0.00	0.00	0.00		1.00	1.00	0.79	0.00	0.00	0.54	0.76	0.76	0.00	0.49	0.04	0.04	0.00	0.00	0.00	0.00
	1	**VITORIA-CIUDAD**	**1000**	0.00	0.00	0.30	0.81	0.17	1.00	0.25	0.01	0.87	0.08	0.00	0.00	1.00	1.00	1.00	0.91	0.00	0.00	0.74	0.89	0.85	0.19	0.43	0.98	0.38	0.00	0.00	0.00	0.00
			2000	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00	0.00		0.65	1.00	1.00	0.00	0.00	0.95	1.00	1.00	0.67	0.51	1.00	1.00	0.50	0.00	0.00	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.48	0.03	1.00	0.00		0.00	0.96	0.23	0.03	0.24	0.60	0.53	0.00	0.02	0.51	0.00	0.04	0.00	0.00	0.25	0.00
3	-	**OLARIZU**	**1000**	0.00	0.00	0.04	0.23	0.00	0.00	0.15	0.00	0.63	0.10	1.00	0.00	0.12	0.05	0.76	0.63	0.01	0.38	0.70	0.60	0.63	0.15	0.66	0.00	0.08	0.00	0.00	0.39	0.00
			2000	1.00	1.00	0.25	0.70	0.17	0.67			0.85	0.41	1.00	0.33		0.20	0.65	0.87	0.02	0.44	0.84	0.82	0.83	1.00	0.46	0.00	0.27	0.00	0.00	0.45	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.04	0.00	0.00		0.01	0.46	0.26	0.02	0.74	0.00	0.22	0.00	0.00	0.40	0.00	0.04	0.00	1.00	0.76	0.50
	3	**OTAZU**	**1000**	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.09	1.00	0.00	0.51	0.00	0.26	0.36	0.05	0.81	0.08	0.22	0.00	0.02	0.21	0.00	0.04	0.00	1.00	0.81	0.50
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.50	0.16	1.00	0.00		0.00	0.12	0.44	0.08	0.85	0.08	0.31	0.00	0.04	0.24	0.02	0.15	0.00	1.00	0.82	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.04	0.00	0.00		0.01	0.37	0.38	0.01	0.72	0.00	0.07	0.00	0.01	0.02	0.00	0.00	0.00	1.00	0.75	0.50
	3	**ABERASTURI**	**1000**	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.01	0.00	0.09	0.00	0.00	0.66	0.01	0.25	0.41	0.05	0.83	0.00	0.07	0.00	0.02	0.01	0.00	0.04	0.00	1.00	0.82	0.50
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.00	0.17	1.00	0.33		0.00	0.06	0.42	0.11	0.94	0.00	0.07	0.00	0.05	0.01	0.00	0.04	0.50	1.00	0.87	1.00
			500	0.00	0.00	0.01	0.07	0.00	0.00			0.25	0.05	1.00	0.33		0.01	0.17	0.30	0.21	0.70	0.08	0.35	0.00	0.01	0.51	0.00	0.00	0.00	1.00	0.58	0.50
	3	**ANDOLLU**	**1000**	0.00	0.00	0.01	0.07	0.00	0.00	0.13	0.20	0.25	0.12	1.00	0.33	0.37	0.00	0.08	0.32	0.23	0.89	0.08	0.35	0.00	0.02	0.51	0.00	0.00	0.00	1.00	0.73	0.50
			2000	0.00	0.00	0.04	0.07	0.00	0.00			0.25	0.29	1.00	0.33		0.00	0.08	0.46	0.26	0.88	0.28	0.39	0.00	0.07	0.36	0.01	0.00	0.50	1.00	0.69	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.62	0.02	0.00	0.33		0.00	0.33	0.27	0.09	0.76	0.00	0.00	0.00	0.01	0.00	0.00	0.04	0.00	1.00	0.73	0.50
	4	**ESTIBALIZ**	**1000**	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.62	0.05	0.00	0.33	0.23	0.00	0.31	0.41	0.10	0.64	0.08	0.25	0.00	0.02	0.19	0.00	0.04	0.00	1.00	0.60	0.50
			2000	1.00	1.00	0.02	0.07	0.00	0.00			0.62	0.10	1.00	0.33		0.00	0.17	0.47	0.09	0.82	0.23	0.38	0.00	0.05	0.32	0.01	0.04	0.50	1.00	0.78	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.04	1.00	0.00		0.01	0.24	0.34	0.04	0.83	0.21	0.22	0.41	0.00	0.59	0.00	0.00	0.50	1.00	0.83	1.00
	3	**TROKONIZ**	**1000**	0.00	0.00	0.01	0.07	0.00	0.00	0.12	0.01	0.00	0.09	1.00	0.00	1.00	0.00	0.09	0.29	0.11	0.92	0.21	0.22	0.41	0.00	0.56	0.00	0.00	0.50	1.00	0.85	1.00
			2000	0.00	0.00	0.03	0.07	0.00	0.00			0.25	0.20	1.00	0.33		0.00	0.05	0.43	0.16	0.93	0.23	0.37	0.41	0.02	0.58	0.00	0.04	0.50	1.00	0.82	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.02	0.00	0.00		0.01	0.53	0.37	0.00	0.69	0.19	0.13	0.00	0.00	0.16	0.00	0.04	0.00	0.00	0.72	0.00
	3	**ERENTXUN**	**1000**	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.07	0.00	0.33	1.00	0.00	0.11	0.38	0.01	0.94	0.21	0.13	0.00	0.00	0.15	0.00	0.04	0.00	1.00	0.97	0.50
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.00	0.17	0.00	0.33		0.00	0.05	0.45	0.07	0.96	0.23	0.17	0.00	0.02	0.10	0.00	0.08	0.00	1.00	0.94	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.03	0.00	0.33		0.00	0.00	0.00	0.04	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
	4	**GAUNA**	**1000**	0.00	0.00	0.01	0.05	0.00	0.00	0.13	0.00	0.00	0.09	0.00	0.33	0.10	0.00	0.03	0.26	0.19	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.79	0.50
			2000	0.00	0.00	0.01	0.05	0.00	0.00			0.00	0.18	0.00	0.33		0.00	0.03	0.36	0.15	0.95	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1.00	0.85	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.04	0.00	0.33		0.00	0.04	0.12	0.57	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	1.00	0.37	0.50
	4	**URIBARRI-JAUREGI**	**1000**	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.08	0.00	0.33	0.06	0.00	0.03	0.12	0.67	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	1.00	0.32	0.50
			2000	0.00	0.00	0.01	0.05	0.00	0.00			0.00	0.18	0.00	0.33		0.00	0.03	0.38	0.55	0.89	0.08	0.00	0.00	0.02	0.02	0.00	0.08	0.00	1.00	0.44	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.01	0.00	0.00		0.00	0.01	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	-	**BRIGADA TUNEL**	**1000**	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.06	0.00	0.00	0.03	0.00	0.04	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.09	0.00	0.33		0.00	0.04	0.00	0.77	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.03	0.00

				N1						N2			N3			U1			U2	U3		C1					C2		C3			
				Rail		Bus		Tram		Car			Cycle	Walk (interurban)		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA	N11	N12	N13	N14	N15	N16	N21	N22	N23	N31	N32	N33	U11	U12	U13	U21	U31	U32	C11	C12	C13	C14	C15	C21	C22	C31	C32	C33	C34
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-	LAMINORIA	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.02	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.05	0.00	0.00		0.00	0.03	0.00	0.52	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.05	0.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.03	0.00	0.00		0.00	0.00	0.00	0.58	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.18	0.50
	4	ZEKUIANO	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.07	0.00	0.00	0.14	0.00	0.11	0.27	0.41	0.65	0.00	0.10	0.00	0.00	0.14	0.00	0.08	0.50	1.00	0.41	1.00
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.39	0.16	0.00	0.00		0.01	0.07	0.50	0.35	0.61	0.19	0.36	0.43	0.01	0.41	0.00	0.12	0.50	1.00	0.43	1.00
			500	0.00	0.00	0.01	0.07	0.00	0.00			0.30	0.04	0.00	0.00		0.06	0.53	0.48	0.05	0.57	0.19	0.34	0.43	0.01	0.44	0.00	0.04	0.00	1.00	0.56	0.50
	3	MAEZTU	1000	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.09	0.39	0.09	0.00	0.00	1.00	0.01	0.28	0.49	0.19	0.69	0.39	0.35	0.43	0.02	0.49	0.00	0.08	1.00	1.00	0.59	1.00
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.52	0.21	0.00	0.00		0.00	0.09	0.49	0.44	0.73	0.39	0.36	0.43	0.05	0.48	0.00	0.15	1.00	1.00	0.45	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.03	0.00	0.00		0.00	0.12	0.00	0.42	0.66	0.08	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.42	1.00
	4	ATAURI	1000	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.11	0.27	0.09	0.00	0.00	0.12	0.00	0.07	0.27	0.57	0.69	0.08	0.00	0.00	0.00	0.07	0.00	0.08	1.00	1.00	0.33	1.00
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.27	0.22	0.00	0.00		0.00	0.05	0.30	0.67	0.68	0.08	0.10	0.00	0.01	0.15	0.00	0.12	1.00	1.00	0.26	0.50
			500	0.00	0.00	0.01	0.07	0.00	0.00			0.28	0.02	1.00	0.67		0.00	0.08	0.22	0.08	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	1.00	0.85	0.50
4	4	ANTOÑANA	1000	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.11	0.33	0.06	1.00	0.67	0.45	0.01	0.15	0.38	0.25	0.85	0.08	0.13	0.00	0.02	0.08	0.00	0.12	0.50	1.00	0.68	1.00
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.33	0.15	1.00	0.67		0.00	0.09	0.41	0.49	0.79	0.08	0.15	0.00	0.05	0.07	0.00	0.12	1.00	1.00	0.44	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.39	0.04	1.00	0.00		0.00	0.40	0.00	0.32	0.98	0.00	0.00	0.00	0.02	0.00	0.00	0.04	0.00	1.00	0.71	0.50
	-	FRESNEDO	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.39	0.09	1.00	0.00	0.05	0.00	0.17	0.00	0.25	0.98	0.00	0.00	0.00	0.03	0.00	0.00	0.04	0.00	1.00	0.78	0.50
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.44	0.18	1.00	0.33		0.01	0.17	0.51	0.17	0.89	0.49	0.40	0.00	0.06	0.39	0.00	0.08	0.00	1.00	0.77	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.37	0.02	1.00	0.33		0.01	0.28	0.33	0.07	0.79	0.13	0.21	0.00	0.01	0.28	0.00	0.00	0.00	1.00	0.77	0.50
	4	KANPEZU	1000	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.20	0.43	0.05	1.00	0.33	0.16	0.02	0.26	0.51	0.11	0.78	0.24	0.47	0.51	0.02	0.60	0.00	0.12	0.00	1.00	0.73	0.50
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.46	0.16	1.00	0.33		0.01	0.12	0.57	0.10	0.90	0.41	0.50	0.51	0.04	0.50	0.00	0.12	0.50	1.00	0.85	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.03	0.00	0.00		0.00	0.17	0.00	0.03	0.89	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.90	0.00
	-	ORRADICHO	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.09	0.00	0.00	0.04	0.00	0.04	0.00	0.02	0.97	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.99	0.00
			2000	0.00	0.00	0.01	0.07	0.00	0.00			0.00	0.14	1.00	0.33		0.00	0.04	0.43	0.12	1.00	0.16	0.44	0.51	0.04	0.65	0.00	0.15	0.50	1.00	0.93	1.00
			500	0.00	0.00	0.01	0.09	0.00	0.00			0.00	0.05	0.00	0.00		0.00	0.40	0.00	0.02	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.88	0.00
	4	ZUÑIGA	1000	0.00	0.00	0.02	0.09	0.00	0.00	0.00	0.20	0.00	0.09	0.00	0.00	0.10	0.00	0.25	0.33	0.21	0.85	0.13	0.07	0.00	0.00	0.11	0.00	0.08	0.00	0.00	0.71	0.00
			2000	0.00	0.00	0.02	0.09	0.00	0.00			0.22	0.18	0.00	0.00		0.00	0.13	0.40	0.35	0.97	0.13	0.07	0.00	0.01	0.05	0.00	0.12	0.50	1.00	0.67	1.00
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.05	0.00	0.00		0.00	0.12	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.50	1.00	0.00	0.50
	-	ARQUITAS	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.02	0.00	0.16	0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.50	1.00	0.00	0.50
			2000	0.00	0.00	0.01	0.09	0.00	0.00			0.00	0.19	0.00	0.00		0.00	0.10	0.00	0.96	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.50	1.00	0.05	0.50
			500	0.00	0.00	0.01	0.09	0.00	0.00			0.00	0.04	0.00	0.00		0.02	0.33	0.37	0.00	0.69	0.13	0.13	0.00	0.00	0.11	0.00	0.12	0.00	0.00	0.72	0.00
	3	ACEDO	1000	0.00	0.00	0.01	0.09	0.00	0.00	0.00	0.17	0.00	0.11	0.00	0.00	0.35	0.01	0.19	0.43	0.07	0.82	0.19	0.18	0.00	0.00	0.11	0.00	0.15	0.00	0.00	0.80	0.00
			2000	0.00	0.00	0.01	0.09	0.00	0.00			0.42	0.19	0.00	0.00		0.00	0.08	0.43	0.42	0.91	0.19	0.34	0.00	0.00	0.32	0.00	0.19	0.00	1.00	0.57	0.50
			500	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.05	0.00	0.00		0.00	0.02	0.00	0.41	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.64	0.50
	-	GRANADA	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.03	0.00	0.02	0.00	0.31	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	1.00	0.67	0.50
			2000	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.18	0.00	0.00		0.00	0.09	0.18	0.54	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	1.00	0.48	0.50
			500	0.00	0.00	0.01	0.09	0.00	0.00			0.35	0.02	0.00	0.00		0.05	0.75	0.46	0.07	0.33	0.26	0.18	0.33	0.01	0.27	0.00	0.08	0.00	1.00	0.32	0.50
	3	ANCIN	1000	0.00	0.00	0.01	0.09	0.00	0.00	0.09	0.03	0.51	0.07	0.00	0.00	1.00	0.02	0.34	0.50	0.20	0.74	0.31	0.18	0.33	0.02	0.21	0.00	0.15	0.00	1.00	0.62	0.50
			2000	0.00	0.00	0.02	0.09	0.00	0.00			0.51	0.16	0.00	0.00		0.00	0.15	0.50	0.27	0.86	0.41	0.18	0.33	0.02	0.26	0.00	0.19	0.00	1.00	0.67	0.50

				N1						N2			N3			U1			U2	U3		C1					C2		C3			
				Rail		Bus		Tram		Car			Cycle	Walk (interurban)		Town centr	Density	Land uses	Population	Density	Land uses	Activities				Mult.	Elements of interest		Activities			Mult.
ZONE	URB. AREA	NODE	AREA	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{21}	N_{22}	N_{23}	N_{31}	N_{32}	N_{33}	U_{11}	U_{12}	U_{13}	U_{21}	U_{31}	U_{32}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{21}	C_{22}	C_{31}	C_{32}	C_{33}	C_{34}
5	3	MURIETA	500	0.00	0.00	0.00	0.00	0.00	0.00			0.33	0.04	0.00	0.00		0.01	0.44	0.24	0.02	0.79	0.00	0.17	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.81	0.00
			1000	0.00	0.00	0.01	0.09	0.00	0.00	0.10	0.04	0.33	0.08	0.00	0.00	1.00	0.02	0.27	0.49	0.05	0.80	0.27	0.32	0.00	0.01	0.18	0.00	0.08	0.00	1.00	0.80	0.50
			2000	0.00	0.00	0.02	0.09	0.00	0.00			0.48	0.17	0.00	0.00		0.00	0.14	0.50	0.03	0.88	0.74	0.32	0.00	0.01	0.51	0.00	0.15	0.00	1.00	0.90	0.50
	4	ZUFIA	500	0.00	0.00	0.01	0.09	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.48	0.00	0.64	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.37	0.50
			1000	0.00	0.00	0.01	0.09	0.00	0.00	0.21	0.10	0.00	0.00	0.00	0.00	0.06	0.00	0.35	0.00	0.47	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.49	0.50
			2000	0.00	0.00	0.02	0.09	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.27	0.40	0.39	0.87	0.16	0.10	0.00	0.00	0.08	0.00	0.04	0.00	1.00	0.57	0.50
	3	ZUBIELQUI	500	0.00	0.00	0.01	0.09	0.00	0.00			0.00	0.02	0.00	0.00		0.01	0.50	0.39	0.00	0.61	0.28	0.33	0.00	0.01	0.45	0.00	0.00	0.00	1.00	0.64	0.50
			1000	0.00	0.00	0.01	0.09	0.00	0.00	0.16	0.12	0.00	0.04	0.00	0.00	0.49	0.01	0.28	0.46	0.11	0.55	0.37	0.41	0.00	0.01	0.45	0.00	0.12	0.00	1.00	0.52	0.50
			2000	0.00	0.00	0.01	0.09	0.00	0.00			0.00	0.09	0.00	0.00		0.00	0.10	0.47	0.24	0.54	0.39	0.42	0.00	0.01	0.45	0.00	0.15	0.00	1.00	0.43	0.50
	2	LIZARRA	500	0.00	0.00	0.03	0.26	0.00	0.00			0.63	0.00	1.00	0.00		0.47	1.00	0.68	0.14	0.04	0.75	0.62	0.65	0.05	0.57	0.01	0.15	0.00	0.00	0.04	0.00
			1000	0.00	0.00	0.08	0.26	0.00	0.00	0.37	0.01	0.77	0.02	1.00	0.00	1.00	0.26	0.85	0.76	0.16	0.05	0.85	0.70	0.77	0.15	0.60	0.04	0.27	0.00	0.00	0.05	0.00
			2000	0.00	0.00	0.13	0.28	0.00	0.00			0.84	0.06	1.00	0.00		0.08	0.49	0.80	0.17	0.19	0.90	0.74	0.79	0.21	0.58	0.04	0.31	0.00	1.00	0.17	0.00

log-transformed parameters

4.2.2. AHP

PAIR WISE COMPARISON

	N11	N12	N13	N14	N15	N16
N11	1.0	1.0	0.3	0.3	1.0	1.0
N12	1.0	1.0	0.3	0.3	1.0	1.0
N13	3.0	3.0	1.0	1.0	3.0	3.0
N14	3.0	3.0	1.0	1.0	3.0	3.0
N15	1.0	1.0	0.3	0.3	1.0	1.0
N16	1.0	1.0	0.3	0.3	1.0	1.0
TOT	**10.0**	**10.0**	**3.3**	**3.3**	**10.0**	**10.0**

	N21	N22	N23
N21	1.0	2.0	1.0
N22	0.5	1.0	0.5
N23	1.0	2.0	1.0
TOT	**2.5**	**5.0**	**2.5**

	N31	N32	N33
N31	1.0	0.8	1.0
N32	1.3	1.0	1.3
N33	1.0	0.8	1.0
TOT	**3.3**	**2.5**	**3.3**

	U11	U12	U13
U11	1.0	1.0	2.0
U12	1.0	1.0	2.0
U13	0.5	0.5	1.0
TOT	**2.5**	**2.5**	**5.0**

	U21
U21	1.0
TOT	**1.0**

	U31	U32
U31	1.0	1.0
U32	1.0	1.0
TOT	**2.0**	**2.0**

	C11	C12	C13	C14	C15
C11	1.0	1.0	1.0	1.0	0.58
C12	1.0	1.0	1.0	1.0	0.58
C13	1.0	1.0	1.0	1.0	0.58
C14	1.0	1.0	1.0	1.0	0.58
C15	1.7	1.7	1.7	1.7	1.0
TOT	**5.7**	**5.7**	**5.7**	**5.7**	**3.3**

	C21	C22
C21	1.0	1.0
C22	1.0	1.0
TOT	**2.0**	**2.0**

	C31	C32	C33	C34
C31	1.0	1.5	1.5	1.0
C32	0.7	1.0	1.0	0.7
C33	0.7	1.0	1.0	0.7
C34	1.0	1.5	1.5	1.0
TOT	**3.3**	**5.0**	**5.0**	**3.3**

NORMALISED MATRIX AND CONSISTENCY ANALYSIS

	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	TOTAL	AVERAGE	CONSISTENCY M.
N_{11}	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.100	6.0
N_{12}	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.100	6.0
N_{13}	0.30	0.30	0.30	0.30	0.30	0.30	1.50	0.300	6.0
N_{14}	0.30	0.30	0.30	0.30	0.30	0.30	1.50	0.300	6.0
N_{15}	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.100	6.0
N_{16}	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.100	6.0
TOT	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**5.0**	**1.0**	
								CI =	0.000
								RI =	1.24
								C.RATIO =	**0.00** **<0.1**

	N_{21}	N_{22}	N_{23}	TOTAL	AVERAGE	CONSISTENCY M.
N_{21}	0.40	0.40	0.40	1.20	0.400	3.00
N_{22}	0.20	0.20	0.20	0.60	0.200	3.00
N_{23}	0.40	0.40	0.40	1.20	0.400	3.00
TOT	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**	
					CI =	0.000
					RI =	0.58
					C.RATIO =	**0.00** **<0.1**

	N_{31}	N_{32}	N_{33}	TOTAL	AVERAGE	CONSISTENCY M.
N_{31}	0.30	0.30	0.30	0.90	0.300	3.00
N_{32}	0.40	0.40	0.40	1.20	0.400	3.00
N_{33}	0.30	0.30	0.30	0.90	0.300	3.00
TOT	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**	
					CI =	0.000
					RI =	0.9
					C.RATIO =	**0.00** **<0.1**

	U_{11}	U_{12}	U_{13}	TOTAL	AVERAGE	CONSISTENCY M.
U_{11}	0.40	0.40	0.40	1.20	0.400	3.00
U_{12}	0.40	0.40	0.40	1.20	0.400	3.00
U_{13}	0.20	0.20	0.20	0.60	0.200	3.00
TOT	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**	
					CI =	0.000
					RI =	0.58
					C.RATIO =	**0.00** **<0.1**

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	TOTAL	AVERAGE	CONSISTENCY M.
C_{11}	0.18	0.18	0.18	0.18	0.18	0.88	0.175	5.00
C_{12}	0.18	0.18	0.18	0.18	0.18	0.88	0.175	5.00
C_{13}	0.18	0.18	0.18	0.18	0.18	0.88	0.175	5.00
C_{14}	0.18	0.18	0.18	0.18	0.18	0.88	0.175	5.00
C_{15}	0.30	0.30	0.30	0.30	0.30	1.50	0.300	5.00
TOT	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**5.0**	**1.0**	
							CI =	0.000
							RI =	1.12
							C.RATIO =	**0.00** **<0.1**

	C_{31}	C_{32}	C_{33}	C_{34}	TOTAL	AVERAGE	CONSISTENCY M.
C_{31}	0.30	0.30	0.30	0.30	1.20	0.300	4.00
C_{32}	0.20	0.20	0.20	0.20	0.80	0.200	4.00
C_{33}	0.20	0.20	0.20	0.20	0.80	0.200	4.00
C_{34}	0.30	0.30	0.30	0.30	1.20	0.300	4.00
TOT	**1.0**	**1.0**	**1.0**	**1.0**	**4.0**	**1.0**	
						CI =	0.000
						RI =	0.9
						C.RATIO =	**0.00** **<0.1**

4.2.3. MCDA

VALUES RESULTED FROM MCA

VALUES RESULTED FROM MCA I				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
1			500	1.63	0.74	1.63	1.15	0.33	0.38	0.95	1.00	4.47	0.93	0.00	0.04	1.58	0.00	0.77	1.84	0.49	1.19	1.04
	-	MALTZAGA	1000	1.64	1.23	1.64	1.48	0.97	0.38	0.61	2.92	4.47	0.93	0.00	0.06	2.92	0.00	1.34	1.84	0.90	1.43	1.36
			2000	2.58	2.50	2.58	3.13	1.87	2.04	0.56	5.50	5.47	6.05	0.12	0.23	2.79	0.00	2.81	3.77	0.92	2.54	2.53
		SORALUZE-	500	1.10	3.16	1.10	4.59	1.73	0.41	7.28	3.99	2.89	6.44	1.20	0.00	0.04	0.00	3.72	3.36	0.01	2.13	2.47
	2	PLACENCIA DE	1000	1.24	3.24	1.24	4.54	1.94	0.44	6.29	4.24	3.22	6.86	1.59	0.05	0.45	0.00	3.52	3.74	0.15	2.24	2.57
		LAS ARMAS	2000	1.37	3.44	1.37	4.60	2.28	0.47	4.49	4.87	3.49	6.97	1.97	0.17	2.34	0.00	3.21	4.00	0.76	2.41	2.75
			500	1.06	1.86	1.06	2.55	1.17	0.17	0.54	3.13	2.88	4.97	0.38	0.14	2.14	0.00	1.32	2.64	0.69	1.46	1.60
	-	LOS MARTIRES	1000	1.25	2.00	1.25	2.83	1.17	0.24	0.29	3.11	3.24	5.02	0.38	0.28	3.17	0.00	1.26	2.78	1.05	1.63	1.75
			2000	1.50	2.12	1.50	2.99	1.25	0.44	0.20	3.17	3.50	5.19	0.58	0.55	3.59	0.00	1.32	2.98	1.27	1.81	1.91
			500	1.32	1.26	1.32	1.80	0.73	0.24	0.75	2.16	3.60	3.00	0.00	0.12	1.65	0.03	1.06	2.16	0.55	1.29	1.28
	-	MEKOALDE	1000	1.35	1.54	1.35	2.29	0.80	0.27	0.37	2.34	3.60	3.38	0.00	0.17	3.12	0.06	1.02	2.28	1.02	1.45	1.48
			2000	1.63	2.00	1.63	2.61	1.40	0.47	0.31	3.58	4.10	4.64	0.58	0.33	2.88	0.04	1.51	3.03	0.99	1.82	1.88
			500	1.77	3.49	1.77	4.88	2.10	0.55	7.67	5.06	4.65	6.83	1.24	0.12	0.13	0.00	4.26	4.11	0.08	2.63	2.92
	2	BERGARA	1000	2.05	4.26	2.05	5.11	3.42	0.58	6.88	5.42	5.39	7.76	4.83	0.20	0.68	0.00	4.16	5.91	0.28	3.16	3.53
			2000	2.23	4.71	2.23	4.89	4.53	0.61	5.12	6.08	5.74	8.00	5.51	0.34	1.54	2.02	3.88	6.34	1.29	3.47	3.88
			500	2.35	1.09	2.35	1.18	0.99	0.42	2.13	2.97	6.53	1.36	0.00	0.12	0.06	0.00	1.83	2.69	0.06	1.72	1.51
	-	ALTOS HORNOS	1000	2.46	1.85	2.46	2.44	1.26	0.48	1.79	3.54	6.75	4.92	0.22	0.15	0.61	0.02	1.94	3.91	0.24	2.15	2.05
			2000	2.63	2.60	2.63	3.29	1.91	0.51	0.89	5.16	6.95	6.97	0.55	0.43	2.00	0.01	2.25	4.72	0.76	2.61	2.61
		SAN	500	1.39	1.56	1.39	1.35	1.77	0.66	0.61	2.94	3.38	1.85	0.38	0.13	1.58	2.00	1.44	1.87	1.22	1.47	1.50
	-	PRUDENCIO	1000	1.46	1.73	1.46	1.68	1.78	0.66	0.31	2.95	3.38	1.94	0.38	0.35	2.78	2.00	1.36	1.90	1.66	1.59	1.64
			2000	1.93	2.00	1.93	2.28	1.73	0.75	0.24	2.80	4.31	3.36	0.38	0.73	3.22	2.00	1.31	2.65	1.92	1.97	1.98
			500	1.13	1.60	1.13	2.05	1.15	0.41	1.29	3.27	2.88	4.50	0.19	0.11	0.37	0.00	1.67	2.43	0.15	1.37	1.45
	-	ZUBILLAGA	1000	1.36	1.81	1.36	2.38	1.25	0.44	0.54	3.51	3.38	4.63	0.19	0.26	1.97	0.03	1.54	2.64	0.69	1.59	1.66
			2000	1.50	2.17	1.50	2.46	1.89	0.53	0.31	3.43	3.51	4.84	0.22	0.47	2.22	2.01	1.48	2.75	1.54	1.84	1.95
			500	1.06	1.30	1.06	1.71	0.89	0.17	1.06	2.64	2.88	3.45	0.02	0.14	0.63	0.00	1.30	2.05	0.24	1.18	1.22
	-	SAN PEDRO	1000	1.21	1.77	1.21	2.20	1.33	0.34	0.76	3.77	3.03	5.03	0.22	0.27	0.82	0.00	1.67	2.64	0.34	1.49	1.58
			2000	1.53	3.30	1.53	3.02	3.57	0.57	0.70	6.08	3.44	6.93	4.62	0.58	1.44	0.02	2.54	4.90	0.64	2.41	2.71
			500	1.07	3.53	1.07	4.34	2.73	0.45	6.82	5.04	2.74	6.19	3.14	0.02	0.00	0.00	3.97	3.91	0.01	2.30	2.71
	2	OÑATI	1000	1.36	4.08	1.36	4.57	3.58	0.48	5.89	5.69	3.20	7.36	5.05	0.39	0.48	0.00	3.92	5.10	0.28	2.72	3.17
			2000	1.53	4.22	1.53	4.52	3.92	0.57	4.82	6.27	3.49	7.76	5.48	0.53	0.97	0.00	3.84	5.47	0.48	2.87	3.32
			500	1.63	3.05	1.63	4.75	1.34	0.71	7.73	3.62	4.09	6.43	0.41	0.09	0.10	0.00	3.83	3.50	0.06	2.34	2.57
	2	ARRASATE	1000	1.82	3.87	1.82	5.22	2.52	0.99	7.45	5.71	4.35	7.56	1.84	0.12	0.65	0.00	4.58	4.44	0.24	2.85	3.19
			2000	2.28	4.17	2.28	5.30	3.04	1.24	5.67	6.61	4.86	8.38	2.47	0.73	1.84	0.03	4.45	5.08	0.82	3.22	3.54

VALUES RESULTED FROM MCA I

ZONE	URB. AREA	NODE	AREA	NODE/PLACE N	NODE/PLACE P	NODUS/URBS/ CIVITAS N	NODUS/URBS/ CIVITAS U	NODUS/URBS/ CIVITAS C	N1-N2-N3 / U1-U2-U3 / C1-C2-C3 N1	U1	C1	N2	U2	C2	N3	U3	C3	URBAN/ GENERAL/RURAL urban	gener.	rural	TOTAL N/P	N/U/C
	-	ULGOR	500	0.49	0.99	0.49	0.83	1.14	0.38	2.42	3.41	0.97	0.00	0.00	0.12	0.09	0.00	2.05	0.34	0.07	0.74	0.82
			1000	1.50	2.45	1.50	2.99	1.91	0.58	2.61	5.72	3.75	6.27	0.00	0.19	0.09	0.00	2.99	3.19	0.09	1.98	2.13
			2000	2.05	3.43	2.05	4.03	2.84	1.39	1.99	6.21	4.06	8.10	2.30	0.70	2.01	0.01	3.25	4.66	0.85	2.74	2.97
	2	ARETXABALETA	500	1.66	3.29	1.66	4.86	1.72	0.58	7.53	4.93	4.26	6.74	0.24	0.15	0.31	0.00	4.19	3.59	0.14	2.48	2.75
			1000	1.79	3.47	1.79	4.88	2.05	0.64	6.23	5.31	4.46	7.32	0.84	0.27	1.11	0.01	3.95	4.05	0.43	2.63	2.91
			2000	1.93	3.53	1.93	4.65	2.42	0.64	4.69	6.00	4.57	7.41	1.25	0.58	1.85	0.00	3.73	4.26	0.76	2.73	3.00
	-	LANDETA-MARIANISTAS	500	2.21	2.19	2.21	2.78	1.61	0.00	2.53	4.44	6.50	4.68	0.38	0.14	1.12	0.00	2.32	3.81	0.38	2.20	2.20
			1000	2.60	2.73	2.60	3.31	2.15	0.48	2.40	5.86	7.04	6.46	0.58	0.27	1.07	0.01	2.94	4.61	0.42	2.66	2.68
			2000	2.89	3.37	2.89	3.67	3.08	0.69	1.97	6.10	7.40	7.71	3.12	0.58	1.31	0.01	2.97	6.00	0.60	3.13	3.21
	2	ESKORIATZA	500	1.42	2.05	1.42	2.90	1.21	0.31	3.15	3.58	3.82	5.14	0.02	0.14	0.41	0.02	2.31	2.89	0.18	1.74	1.84
			1000	1.70	2.78	1.70	3.60	1.96	0.55	2.10	4.32	4.29	6.46	1.51	0.26	2.25	0.06	2.33	3.97	0.79	2.24	2.42
			2000	1.86	3.00	1.86	3.63	2.36	0.61	1.40	4.94	4.52	6.90	2.11	0.45	2.59	0.04	2.36	4.39	0.95	2.43	2.62
	-	CASTAÑARES	500	0.34	0.95	0.34	1.72	0.18	0.17	0.21	0.46	0.85	2.39	0.00	0.00	2.55	0.08	0.28	1.02	0.79	0.64	0.75
			1000	0.97	1.25	0.97	2.07	0.43	0.20	0.36	1.26	2.67	3.68	0.00	0.05	2.16	0.04	0.62	2.04	0.68	1.11	1.16
			2000	1.00	1.74	1.00	2.56	0.91	0.20	0.32	2.73	2.67	4.19	0.00	0.12	3.16	0.01	1.12	2.19	0.99	1.37	1.49
2	-	MAZMELA	500	0.29	0.59	0.29	1.18	0.00	0.00	0.42	0.00	0.87	0.00	0.00	0.00	3.10	0.00	0.13	0.30	0.93	0.44	0.49
			1000	0.29	0.90	0.29	1.80	0.00	0.00	0.36	0.00	0.87	1.85	0.00	0.00	3.18	0.01	0.11	0.86	0.96	0.60	0.70
			2000	0.94	1.59	0.94	2.39	0.80	0.00	0.39	2.40	2.69	3.96	0.00	0.12	2.81	0.01	0.95	2.13	0.89	1.27	1.38
	-	ZARIMUZ	500	0.19	0.60	0.19	1.21	0.00	0.00	0.65	0.00	0.56	1.85	0.00	0.00	1.12	0.00	0.20	0.75	0.33	0.39	0.46
			1000	0.19	0.88	0.19	1.75	0.00	0.00	0.46	0.00	0.56	2.44	0.00	0.00	2.35	0.01	0.14	0.93	0.71	0.53	0.65
			2000	0.19	1.35	0.19	2.37	0.33	0.00	0.24	0.98	0.56	3.45	0.00	0.00	3.40	0.00	0.42	1.23	1.02	0.77	0.96
	-	MARIN	500	0.21	0.91	0.21	1.81	0.00	0.17	0.71	0.00	0.47	1.36	0.00	0.00	3.37	0.01	0.27	0.57	1.01	0.56	0.68
			1000	0.21	1.27	0.21	2.28	0.25	0.17	0.30	0.71	0.47	2.64	0.00	0.00	3.90	0.04	0.40	0.96	1.18	0.74	0.91
			2000	0.21	1.36	0.21	2.49	0.22	0.17	0.16	0.66	0.47	3.36	0.00	0.00	3.94	0.02	0.34	1.17	1.19	0.78	0.97
	4	LEINTZ-GATZAGA	500	0.16	0.93	0.16	1.52	0.34	0.00	0.47	1.03	0.49	2.57	0.00	0.00	1.53	0.00	0.50	0.94	0.46	0.55	0.68
			1000	1.78	1.40	1.78	1.91	0.88	0.17	0.35	1.15	2.16	3.35	0.00	3.00	2.03	1.50	0.57	1.76	2.18	1.59	1.52
			2000	2.02	2.16	2.02	2.74	1.57	0.33	0.35	1.69	2.65	4.64	1.53	3.07	3.23	1.50	0.81	2.86	2.57	2.09	2.11
	-	ARLABAN	500	2.09	1.16	2.09	1.74	0.58	0.24	0.32	0.03	2.97	1.64	0.19	3.06	3.26	1.50	0.19	1.60	2.57	1.62	1.47
			1000	2.19	2.25	2.19	2.24	2.25	0.27	0.19	1.37	3.17	2.64	0.38	3.14	3.90	5.00	0.63	2.04	4.02	2.22	2.23
			2000	2.26	2.43	2.26	2.51	2.34	0.33	0.16	1.38	3.17	3.68	0.65	3.27	3.69	5.00	0.65	2.44	4.00	2.34	2.37
	-	LANDA	500	1.35	1.58	1.35	2.00	1.16	0.17	0.47	1.48	2.75	2.23	0.00	1.13	3.32	2.00	0.72	1.63	2.09	1.47	1.51
			1000	1.39	1.85	1.39	2.34	1.36	0.17	0.24	1.83	2.75	3.09	0.19	1.24	3.70	2.06	0.77	1.96	2.26	1.62	1.70
			2000	1.63	2.30	1.63	2.04	2.56	0.17	0.22	2.09	3.23	3.32	0.58	1.49	2.59	5.03	0.86	2.33	3.06	1.97	2.08
	4	LEGUTIO	500	0.69	0.25	0.69	0.50	0.00	0.00	0.34	0.00	1.00	1.17	0.00	1.07	0.00	0.00	0.10	0.70	0.37	0.47	0.40
			1000	0.75	0.89	0.75	1.06	0.71	0.00	0.64	0.05	1.00	1.85	0.00	1.24	0.69	2.08	0.21	0.91	1.37	0.82	0.84
			2000	0.83	1.50	0.83	1.52	1.47	0.00	0.58	1.91	1.00	2.16	0.38	1.50	1.83	2.10	0.84	1.13	1.81	1.16	1.28

VALUES RESULTED FROM MCA I

ZONE	URB. AREA	NODE	AREA	NODE/PLACE N	NODE/PLACE P	NODUS/URBS/ CIVITAS N	U	C	N1-N2-N3 / U1-U2-U3 / C1-C2-C3 N1	U1	C1	N2	U2	C2	N3	U3	C3	URBAN/ GENERAL/RURAL urban	gener.	rural	TOTAL N/P	N/U/C
3	3	URBINA	500	0.96	2.00	0.96	2.55	1.44	0.00	1.48	0.25	1.80	3.33	0.00	1.08	2.85	4.06	0.53	1.63	2.65	1.48	1.65
			1000	1.54	2.71	1.54	3.22	2.20	0.20	1.33	2.24	3.23	4.05	0.05	1.21	4.28	4.32	1.25	2.36	3.22	2.13	2.32
			2000	1.73	2.71	1.73	2.92	2.51	0.26	1.66	3.39	3.43	4.38	0.10	1.50	2.71	4.04	1.77	2.55	2.75	2.22	2.39
	4	ERRETANA	500	0.49	1.47	0.49	2.32	0.62	0.00	0.80	0.02	1.34	1.75	0.00	0.14	4.40	1.83	0.25	0.99	2.01	0.98	1.14
			1000	0.60	2.46	0.60	2.87	2.05	0.17	1.07	1.03	1.34	3.35	0.00	0.28	4.19	5.11	0.74	1.47	3.14	1.53	1.84
			2000	1.03	3.10	1.03	3.18	3.01	0.20	1.19	3.96	1.34	4.17	0.02	1.54	4.18	5.06	1.81	1.73	3.57	2.06	2.41
	3	DURANA	500	0.69	2.53	0.69	2.68	2.38	0.27	1.23	2.20	1.68	3.23	0.02	0.11	3.57	4.91	1.23	1.56	2.83	1.61	1.91
			1000	1.20	3.12	1.20	3.28	2.95	0.27	1.31	3.98	3.06	4.80	0.02	0.26	3.73	4.85	1.88	2.52	2.91	2.16	2.48
			2000	1.51	3.32	1.51	3.46	3.18	0.37	1.27	4.56	3.69	5.12	0.02	0.48	4.00	4.97	2.10	2.84	3.11	2.42	2.72
	1	VITORIA APEADERO	500	2.16	3.71	2.16	5.55	1.88	1.82	8.92	5.25	4.38	7.71	0.38	0.28	0.00	0.00	5.15	3.98	0.10	2.94	3.19
			1000	2.94	4.05	2.94	5.67	2.43	3.05	8.26	6.15	4.92	8.74	1.15	0.86	0.00	0.00	5.70	4.75	0.30	3.50	3.68
			2000	4.92	6.16	4.92	5.96	6.37	6.99	8.09	8.06	5.22	9.78	9.54	2.55	0.00	1.50	7.69	8.10	1.42	5.54	5.75
	1	VITORIA-CIUDAD	500	2.14	3.90	2.14	5.97	1.82	2.32	10.00	5.06	4.10	7.92	0.41	0.00	0.00	0.00	5.58	3.95	0.00	3.02	3.31
			1000	3.09	5.32	3.09	6.37	4.26	4.52	9.99	5.96	4.51	9.13	6.83	0.23	0.00	0.00	6.67	6.71	0.08	4.20	4.58
			2000	7.34	6.33	7.34	6.20	6.45	10.00	8.59	7.86	5.03	10.00	10.00	7.00	0.01	1.50	8.83	8.26	2.98	6.83	6.67
	-	OLARIZU	500	2.21	1.72	2.21	2.02	1.41	0.00	2.41	3.53	2.54	2.28	0.22	4.08	1.37	0.49	1.96	1.65	2.01	1.96	1.88
			1000	2.75	2.88	2.75	3.49	2.27	0.82	2.22	5.63	3.13	6.28	0.41	4.29	1.97	0.78	2.92	3.12	2.37	2.82	2.84
			2000	5.30	3.90	5.30	4.55	3.26	5.66	2.57	7.50	4.02	8.74	1.37	6.22	2.34	0.91	5.38	4.51	3.20	4.60	4.37
	3	OTAZU	500	0.17	2.72	0.17	3.16	2.28	0.00	3.00	1.60	0.38	2.64	0.22	0.12	3.83	5.02	1.46	1.00	2.95	1.44	1.87
			1000	1.55	2.85	1.55	3.51	2.18	0.00	2.59	1.20	0.38	3.63	0.22	4.26	4.32	5.12	1.20	1.30	4.58	2.20	2.41
			2000	2.37	3.14	2.37	3.79	2.50	0.24	2.30	1.46	2.38	4.36	0.89	4.48	4.70	5.14	1.29	2.45	4.78	2.76	2.88
	3	ABERASTURI	500	0.19	2.68	0.19	3.64	1.73	0.00	3.42	0.20	0.44	3.80	0.00	0.13	3.70	4.99	1.10	1.29	2.90	1.44	1.85
			1000	0.23	2.87	0.23	3.89	1.85	0.00	3.17	0.20	0.44	4.12	0.19	0.26	4.39	5.15	1.02	1.46	3.21	1.55	1.99
			2000	2.06	3.47	2.06	4.05	2.89	0.24	2.76	0.24	0.44	4.16	0.19	5.51	5.23	8.25	0.99	1.47	6.38	2.77	3.00
	3	ANDOLLU	500	2.43	2.73	2.43	3.13	2.32	0.24	1.85	2.29	1.90	3.00	0.00	5.16	4.55	4.66	1.44	1.56	4.80	2.58	2.63
			1000	2.49	2.94	2.49	3.46	2.43	0.24	1.64	2.32	1.90	3.15	0.00	5.35	5.58	4.95	1.39	1.61	5.28	2.72	2.79
			2000	2.70	3.71	2.70	3.99	3.44	0.33	1.64	2.39	1.90	4.64	0.05	5.86	5.70	7.87	1.44	2.07	6.52	3.21	3.38
	4	ESTIBALIZ	500	1.44	2.28	1.44	2.84	1.73	0.00	1.59	0.02	3.25	2.68	0.22	1.07	4.24	4.96	0.48	2.02	3.38	1.86	2.00
			1000	1.47	2.57	1.47	3.11	2.04	0.00	1.56	1.20	3.25	4.09	0.22	1.15	3.68	4.70	0.89	2.44	3.15	2.02	2.20
			2000	3.61	3.48	3.61	3.50	3.47	2.27	1.27	2.09	3.25	4.67	0.26	5.30	4.56	8.06	1.91	2.63	6.04	3.55	3.53
	3	TROKONIZ	500	1.55	3.93	1.55	4.07	3.79	0.00	4.51	3.23	0.51	3.36	0.00	4.12	4.33	8.16	2.48	1.19	5.60	2.74	3.14
			1000	1.67	3.94	1.67	4.10	3.78	0.24	4.20	3.14	0.51	2.92	0.00	4.26	5.16	8.21	2.44	1.06	5.91	2.81	3.18
			2000	2.47	4.29	2.47	4.63	3.96	0.30	4.11	3.54	1.50	4.35	0.19	5.61	5.44	8.14	2.57	1.90	6.44	3.38	3.69
	3	ERENTXUN	500	0.19	2.48	0.19	4.08	0.89	0.00	5.11	1.02	0.49	3.66	0.19	0.07	3.46	1.45	1.89	1.34	1.57	1.33	1.72
			1000	0.57	3.25	0.57	4.27	2.22	0.00	4.23	1.04	0.49	3.83	0.19	1.22	4.76	5.44	1.63	1.39	3.76	1.91	2.35
			2000	0.75	3.42	0.75	4.59	2.26	0.24	4.11	1.01	0.49	4.51	0.38	1.52	5.14	5.38	1.67	1.66	3.96	2.08	2.53

VALUES RESULTED FROM MCA I

				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
4	4	GAUNA	500	0.53	1.26	0.53	1.85	0.67	0.00	0.38	0.00	0.52	0.00	0.00	1.08	5.16	2.00	0.12	0.18	2.63	0.90	1.02
			1000	0.65	2.29	0.65	2.88	1.70	0.17	0.44	0.00	0.52	2.61	0.00	1.26	5.60	5.09	0.19	0.96	3.90	1.47	1.74
			2000	0.75	2.46	0.75	3.18	1.74	0.17	0.45	0.01	0.52	3.58	0.00	1.55	5.50	5.20	0.20	1.26	4.01	1.60	1.89
	4	URIBARRI-JAUREGI	500	0.54	2.11	0.54	2.75	1.48	0.00	0.34	0.00	0.49	1.17	0.19	1.13	6.73	4.24	0.10	0.59	3.90	1.33	1.59
			1000	0.58	2.22	0.58	3.00	1.44	0.00	0.31	0.00	0.49	1.17	0.19	1.25	7.52	4.14	0.09	0.59	4.14	1.40	1.68
			2000	0.74	2.72	0.74	3.78	1.67	0.17	0.32	0.24	0.49	3.80	0.38	1.54	7.22	4.39	0.24	1.45	4.24	1.73	2.06
	-	BRIGADA TUNEL	500	0.16	1.10	0.16	1.53	0.67	0.00	0.14	0.00	0.44	0.00	0.00	0.04	4.46	2.00	0.04	0.16	2.05	0.63	0.79
			1000	0.21	1.07	0.21	1.47	0.67	0.00	0.19	0.00	0.44	0.00	0.00	0.19	4.21	2.00	0.06	0.16	2.03	0.64	0.78
			2000	0.57	1.11	0.57	1.52	0.69	0.00	0.19	0.00	0.44	0.00	0.00	1.26	4.37	2.06	0.06	0.16	2.47	0.84	0.93
	-	LAMINORIA	500	0.00	0.07	0.00	0.13	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.02	0.00	0.10	0.03	0.04
			1000	0.01	0.72	0.01	0.77	0.67	0.00	0.11	0.00	0.00	0.00	0.00	0.02	2.21	2.00	0.03	0.00	1.37	0.36	0.48
			2000	0.05	0.88	0.05	1.06	0.70	0.00	0.13	0.00	0.00	0.00	0.00	0.16	3.06	2.10	0.04	0.00	1.71	0.47	0.61
	4	ZEKUIANO	500	0.04	1.79	0.04	1.8	1.79	0.00	0.55	0.00	0.01	0.00	0.00	0.10	4.85	5.37	0.16	0.00	3.37	0.92	1.21
			1000	0.07	2.85	0.07	2.9	2.77	0.00	0.78	0.59	0.01	2.71	0.38	0.21	5.30	7.33	0.44	0.95	4.23	1.46	1.92
			2000	0.68	3.56	0.68	3.5	3.62	0.00	0.71	2.94	1.57	4.98	0.58	0.47	4.80	7.36	1.24	2.25	4.18	2.12	2.60
	3	MAEZTU	500	0.59	3.50	0.59	4.40	2.60	0.24	5.31	2.99	1.40	4.82	0.19	0.13	3.08	4.62	2.72	2.00	2.59	2.05	2.53
			1000	0.75	4.50	0.75	4.63	4.37	0.24	4.61	3.55	1.74	4.90	0.38	0.26	4.38	9.18	2.71	2.21	4.62	2.62	3.25
			2000	1.03	4.70	1.03	4.99	4.42	0.24	4.20	3.58	2.24	4.94	0.77	0.62	5.84	8.90	2.60	2.54	5.08	2.87	3.48
	4	ATAURI	500	0.11	2.52	0.11	2.04	2.99	0.00	0.72	0.14	0.22	0.00	0.00	0.10	5.41	8.84	0.27	0.08	4.75	1.31	1.71
			1000	0.59	3.18	0.59	3.22	3.14	0.24	0.64	0.36	1.29	2.71	0.38	0.26	6.29	8.66	0.40	1.40	5.01	1.89	2.32
			2000	0.73	3.12	0.73	3.44	2.80	0.24	0.59	0.80	1.29	2.97	0.58	0.66	6.74	7.02	0.54	1.54	4.71	1.92	2.32
	4	ANTOÑANA	500	2.54	2.42	2.54	2.99	1.86	0.24	1.97	0.01	1.32	2.16	0.38	6.07	4.82	5.20	0.68	1.25	5.39	2.48	2.46
			1000	2.65	3.43	2.65	3.81	3.04	0.24	2.14	0.64	1.55	3.81	0.60	6.18	5.49	7.86	0.95	1.90	6.56	3.04	3.17
			2000	2.75	3.79	2.75	4.18	3.39	0.24	1.99	0.70	1.55	4.15	0.60	6.46	6.39	8.89	0.93	2.00	7.29	3.27	3.44
	-	FRESNEDO	500	1.99	2.11	1.99	2.50	1.72	0.00	1.02	0.03	1.85	0.00	0.19	4.13	6.48	4.92	0.32	0.71	5.11	2.05	2.07
			1000	2.04	2.00	2.04	2.24	1.77	0.00	0.55	0.06	1.85	0.00	0.19	4.27	6.17	5.05	0.19	0.71	5.12	2.02	2.02
			2000	2.60	3.22	2.60	3.67	2.76	0.24	0.59	2.84	2.04	5.14	0.41	5.53	5.29	5.05	1.25	2.40	5.29	2.91	3.01
	4	KANPEZU	500	2.31	2.56	2.31	2.97	2.15	0.00	1.25	1.42	1.87	3.35	0.00	5.06	4.32	5.04	0.87	1.66	4.83	2.44	2.48
			1000	2.51	3.39	2.51	3.61	3.17	0.24	1.25	3.97	2.14	5.11	0.58	5.15	4.47	4.97	1.85	2.48	4.88	2.95	3.10
			2000	2.65	4.08	2.65	3.88	4.29	0.24	0.92	4.06	2.23	5.71	0.60	5.49	5.01	8.20	1.78	2.70	6.29	3.37	3.61
	-	ORRADICHO	500	0.17	1.16	0.17	1.71	0.60	0.00	0.51	0.01	0.40	0.00	0.00	0.10	4.62	1.80	0.16	0.14	2.05	0.66	0.83
			1000	0.22	1.20	0.22	1.73	0.67	0.00	0.24	0.03	0.40	0.00	0.00	0.26	4.94	1.98	0.08	0.14	2.26	0.71	0.87
			2000	2.02	3.87	2.02	3.38	4.37	0.24	0.25	3.97	0.40	4.29	0.77	5.43	5.58	8.36	1.55	1.70	6.50	2.95	3.25
	4	ZUÑIGA	500	0.28	1.26	0.28	1.87	0.65	0.31	1.20	0.00	0.40	0.00	0.19	0.14	4.40	1.76	0.47	0.21	1.98	0.77	0.93
			1000	0.33	2.00	0.33	3.17	0.82	0.34	0.93	0.66	0.40	3.30	0.38	0.27	5.29	1.41	0.63	1.26	2.17	1.17	1.44
			2000	0.72	3.36	0.72	3.74	2.99	0.34	0.67	0.51	1.29	3.96	0.60	0.54	6.60	7.85	0.50	1.85	4.92	2.04	2.48

VALUES RESULTED FROM MCA I

				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
	-	ARQUITAS	500	0.05	1.75	0.05	1.77	1.73	0.00	0.30	0.00	0.01	0.00	0.19	0.14	5.00	5.00	0.09	0.07	3.30	0.90	1.18
			1000	0.10	1.76	0.10	1.78	1.73	0.00	0.39	0.00	0.01	0.00	0.19	0.30	4.96	5.00	0.12	0.07	3.34	0.93	1.21
			2000	0.30	2.15	0.30	2.55	1.76	0.31	0.27	0.00	0.01	0.00	0.19	0.57	7.37	5.09	0.19	0.07	4.20	1.23	1.54
	3	ACEDO	500	0.25	2.02	0.25	3.11	0.94	0.31	2.14	0.79	0.33	3.72	0.58	0.11	3.46	1.45	1.02	1.43	1.58	1.13	1.43
			1000	0.32	2.32	0.32	3.52	1.12	0.31	1.80	0.99	0.33	4.30	0.77	0.32	4.47	1.61	0.99	1.67	2.02	1.32	1.65
			2000	0.97	3.33	0.97	4.17	2.50	0.31	1.55	1.90	2.01	4.30	0.96	0.58	6.67	4.64	1.24	2.33	3.82	2.15	2.54
	-	GRANADA	500	0.05	2.00	0.05	2.41	1.59	0.00	0.16	0.00	0.01	0.00	0.00	0.14	7.06	4.78	0.05	0.00	3.84	1.02	1.35
			1000	0.10	1.89	0.10	2.09	1.68	0.00	0.16	0.00	0.01	0.00	0.19	0.28	6.12	4.84	0.05	0.07	3.63	0.99	1.29
			2000	0.18	2.39	0.18	3.16	1.61	0.00	0.31	0.00	0.01	1.75	0.38	0.55	7.42	4.46	0.09	0.66	3.98	1.29	1.65
5	3	ANCIN	500	0.74	3.16	0.74	4.09	2.23	0.31	5.71	2.16	1.85	4.58	0.38	0.07	1.98	4.14	2.58	2.16	2.07	1.95	2.35
			1000	1.00	3.67	1.00	4.80	2.54	0.31	4.74	2.10	2.48	4.96	0.77	0.21	4.70	4.75	2.26	2.62	3.14	2.33	2.78
			2000	1.10	3.87	1.10	5.00	2.75	0.34	4.32	2.44	2.48	5.01	0.96	0.48	5.66	4.85	2.27	2.71	3.56	2.49	2.95
	3	MURIETA	500	0.64	2.39	0.64	3.79	0.99	0.00	4.93	1.35	1.80	2.39	0.00	0.11	4.06	1.62	1.95	1.35	1.82	1.51	1.81
			1000	0.78	3.48	0.78	4.59	2.36	0.31	4.61	1.61	1.80	4.94	0.38	0.24	4.24	5.10	2.05	2.25	3.14	2.13	2.58
			2000	1.08	3.89	1.08	4.62	3.16	0.34	4.30	3.41	2.40	5.02	0.77	0.50	4.54	5.30	2.60	2.62	3.39	2.48	2.95
	4	ZUFIA	500	0.45	2.18	0.45	2.95	1.41	0.31	1.22	0.00	1.05	0.00	0.00	0.00	7.63	4.24	0.47	0.37	3.77	1.32	1.61
			1000	0.45	1.99	0.45	2.50	1.49	0.31	0.97	0.00	1.05	0.00	0.00	0.00	6.53	4.47	0.40	0.37	3.52	1.22	1.48
			2000	0.46	2.78	0.46	3.70	1.85	0.34	0.80	0.71	1.05	3.98	0.19	0.00	6.33	4.65	0.61	1.63	3.53	1.62	2.00
	3	ZUBIELQUI	500	0.42	2.86	0.42	3.31	2.40	0.31	2.99	2.44	0.88	3.88	0.00	0.06	3.05	4.77	1.86	1.47	2.61	1.64	2.04
			1000	0.44	3.04	0.44	3.47	2.62	0.31	2.53	2.74	0.88	4.57	0.58	0.13	3.30	4.54	1.83	1.88	2.62	1.74	2.18
			2000	0.49	3.12	0.49	3.60	2.64	0.31	2.16	2.80	0.88	4.71	0.77	0.27	3.92	4.37	1.74	1.99	2.80	1.80	2.24
	2	LIZARRA	500	2.97	3.64	2.97	5.21	2.07	0.86	7.88	5.31	4.04	6.85	0.82	4.00	0.90	0.08	4.52	3.75	1.70	3.30	3.41
			1000	3.21	3.86	3.21	5.14	2.59	1.00	6.76	6.14	4.58	7.61	1.54	4.05	1.05	0.09	4.53	4.42	1.76	3.54	3.65
			2000	3.43	4.25	3.43	5.04	3.47	1.22	5.31	6.35	4.89	7.96	1.73	4.19	1.83	2.34	4.24	4.70	2.83	3.84	3.98

VALUES RESULTED FROM MCA II

VALUES RESULTED FROM MCA II

				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
1			500	1.51	0.81	1.51	1.29	0.33	0.38	1.37	1.00	4.10	0.93	0.00	0.04	1.58	0.00	0.90	1.71	0.49	1.16	1.04
	-	MALTZAGA	1000	1.51	1.27	1.51	1.57	0.97	0.38	0.86	2.92	4.10	0.93	0.00	0.06	2.92	0.00	1.41	1.71	0.90	1.39	1.35
			2000	2.54	2.53	2.54	3.19	1.87	2.04	0.75	5.50	5.34	6.05	0.12	0.23	2.79	0.00	2.86	3.72	0.92	2.54	2.53
		SORALUZE-	500	1.20	3.30	1.20	4.86	1.73	0.41	8.10	3.99	3.18	6.44	1.20	0.00	0.04	0.00	3.97	3.47	0.01	2.25	2.60
	2	PLACENCIA DE	1000	1.36	3.40	1.36	4.87	1.94	0.44	7.29	4.24	3.60	6.86	1.59	0.05	0.45	0.00	3.82	3.87	0.15	2.38	2.72
		LAS ARMAS	2000	1.52	3.62	1.52	4.95	2.28	0.47	5.56	4.87	3.93	6.97	1.97	0.17	2.34	0.00	3.53	4.15	0.76	2.57	2.92
			500	1.14	1.88	1.14	2.59	1.17	0.17	0.66	3.13	3.10	4.97	0.38	0.14	2.14	0.00	1.35	2.71	0.69	1.51	1.63
	-	LOS MARTIRES	1000	1.36	2.01	1.36	2.86	1.17	0.24	0.38	3.11	3.55	5.02	0.38	0.28	3.17	0.00	1.29	2.88	1.05	1.68	1.79
			2000	1.62	2.13	1.62	3.01	1.25	0.44	0.26	3.17	3.87	5.19	0.58	0.55	3.59	0.00	1.34	3.11	1.27	1.88	1.96
			500	1.37	1.32	1.37	1.91	0.73	0.24	1.09	2.16	3.75	3.00	0.00	0.12	1.65	0.03	1.16	2.21	0.55	1.34	1.34
	-	MEKOALDE	1000	1.40	1.57	1.40	2.34	0.80	0.27	0.52	2.34	3.75	3.38	0.00	0.17	3.12	0.06	1.07	2.33	1.02	1.48	1.51
			2000	1.72	2.02	1.72	2.65	1.40	0.47	0.43	3.58	4.37	4.64	0.58	0.33	2.88	0.04	1.55	3.12	0.99	1.87	1.92
			500	1.77	3.65	1.77	5.21	2.10	0.55	8.66	5.06	4.63	6.83	1.24	0.12	0.13	0.00	4.56	4.10	0.08	2.71	3.02
	2	BERGARA	1000	2.11	4.44	2.11	5.46	3.42	0.58	7.94	5.42	5.55	7.76	4.83	0.20	0.68	0.00	4.48	5.96	0.28	3.27	3.66
			2000	2.31	4.91	2.31	5.28	4.53	0.61	6.29	6.08	5.99	8.00	5.51	0.34	1.54	2.02	4.23	6.42	1.29	3.61	4.04
			500	2.23	1.25	2.23	1.51	0.99	0.42	3.12	2.97	6.15	1.36	0.00	0.12	0.06	0.00	2.12	2.56	0.06	1.74	1.58
	-	ALTOS HORNOS	1000	2.35	1.98	2.35	2.70	1.26	0.48	2.57	3.54	6.43	4.92	0.22	0.15	0.61	0.02	2.18	3.80	0.24	2.16	2.10
			2000	2.54	2.64	2.54	3.38	1.91	0.51	1.17	5.16	6.68	6.97	0.55	0.43	2.00	0.01	2.33	4.62	0.76	2.59	2.61
		SAN	500	1.28	1.61	1.28	1.44	1.77	0.66	0.90	2.94	3.04	1.85	0.38	0.13	1.58	2.00	1.53	1.76	1.22	1.44	1.50
	-	PRUDENCIO	1000	1.35	1.75	1.35	1.73	1.78	0.66	0.46	2.95	3.04	1.94	0.38	0.35	2.78	2.00	1.40	1.78	1.66	1.55	1.62
			2000	1.90	2.02	1.90	2.31	1.73	0.75	0.35	2.80	4.21	3.36	0.38	0.73	3.22	2.00	1.35	2.62	1.92	1.96	1.98
			500	1.23	1.68	1.23	2.21	1.15	0.41	1.75	3.27	3.18	4.50	0.19	0.11	0.37	0.00	1.81	2.53	0.15	1.46	1.53
	-	ZUBILLAGA	1000	1.50	1.85	1.50	2.46	1.25	0.44	0.77	3.51	3.80	4.63	0.19	0.26	1.97	0.03	1.61	2.79	0.69	1.68	1.73
			2000	1.65	2.19	1.65	2.50	1.89	0.53	0.45	3.43	3.96	4.84	0.22	0.47	2.22	2.01	1.52	2.91	1.54	1.92	2.01
			500	1.21	1.37	1.21	1.86	0.89	0.17	1.50	2.64	3.32	3.45	0.02	0.14	0.63	0.00	1.43	2.21	0.24	1.29	1.32
	-	SAN PEDRO	1000	1.37	1.82	1.37	2.30	1.33	0.34	1.05	3.77	3.50	5.03	0.22	0.27	0.82	0.00	1.75	2.81	0.34	1.59	1.67
			2000	1.72	3.33	1.72	3.09	3.57	0.57	0.91	6.08	4.02	6.93	4.62	0.58	1.44	0.02	2.60	5.10	0.64	2.53	2.80
			500	1.22	3.76	1.22	4.79	2.73	0.45	8.19	5.04	3.20	6.19	3.14	0.02	0.00	0.00	4.38	4.07	0.01	2.49	2.91
	2	OÑATI	1000	1.54	4.30	1.54	5.02	3.58	0.48	7.21	5.69	3.77	7.36	5.05	0.39	0.48	0.00	4.32	5.29	0.28	2.92	3.38
			2000	1.74	4.41	1.74	4.91	3.92	0.57	5.99	6.27	4.13	7.76	5.48	0.53	0.97	0.00	4.19	5.69	0.48	3.08	3.52
			500	1.72	3.23	1.72	5.12	1.34	0.71	8.83	3.62	4.35	6.43	0.41	0.09	0.10	0.00	4.16	3.60	0.06	2.47	2.73
	2	ARRASATE	1000	1.93	4.03	1.93	5.55	2.52	0.99	8.43	5.71	4.69	7.56	1.84	0.12	0.65	0.00	4.88	4.55	0.24	2.98	3.33
			2000	2.43	4.36	2.43	5.69	3.04	1.24	6.86	6.61	5.32	8.38	2.47	0.73	1.84	0.03	4.80	5.24	0.82	3.40	3.72

VALUES RESULTED FROM MCA II

				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
	-	ULGOR	500	0.41	1.17	0.41	1.19	1.14	0.38	3.50	3.41	0.74	0.00	0.00	0.12	0.09	0.00	2.38	0.26	0.07	0.79	0.91
			1000	1.66	2.56	1.66	3.21	1.91	0.58	3.26	5.72	4.21	6.27	0.00	0.19	0.09	0.00	3.18	3.35	0.09	2.11	2.26
			2000	2.23	3.48	2.23	4.13	2.84	1.39	2.29	6.21	4.60	8.10	2.30	0.70	2.01	0.01	3.34	4.85	0.85	2.86	3.07
	2	ARETXABALETA	500	1.78	3.47	1.78	5.23	1.72	0.58	8.63	4.93	4.63	6.74	0.24	0.15	0.31	0.00	4.52	3.72	0.14	2.63	2.91
			1000	1.93	3.68	1.93	5.30	2.05	0.64	7.47	5.31	4.89	7.32	0.84	0.27	1.11	0.01	4.32	4.20	0.43	2.80	3.10
			2000	2.08	3.73	2.08	5.04	2.42	0.64	5.87	6.00	5.02	7.41	1.25	0.58	1.85	0.00	4.08	4.42	0.76	2.90	3.18
	-	LANDETA-MARIANISTAS	500	2.22	2.34	2.22	3.07	1.61	0.00	3.42	4.44	6.54	4.68	0.38	0.14	1.12	0.00	2.58	3.83	0.38	2.28	2.30
			1000	2.65	2.84	2.65	3.54	2.15	0.48	3.09	5.86	7.21	6.46	0.58	0.27	1.07	0.01	3.14	4.67	0.42	2.75	2.78
			2000	2.98	3.44	2.98	3.80	3.08	0.69	2.38	6.10	7.66	7.71	3.12	0.58	1.31	0.01	3.09	6.09	0.60	3.21	3.28
	2	ESKORIATZA	500	1.45	2.20	1.45	3.19	1.21	0.31	4.04	3.58	3.92	5.14	0.02	0.14	0.41	0.02	2.57	2.92	0.18	1.83	1.95
			1000	1.77	2.86	1.77	3.75	1.96	0.55	2.55	4.32	4.50	6.46	1.51	0.26	2.25	0.06	2.47	4.04	0.79	2.31	2.50
			2000	1.95	3.05	1.95	3.75	2.36	0.61	1.75	4.94	4.79	6.90	2.11	0.45	2.59	0.04	2.46	4.49	0.95	2.50	2.69
	-	CASTAÑARES	500	0.27	0.96	0.27	1.74	0.18	0.17	0.27	0.46	0.64	2.39	0.00	0.00	2.55	0.08	0.30	0.94	0.79	0.61	0.73
			1000	1.05	1.27	1.05	2.11	0.43	0.20	0.48	1.26	2.92	3.68	0.00	0.05	2.16	0.04	0.65	2.13	0.68	1.16	1.20
			2000	1.08	1.76	1.08	2.60	0.91	0.20	0.45	2.73	2.92	4.19	0.00	0.12	3.16	0.01	1.16	2.28	0.99	1.42	1.53
2	-	MAZMELA	500	0.22	0.62	0.22	1.24	0.00	0.00	0.62	0.00	0.65	0.00	0.00	0.00	3.10	0.00	0.19	0.23	0.93	0.42	0.49
			1000	0.22	0.93	0.22	1.85	0.00	0.00	0.53	0.00	0.65	1.85	0.00	0.00	3.18	0.01	0.16	0.78	0.96	0.57	0.69
			2000	1.02	1.62	1.02	2.44	0.80	0.00	0.55	2.40	2.93	3.96	0.00	0.12	2.81	0.01	1.00	2.21	0.89	1.32	1.42
	-	ZARIMUZ	500	0.14	0.65	0.14	1.31	0.00	0.00	0.95	0.00	0.42	1.85	0.00	0.00	1.12	0.00	0.29	0.70	0.33	0.40	0.48
			1000	0.14	0.91	0.14	1.82	0.00	0.00	0.67	0.00	0.42	2.44	0.00	0.00	2.35	0.01	0.20	0.88	0.71	0.52	0.65
			2000	0.14	1.36	0.14	2.40	0.33	0.00	0.34	0.98	0.42	3.45	0.00	0.00	3.40	0.00	0.45	1.18	1.02	0.75	0.96
	-	MARIN	500	0.17	0.97	0.17	1.93	0.00	0.17	1.06	0.00	0.35	1.36	0.00	0.00	3.37	0.01	0.38	0.53	1.01	0.57	0.70
			1000	0.17	1.29	0.17	2.33	0.25	0.17	0.44	0.71	0.35	2.64	0.00	0.00	3.90	0.04	0.44	0.92	1.18	0.73	0.92
			2000	0.17	1.37	0.17	2.51	0.22	0.17	0.22	0.66	0.35	3.36	0.00	0.00	3.94	0.02	0.36	1.13	1.19	0.77	0.97
	4	LEINTZ-GATZAGA	500	0.12	0.96	0.12	1.57	0.34	0.00	0.62	1.03	0.37	2.57	0.00	0.00	1.53	0.00	0.55	0.90	0.46	0.54	0.68
			1000	1.54	1.41	1.54	1.94	0.88	0.17	0.45	1.15	2.46	3.35	0.00	2.00	2.03	1.50	0.60	1.87	1.83	1.48	1.46
			2000	1.82	2.17	1.82	2.77	1.57	0.33	0.44	1.69	3.07	4.64	1.53	2.07	3.23	1.50	0.84	3.00	2.22	2.00	2.06
	-	ARLABAN	500	1.88	1.18	1.88	1.78	0.58	0.24	0.44	0.03	3.34	1.64	0.19	2.06	3.26	1.50	0.23	1.73	2.22	1.53	1.41
			1000	2.00	2.26	2.00	2.27	2.25	0.27	0.26	1.37	3.59	2.64	0.38	2.14	3.90	5.00	0.65	2.18	3.67	2.13	2.17
			2000	2.06	2.44	2.06	2.53	2.34	0.33	0.21	1.38	3.59	3.68	0.65	2.27	3.69	5.00	0.66	2.59	3.65	2.25	2.31
	-	LANDA	500	1.37	1.62	1.37	2.08	1.16	0.17	0.69	1.48	3.13	2.23	0.00	0.80	3.32	2.00	0.78	1.76	1.98	1.49	1.53
			1000	1.40	1.87	1.40	2.38	1.36	0.17	0.35	1.83	3.13	3.09	0.19	0.91	3.70	2.06	0.80	2.09	2.15	1.63	1.71
			2000	1.68	2.32	1.68	2.08	2.56	0.17	0.33	2.09	3.71	3.32	0.58	1.16	2.59	5.03	0.89	2.50	2.94	2.00	2.11
	4	LEGUTIO	500	0.51	0.28	0.51	0.56	0.00	0.00	0.50	0.00	0.79	1.17	0.00	0.74	0.00	0.00	0.15	0.63	0.26	0.39	0.36
			1000	0.57	0.94	0.57	1.17	0.71	0.00	0.95	0.05	0.79	1.85	0.00	0.91	0.69	2.08	0.30	0.83	1.25	0.75	0.81
			2000	0.65	1.54	0.65	1.62	1.47	0.00	0.87	1.91	0.79	2.16	0.38	1.17	1.83	2.10	0.93	1.06	1.69	1.10	1.25

VALUES RESULTED FROM MCA II

				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
3	3	URBINA	500	0.70	2.07	0.70	2.71	1.44	0.00	1.96	0.25	1.35	3.33	0.00	0.75	2.85	4.06	0.68	1.47	2.54	1.39	1.62
			1000	1.40	2.78	1.40	3.36	2.20	0.20	1.74	2.24	3.14	4.05	0.05	0.87	4.28	4.32	1.37	2.33	3.10	2.09	2.32
			2000	1.61	2.81	1.61	3.11	2.51	0.26	2.25	3.39	3.40	4.38	0.10	1.17	2.71	4.04	1.95	2.54	2.64	2.21	2.41
	4	ERRETANA	500	0.39	1.51	0.39	2.40	0.62	0.00	1.05	0.02	1.02	1.75	0.00	0.14	4.40	1.83	0.32	0.88	2.01	0.95	1.14
			1000	0.49	2.52	0.49	3.00	2.05	0.17	1.46	1.03	1.02	3.35	0.00	0.28	4.19	5.11	0.86	1.36	3.14	1.51	1.85
			2000	0.81	3.17	0.81	3.33	3.01	0.20	1.64	3.96	1.02	4.17	0.02	1.21	4.18	5.06	1.95	1.62	3.45	1.99	2.38
	3	DURANA	500	0.55	2.60	0.55	2.81	2.38	0.27	1.63	2.20	1.27	3.23	0.02	0.11	3.57	4.91	1.35	1.42	2.83	1.57	1.91
			1000	1.18	3.19	1.18	3.43	2.95	0.27	1.75	3.98	3.00	4.80	0.02	0.26	3.73	4.85	2.01	2.50	2.91	2.18	2.52
			2000	1.54	3.40	1.54	3.61	3.18	0.37	1.70	4.56	3.78	5.12	0.02	0.48	4.00	4.97	2.23	2.87	3.11	2.47	2.78
	1	VITORIA APEADERO	500	2.30	3.80	2.30	5.73	1.88	1.82	9.46	5.25	4.80	7.71	0.38	0.28	0.00	0.00	5.31	4.13	0.10	3.05	3.30
			1000	3.13	4.20	3.13	5.96	2.43	3.05	9.13	6.15	5.48	8.74	1.15	0.86	0.00	0.00	5.96	4.95	0.30	3.66	3.84
			2000	5.13	6.32	5.13	6.28	6.37	6.99	9.05	8.06	5.86	9.78	9.54	2.55	0.00	1.50	7.98	8.33	1.42	5.73	5.93
	1	VITORIA-CIUDAD	500	2.31	3.90	2.31	5.97	1.82	2.32	10.00	5.06	4.62	7.92	0.41	0.00	0.00	0.00	5.58	4.13	0.00	3.10	3.37
			1000	3.30	5.32	3.30	6.38	4.26	4.52	10.00	5.96	5.14	9.13	6.83	0.23	0.00	0.00	6.67	6.93	0.08	4.31	4.64
			2000	7.93	6.44	7.93	6.43	6.45	10.00	9.30	7.86	5.78	10.00	10.00	8.00	0.01	1.50	9.04	8.52	3.33	7.18	6.94
	-	OLARIZU	500	2.65	1.90	2.65	2.38	1.41	0.00	3.49	3.53	2.86	2.28	0.22	5.08	1.37	0.49	2.28	1.76	2.36	2.27	2.15
			1000	3.24	3.01	3.24	3.75	2.27	0.82	3.00	5.63	3.61	6.28	0.41	5.29	1.97	0.78	3.15	3.29	2.72	3.13	3.09
			2000	5.75	3.97	5.75	4.68	3.26	5.66	2.95	7.50	4.71	8.74	1.37	6.89	2.34	0.91	5.49	4.75	3.43	4.86	4.56
	3	OTAZU	500	0.14	2.88	0.14	3.48	2.28	0.00	3.97	1.60	0.29	2.64	0.22	0.12	3.83	5.02	1.75	0.97	2.95	1.51	1.96
			1000	1.85	2.97	1.85	3.77	2.18	0.00	3.37	1.20	0.29	3.63	0.22	5.26	4.32	5.12	1.43	1.26	4.93	2.41	2.60
			2000	2.84	3.25	2.84	4.00	2.50	0.24	2.94	1.46	2.79	4.36	0.89	5.48	4.70	5.14	1.48	2.60	5.13	3.04	3.11
	3	ABERASTURI	500	0.15	2.85	0.15	3.97	1.73	0.00	4.42	0.20	0.33	3.80	0.00	0.13	3.70	4.99	1.40	1.26	2.90	1.50	1.95
			1000	0.20	3.02	0.20	4.19	1.85	0.00	4.07	0.20	0.33	4.12	0.19	0.26	4.39	5.15	1.29	1.42	3.21	1.61	2.08
			2000	2.25	3.59	2.25	4.29	2.89	0.24	3.47	0.24	0.33	4.16	0.19	6.18	5.23	8.25	1.21	1.43	6.62	2.92	3.14
	3	ANDOLLU	500	2.69	2.81	2.69	3.31	2.32	0.24	2.38	2.29	2.02	3.00	0.00	5.82	4.55	4.66	1.60	1.61	5.03	2.75	2.77
			1000	2.76	3.01	2.76	3.60	2.43	0.24	2.08	2.32	2.02	3.15	0.00	6.01	5.58	4.95	1.52	1.65	5.51	2.89	2.93
			2000	2.96	3.79	2.96	4.14	3.44	0.33	2.08	2.39	2.02	4.64	0.05	6.53	5.70	7.87	1.58	2.11	6.75	3.37	3.51
	4	ESTIBALIZ	500	1.47	2.38	1.47	3.02	1.73	0.00	2.14	0.02	3.68	2.68	0.22	0.74	4.24	4.96	0.65	2.17	3.27	1.92	2.07
			1000	1.50	2.66	1.50	3.29	2.04	0.00	2.09	1.20	3.68	4.09	0.22	0.82	3.68	4.70	1.05	2.59	3.04	2.08	2.27
			2000	3.97	3.55	3.97	3.63	3.47	2.27	1.67	2.09	3.68	4.67	0.26	5.97	4.56	8.06	2.02	2.78	6.28	3.76	3.69
	3	TROKONIZ	500	1.84	4.14	1.84	4.48	3.79	0.00	5.74	3.23	0.39	3.36	0.00	5.12	4.33	8.16	2.85	1.15	5.95	2.99	3.37
			1000	1.96	4.12	1.96	4.46	3.78	0.24	5.29	3.14	0.39	2.92	0.00	5.26	5.16	8.21	2.77	1.01	6.26	3.04	3.40
			2000	2.74	4.47	2.74	4.98	3.96	0.30	5.16	3.54	1.63	4.35	0.19	6.28	5.44	8.14	2.89	1.94	6.68	3.60	3.89
	3	ERENTXUN	500	0.15	2.73	0.15	4.58	0.89	0.00	6.62	1.02	0.37	3.66	0.19	0.07	3.46	1.45	2.34	1.30	1.57	1.44	1.87
			1000	0.42	3.43	0.42	4.64	2.22	0.00	5.33	1.04	0.37	3.83	0.19	0.88	4.76	5.44	1.96	1.35	3.64	1.92	2.43
			2000	0.60	3.60	0.60	4.94	2.26	0.24	5.16	1.01	0.37	4.51	0.38	1.18	5.14	5.38	1.99	1.62	3.84	2.10	2.60

VALUES RESULTED FROM MCA II

ZONE	URB. AREA	NODE	AREA	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
				N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
			500	0.38	1.27	0.38	1.88	0.67	0.00	0.48	0.00	0.39	0.00	0.00	0.74	5.16	2.00	0.14	0.14	2.51	0.83	0.98
	4	**GAUNA**	**1000**	0.49	2.31	0.49	2.92	1.70	0.17	0.56	0.00	0.39	2.61	0.00	0.92	5.60	5.09	0.23	0.92	3.78	1.40	1.70
			2000	0.59	2.48	0.59	3.22	1.74	0.17	0.58	0.01	0.39	3.58	0.00	1.22	5.50	5.20	0.24	1.21	3.90	1.54	1.85
			500	0.39	2.13	0.39	2.78	1.48	0.00	0.45	0.00	0.37	1.17	0.19	0.80	6.73	4.24	0.14	0.55	3.78	1.26	1.55
	4	**URIBARRI-JAUREGI**	**1000**	0.43	2.24	0.43	3.03	1.44	0.00	0.40	0.00	0.37	1.17	0.19	0.91	7.52	4.14	0.12	0.55	4.02	1.33	1.63
			2000	0.58	2.74	0.58	3.81	1.67	0.17	0.41	0.24	0.37	3.80	0.38	1.21	7.22	4.39	0.27	1.41	4.12	1.66	2.02
			500	0.12	1.11	0.12	1.54	0.67	0.00	0.18	0.00	0.33	0.00	0.00	0.04	4.46	2.00	0.05	0.12	2.05	0.61	0.78
	-	**BRIGADA TUNEL**	**1000**	0.17	1.08	0.17	1.49	0.67	0.00	0.25	0.00	0.33	0.00	0.00	0.19	4.21	2.00	0.08	0.12	2.03	0.63	0.78
			2000	0.42	1.12	0.42	1.54	0.69	0.00	0.26	0.00	0.33	0.00	0.00	0.93	4.37	2.06	0.08	0.12	2.36	0.77	0.88
			500	0.00	0.07	0.00	0.14	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.03	0.00	0.10	0.04	0.05
	-	**LAMINORIA**	**1000**	0.01	0.73	0.01	0.79	0.67	0.00	0.15	0.00	0.00	0.00	0.00	0.02	2.21	2.00	0.05	0.00	1.37	0.37	0.49
			2000	0.05	0.89	0.05	1.08	0.70	0.00	0.18	0.00	0.00	0.00	0.00	0.16	3.06	2.10	0.05	0.00	1.71	0.47	0.61
			500	0.04	1.82	0.04	1.8	1.79	0.00	0.68	0.00	0.01	0.00	0.00	0.10	4.85	5.37	0.21	0.00	3.37	0.93	1.22
	4	**ZEKUIANO**	**1000**	0.07	2.89	0.07	3.0	2.77	0.00	1.01	0.59	0.01	2.71	0.38	0.21	5.30	7.33	0.51	0.95	4.23	1.48	1.95
			2000	0.81	3.59	0.81	3.6	3.62	0.00	0.90	2.94	1.96	4.98	0.58	0.47	4.80	7.36	1.30	2.38	4.18	2.20	2.66
			500	0.69	3.74	0.69	4.88	2.60	0.24	6.73	2.99	1.70	4.82	0.19	0.13	3.08	4.62	3.15	2.11	2.59	2.21	2.72
	3	**MAEZTU**	**1000**	0.88	4.71	0.88	5.04	4.37	0.24	5.86	3.55	2.13	4.90	0.38	0.26	4.38	9.18	3.08	2.35	4.62	2.79	3.43
			2000	1.21	4.88	1.21	5.35	4.42	0.24	5.28	3.58	2.76	4.94	0.77	0.62	5.84	8.90	2.92	2.72	5.08	3.04	3.66
			500	0.11	2.56	0.11	2.12	2.99	0.00	0.96	0.14	0.22	0.00	0.00	0.10	5.41	8.84	0.34	0.08	4.75	1.33	1.74
	4	**ATAURI**	**1000**	0.68	3.21	0.68	3.28	3.14	0.24	0.84	0.36	1.56	2.71	0.38	0.26	6.29	8.66	0.46	1.49	5.01	1.95	2.37
			2000	0.82	3.15	0.82	3.49	2.80	0.24	0.77	0.80	1.56	2.97	0.58	0.66	6.74	7.02	0.59	1.64	4.71	1.98	2.37
			500	2.75	2.51	2.75	3.16	1.86	0.24	2.50	0.01	1.60	2.16	0.38	6.40	4.82	5.20	0.84	1.34	5.51	2.63	2.59
4	4	**ANTOÑANA**	**1000**	2.88	3.52	2.88	4.01	3.04	0.24	2.72	0.64	1.88	3.81	0.60	6.51	5.49	7.86	1.13	2.01	6.68	3.20	3.31
			2000	2.97	3.87	2.97	4.35	3.39	0.24	2.53	0.70	1.88	4.15	0.60	6.79	6.39	8.89	1.09	2.11	7.40	3.42	3.57
			500	2.46	2.18	2.46	2.65	1.72	0.00	1.48	0.03	2.24	0.00	0.19	5.13	6.48	4.92	0.45	0.85	5.46	2.32	2.27
	-	**FRESNEDO**	**1000**	2.50	2.04	2.50	2.31	1.77	0.00	0.77	0.06	2.24	0.00	0.19	5.27	6.17	5.05	0.25	0.85	5.47	2.27	2.20
			2000	2.97	3.25	2.97	3.74	2.76	0.24	0.80	2.84	2.48	5.14	0.41	6.20	5.29	5.05	1.32	2.55	5.52	3.11	3.16
			500	2.66	2.63	2.66	3.11	2.15	0.00	1.67	1.42	2.24	3.35	0.00	5.72	4.32	5.04	1.00	1.79	5.06	2.64	2.64
	4	**KANPEZU**	**1000**	2.88	3.45	2.88	3.74	3.17	0.24	1.63	3.97	2.57	5.11	0.58	5.82	4.47	4.97	1.96	2.63	5.12	3.17	3.26
			2000	3.03	4.13	3.03	3.97	4.29	0.24	1.19	4.06	2.69	5.71	0.60	6.16	5.01	8.20	1.86	2.86	6.53	3.58	3.76
			500	0.17	1.19	0.17	1.78	0.60	0.00	0.72	0.01	0.40	0.00	0.00	0.10	4.62	1.80	0.22	0.14	2.05	0.68	0.85
	-	**ORRADICHO**	**1000**	0.22	1.21	0.22	1.75	0.67	0.00	0.32	0.03	0.40	0.00	0.00	0.26	4.94	1.98	0.11	0.14	2.26	0.71	0.88
			2000	2.24	3.88	2.24	3.40	4.37	0.24	0.33	3.97	0.40	4.29	0.77	6.09	5.58	8.36	1.57	1.70	6.73	3.06	3.34
			500	0.28	1.34	0.28	2.03	0.65	0.31	1.70	0.00	0.40	0.00	0.19	0.14	4.40	1.76	0.62	0.21	1.98	0.81	0.99
	4	**ZUÑIGA**	**1000**	0.33	2.05	0.33	3.29	0.82	0.34	1.27	0.66	0.40	3.30	0.38	0.27	5.29	1.41	0.73	1.26	2.17	1.19	1.48
			2000	0.80	3.40	0.80	3.82	2.99	0.34	0.89	0.51	1.52	3.96	0.60	0.54	6.60	7.85	0.56	1.93	4.92	2.10	2.53

VALUES RESULTED FROM MCA II

				NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENERAL/RURAL			TOTAL	
ZONE	URB. AREA	NODE	AREA	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	gener.	rural	N/P	N/U/C
	-	ARQUITAS	500	0.05	1.77	0.05	1.81	1.73	0.00	0.43	0.00	0.01	0.00	0.19	0.14	5.00	5.00	0.13	0.07	3.30	0.91	1.20
			1000	0.10	1.79	0.10	1.84	1.73	0.00	0.57	0.00	0.01	0.00	0.19	0.30	4.96	5.00	0.17	0.07	3.34	0.94	1.23
			2000	0.30	2.17	0.30	2.59	1.76	0.31	0.38	0.00	0.01	0.00	0.19	0.57	7.37	5.09	0.22	0.07	4.20	1.24	1.55
	3	ACEDO	500	0.25	2.13	0.25	3.32	0.94	0.31	2.78	0.79	0.33	3.72	0.58	0.11	3.46	1.45	1.22	1.43	1.58	1.19	1.50
			1000	0.32	2.41	0.32	3.70	1.12	0.31	2.33	0.99	0.33	4.30	0.77	0.32	4.47	1.61	1.15	1.67	2.02	1.36	1.71
			2000	1.11	3.40	1.11	4.31	2.50	0.31	1.97	1.90	2.43	4.30	0.96	0.58	6.67	4.64	1.36	2.48	3.82	2.26	2.64
	-	GRANADA	500	0.05	2.01	0.05	2.42	1.59	0.00	0.21	0.00	0.01	0.00	0.00	0.14	7.06	4.78	0.06	0.00	3.84	1.03	1.35
			1000	0.10	1.89	0.10	2.11	1.68	0.00	0.21	0.00	0.01	0.00	0.19	0.28	6.12	4.84	0.06	0.07	3.63	0.99	1.29
			2000	0.18	2.41	0.18	3.20	1.61	0.00	0.43	0.00	0.01	1.75	0.38	0.55	7.42	4.46	0.13	0.66	3.98	1.30	1.67
5	3	ANCIN	500	0.83	3.43	0.83	4.64	2.23	0.31	7.35	2.16	2.11	4.58	0.38	0.07	1.98	4.14	3.07	2.25	2.07	2.13	2.56
			1000	1.14	3.89	1.14	5.24	2.54	0.31	6.05	2.10	2.89	4.96	0.77	0.21	4.70	4.75	2.66	2.77	3.14	2.51	2.97
			2000	1.24	4.06	1.24	5.38	2.75	0.34	5.47	2.44	2.89	5.01	0.96	0.48	5.66	4.85	2.61	2.85	3.56	2.65	3.12
	3	MURIETA	500	0.71	2.63	0.71	4.26	0.99	0.00	6.34	1.35	2.02	2.39	0.00	0.11	4.06	1.62	2.38	1.42	1.82	1.67	1.99
			1000	0.86	3.68	0.86	5.00	2.36	0.31	5.83	1.61	2.02	4.94	0.38	0.24	4.24	5.10	2.42	2.32	3.14	2.27	2.74
			2000	1.21	4.08	1.21	4.99	3.16	0.34	5.43	3.41	2.78	5.02	0.77	0.50	4.54	5.30	2.94	2.75	3.39	2.64	3.12
	4	ZUFIA	500	0.38	2.27	0.38	3.13	1.41	0.31	1.77	0.00	0.84	0.00	0.00	0.00	7.63	4.24	0.64	0.29	3.77	1.33	1.64
			1000	0.38	2.06	0.38	2.64	1.49	0.31	1.38	0.00	0.84	0.00	0.00	0.00	6.53	4.47	0.52	0.29	3.52	1.22	1.50
			2000	0.39	2.83	0.39	3.81	1.85	0.34	1.13	0.71	0.84	3.98	0.19	0.00	6.33	4.65	0.71	1.55	3.53	1.61	2.02
	3	ZUBIELQUI	500	0.37	3.02	0.37	3.63	2.40	0.31	3.95	2.44	0.72	3.88	0.00	0.06	3.05	4.77	2.15	1.42	2.61	1.69	2.13
			1000	0.39	3.17	0.39	3.72	2.62	0.31	3.28	2.74	0.72	4.57	0.58	0.13	3.30	4.54	2.05	1.83	2.62	1.78	2.24
			2000	0.43	3.22	0.43	3.79	2.64	0.31	2.75	2.80	0.72	4.71	0.77	0.27	3.92	4.37	1.91	1.94	2.80	1.83	2.29
	2	LIZARRA	500	3.39	3.81	3.39	5.56	2.07	0.86	8.94	5.31	4.30	6.85	0.82	5.00	0.90	0.08	4.84	3.85	2.05	3.60	3.67
			1000	3.68	4.09	3.68	5.58	2.59	1.00	8.09	6.14	4.97	7.61	1.54	5.05	1.05	0.09	4.92	4.56	2.11	3.88	3.95
			2000	3.92	4.48	3.92	5.48	3.47	1.22	6.64	6.35	5.36	7.96	1.73	5.19	1.83	2.34	4.64	4.87	3.18	4.20	4.29

4.2.4. Sensitivity analysis

N1	COMBINATION OF WEIGHTS						
N11	1.67	2.00	2.00	1.00	3.00	1.00	1.00
N12	1.67	2.00	2.00	1.00	3.00	1.00	1.00
N13	1.67	2.00	1.00	2.00	1.00	3.00	1.00
N14	1.67	2.00	1.00	2.00	1.00	3.00	1.00
N15	1.67	1.00	2.00	2.00	1.00	1.00	3.00
N16	1.67	1.00	2.00	2.00	1.00	1.00	3.00
	2.99	3.59	3.46	1.92	5.13	2.04	1.79
	0.26	0.31	0.16	0.31	0.16	0.47	0.16
	0.24	0.29	0.15	0.29	0.15	0.44	0.15
	0.26	0.31	0.16	0.31	0.16	0.47	0.16
	0.34	0.40	0.20	0.40	0.20	0.61	0.20
	0.28	0.34	0.17	0.34	0.17	0.51	0.17
	0.42	0.50	0.25	0.50	0.25	0.75	0.25
	0.29	0.35	0.18	0.35	0.18	0.53	0.18
	0.31	0.38	0.19	0.38	0.19	0.57	0.19
	0.31	0.38	0.19	0.38	0.19	0.57	0.19
	0.69	0.83	0.41	0.83	0.41	1.24	0.41
	0.77	0.92	0.46	0.92	0.46	1.39	0.46
	0.35	0.42	0.21	0.42	0.21	0.64	0.21
	0.39	0.46	0.23	0.46	0.23	0.69	0.23
	0.34	0.40	0.20	0.40	0.20	0.61	0.20
	0.11	0.13	0.07	0.13	0.07	0.20	0.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.18	0.22	0.11	0.22	0.11	0.33	0.11
	0.18	0.22	0.11	0.22	0.11	0.33	0.11
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.14	0.17	0.09	0.17	0.09	0.26	0.09
	0.11	0.13	0.07	0.13	0.07	0.20	0.07
	0.20	0.24	0.12	0.24	0.12	0.37	0.12
	5.75	5.22	5.11	6.88	3.44	6.99	6.77
	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	6.31	6.72	6.61	5.55	7.78	5.66	5.44
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.18	0.22	0.11	0.22	0.11	0.33	0.11
	3.49	4.18	4.09	2.18	6.09	2.27	2.09
	0.17	0.20	0.10	0.20	0.10	0.30	0.10
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.09	0.11	0.06	0.11	0.06	0.17	0.06
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.13	0.16	0.08	0.16	0.08	0.24	0.08
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.17	0.21	0.10	0.21	0.10	0.31	0.10
	0.17	0.21	0.10	0.21	0.10	0.31	0.10
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.19	0.23	0.11	0.23	0.11	0.34	0.11
	0.17	0.21	0.10	0.21	0.10	0.31	0.10
	0.68	0.81	0.41	0.81	0.41	1.22	0.41
TOTAL VALUE	38.59	41.74	35.29	38.58	38.45	45.03	32.12
INCREMENT	0.00	3.15	-3.30	-0.02	-0.14	6.44	-6.47
%	0.00	8.16	-8.56	-0.04	-0.36	16.68	-16.77

better results | including extra conditions

N2	COMBINATION OF WEIGHTS																											
N_{21}	3.33	6.00	2.00	2.00	6.00	6.00	1.00	3.00	1.00	3.00	5.00	5.00	1.00	4.00	1.00	4.00	5.00	5.00	2.00	3.00	2.00	3.00	4.00	3.00	3.00	4.00	4.00	2.00
N_{22}	3.33	2.00	6.00	2.00	3.00	1.00	6.00	6.00	3.00	1.00	4.00	1.00	5.00	5.00	4.00	1.00	3.00	2.00	5.00	5.00	3.00	2.00	3.00	4.00	3.00	4.00	2.00	4.00
N_{23}	3.33	2.00	2.00	6.00	1.00	3.00	3.00	1.00	6.00	6.00	1.00	4.00	4.00	1.00	5.00	5.00	2.00	3.00	3.00	2.00	5.00	5.00	3.00	3.00	4.00	2.00	4.00	4.00
	4.72	5.73	3.23	5.21	5.23	6.22	3.10	3.36	4.59	5.84	4.61	6.09	3.59	3.98	4.09	5.96	5.10	5.60	3.72	3.85	4.71	5.34	4.97	4.35	4.84	4.48	5.47	4.22
	2.92	2.61	1.79	4.37	1.96	3.25	2.23	1.35	4.16	4.57	1.76	3.69	2.87	1.55	3.52	4.13	2.40	3.05	2.43	1.99	3.72	3.93	2.84	2.64	3.28	2.20	3.49	3.08
	3.05	2.76	2.16	4.24	2.24	3.28	2.53	1.79	4.09	4.39	2.09	3.65	3.05	1.94	3.57	4.02	2.61	3.13	2.68	2.31	3.72	3.87	2.98	2.83	3.35	2.46	3.50	3.20
	3.53	3.57	2.40	4.64	3.01	4.13	2.67	2.13	4.35	4.93	2.72	4.39	3.23	2.43	3.79	4.66	3.28	3.84	2.96	2.69	4.08	4.37	3.54	3.25	3.81	2.99	4.10	3.52
	4.86	5.23	3.12	6.24	4.46	6.01	3.38	2.87	5.71	6.77	3.93	6.27	4.16	3.40	4.93	6.52	4.71	5.49	3.90	3.65	5.46	5.99	4.96	4.43	5.21	4.18	5.74	4.68
	5.85	7.50	3.67	6.40	6.81	8.18	3.40	3.94	5.45	7.36	5.86	7.91	4.08	4.90	4.76	7.63	6.54	7.22	4.35	4.63	5.72	6.68	6.27	5.31	5.99	5.58	6.95	5.04
	3.65	4.51	2.33	4.12	4.06	4.95	2.24	2.43	3.57	4.66	3.52	4.85	2.68	2.97	3.13	4.76	3.96	4.41	2.78	2.88	3.67	4.21	3.87	3.32	3.77	3.42	4.31	3.23
	2.92	2.59	1.76	4.42	1.93	3.26	2.22	1.31	4.21	4.63	1.72	3.71	2.88	1.51	3.55	4.17	2.38	3.05	2.43	1.97	3.75	3.96	2.84	2.63	3.30	2.18	3.51	3.09
	2.86	2.28	1.72	4.60	1.56	3.00	2.30	1.14	4.46	4.74	1.42	3.58	3.02	1.28	3.74	4.16	2.14	2.86	2.44	1.86	3.88	4.02	2.72	2.58	3.30	2.00	3.44	3.16
	2.90	2.21	1.74	4.77	1.45	2.96	2.39	1.10	4.66	4.89	1.33	3.60	3.14	1.22	3.90	4.25	2.09	2.85	2.50	1.86	4.01	4.13	2.73	2.62	3.37	1.98	3.49	3.26
	4.07	3.95	2.51	5.78	3.13	4.76	2.97	2.05	5.42	6.14	2.77	5.22	3.78	2.41	4.60	5.68	3.59	4.40	3.33	2.87	4.96	5.32	4.05	3.69	4.50	3.23	4.86	4.14
	3.41	2.98	2.13	5.15	2.22	3.73	2.67	1.59	4.93	5.36	2.01	4.27	3.43	1.80	4.18	4.81	2.77	3.52	2.89	2.34	4.39	4.60	3.31	3.10	3.85	2.55	4.06	3.64
	3.89	3.67	2.53	5.47	2.94	4.41	2.98	2.08	5.19	5.76	2.65	4.86	3.71	2.36	4.45	5.31	3.39	4.12	3.26	2.81	4.74	5.02	3.84	3.55	4.29	3.10	4.57	4.00
	7.82	6.88	8.70	7.92	7.07	6.68	8.96	8.44	8.37	7.46	7.53	6.94	8.76	7.98	8.57	7.20	7.33	7.14	8.50	8.24	8.11	7.66	7.59	8.05	7.85	7.79	7.40	8.31
	3.81	3.98	2.40	5.06	3.31	4.64	2.67	2.13	4.66	5.45	2.92	4.91	3.33	2.52	4.00	5.18	3.58	4.25	3.06	2.79	4.39	4.79	3.85	3.46	4.12	3.19	4.52	3.73
	2.23	2.19	1.35	3.16	1.73	2.64	1.60	1.11	2.95	3.37	1.53	2.88	2.05	1.32	2.50	3.13	1.98	2.43	1.81	1.56	2.71	2.92	2.22	2.01	2.47	1.77	2.67	2.26
	2.24	2.21	1.36	3.17	1.76	2.67	1.60	1.12	2.95	3.38	1.55	2.90	2.05	1.33	2.50	3.14	2.00	2.45	1.81	1.57	2.72	2.93	2.24	2.02	2.48	1.79	2.69	2.26
	0.46	0.83	0.28	0.28	0.83	0.83	0.14	0.42	0.14	0.42	0.70	0.69	0.14	0.56	0.14	0.56	0.70	0.69	0.28	0.42	0.28	0.42	0.56	0.42	0.42	0.56	0.56	0.28
	0.39	0.70	0.23	0.23	0.70	0.70	0.12	0.35	0.12	0.35	0.58	0.58	0.12	0.47	0.12	0.47	0.58	0.58	0.23	0.35	0.23	0.35	0.47	0.35	0.35	0.47	0.47	0.23
	2.22	1.80	1.37	3.49	1.27	2.33	1.79	0.95	3.38	3.60	1.17	2.75	2.32	1.06	2.85	3.17	1.70	2.22	1.90	1.48	2.96	3.07	2.12	2.01	2.54	1.59	2.65	2.43
	3.19	2.33	3.25	4.01	2.14	2.52	3.67	2.83	4.24	3.78	2.37	2.94	3.86	2.60	4.05	3.36	2.56	2.75	3.44	3.02	3.82	3.59	2.98	3.21	3.40	2.79	3.17	3.63
	2.85	2.25	2.11	4.20	1.72	2.77	2.60	1.62	4.17	4.24	1.69	3.26	3.12	1.65	3.64	3.75	2.21	2.74	2.63	2.14	3.68	3.71	2.70	2.67	3.19	2.18	3.23	3.15
	0.97	1.42	0.91	0.58	1.50	1.34	0.70	1.12	0.46	0.71	1.38	1.13	0.62	1.25	0.54	0.92	1.29	1.21	0.83	1.04	0.66	0.79	1.08	0.96	0.87	1.17	1.00	0.75
	2.87	3.50	1.75	3.36	3.10	3.91	1.72	1.79	2.92	3.80	2.66	3.87	2.12	2.23	2.52	3.83	3.07	3.47	2.15	2.19	2.96	3.40	3.03	2.59	2.99	2.63	3.43	2.56
	1.17	1.97	0.85	0.71	2.01	1.94	0.53	1.16	0.42	0.99	1.73	1.62	0.50	1.45	0.46	1.30	1.69	1.66	0.81	1.13	0.74	1.02	1.38	1.09	1.06	1.41	1.34	0.78
	3.10	3.50	1.94	3.88	3.02	3.99	2.03	1.84	3.49	4.27	2.63	4.08	2.52	2.23	3.00	4.17	3.11	3.60	2.42	2.33	3.39	3.78	3.20	2.81	3.30	2.72	3.69	2.91
	4.36	3.94	2.67	6.49	2.99	4.90	3.31	2.03	6.17	6.81	2.67	5.54	4.26	2.35	5.22	6.17	3.63	4.58	3.63	2.99	5.54	5.86	4.26	3.94	4.90	3.31	5.22	4.58
	4.21	3.53	2.59	6.53	2.54	4.51	3.34	1.84	6.29	6.76	2.31	5.26	4.32	2.07	5.31	6.01	3.29	4.28	3.57	2.82	5.54	5.78	4.04	3.81	4.79	3.06	5.03	4.56
	3.35	2.63	2.02	5.40	1.78	3.47	2.71	1.33	5.25	5.56	1.63	4.17	3.56	1.48	4.41	4.86	2.48	3.32	2.87	2.17	4.56	4.71	3.17	3.02	3.86	2.33	4.02	3.71
	1.99	1.56	1.21	3.20	1.07	2.06	1.62	0.80	3.11	3.28	0.98	2.47	2.11	0.89	2.61	2.88	1.48	1.97	1.71	1.30	2.70	2.79	1.88	1.79	2.29	1.39	2.38	2.20
	0.38	0.65	0.25	0.23	0.66	0.64	0.15	0.36	0.13	0.33	0.56	0.54	0.14	0.46	0.13	0.43	0.55	0.54	0.25	0.35	0.23	0.33	0.44	0.34	0.34	0.45	0.44	0.24
	1.91	1.66	1.94	2.14	1.61	1.71	2.06	1.83	2.21	2.07	1.68	1.83	2.11	1.75	2.16	1.95	1.73	1.78	1.99	1.87	2.09	2.02	1.85	1.92	1.97	1.80	1.90	2.04
	2.71	2.39	1.64	4.10	1.78	3.01	2.07	1.22	3.92	4.29	1.59	3.44	2.69	1.40	3.30	3.86	2.21	2.82	2.26	1.83	3.49	3.68	2.63	2.45	3.06	2.02	3.25	2.87
	1.27	1.25	0.82	1.76	1.02	1.49	0.95	0.69	1.65	1.86	0.91	1.61	1.18	0.80	1.41	1.74	1.14	1.38	1.05	0.93	1.52	1.63	1.27	1.16	1.40	1.04	1.50	1.29
	0.41	0.73	0.27	0.25	0.73	0.72	0.15	0.39	0.13	0.36	0.62	0.60	0.14	0.50	0.14	0.48	0.61	0.61	0.26	0.38	0.25	0.37	0.49	0.38	0.37	0.50	0.49	0.26
	0.44	0.78	0.27	0.26	0.78	0.78	0.14	0.40	0.13	0.39	0.65	0.65	0.14	0.53	0.13	0.52	0.65	0.65	0.27	0.40	0.26	0.39	0.52	0.39	0.39	0.52	0.52	0.26
	0.41	0.74	0.25	0.25	0.74	0.74	0.12	0.37	0.12	0.37	0.62	0.62	0.12	0.49	0.12	0.49	0.62	0.62	0.25	0.37	0.25	0.37	0.49	0.37	0.37	0.49	0.49	0.25
	0.37	0.67	0.22	0.22	0.67	0.67	0.11	0.33	0.11	0.33	0.56	0.56	0.11	0.44	0.11	0.44	0.56	0.56	0.22	0.33	0.22	0.33	0.44	0.33	0.33	0.44	0.44	0.22
	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.32	0.79	0.81	2.35	0.40	1.18	1.20	0.41	2.36	2.35	0.41	1.57	1.58	0.41	1.97	1.96	0.79	1.18	1.19	0.80	1.97	1.96	1.19	1.19	1.58	0.80	1.57	1.58
	2.02	1.21	1.57	3.28	0.79	1.64	2.09	1.05	3.37	3.19	0.87	2.16	2.51	0.96	2.94	2.67	1.30	1.73	2.00	1.48	2.85	2.76	1.82	1.91	2.33	1.39	2.24	2.42
	1.26	0.75	1.19	1.82	0.60	0.91	1.46	0.93	1.93	1.71	0.71	1.18	1.62	0.82	1.77	1.45	0.86	1.02	1.35	1.08	1.67	1.56	1.13	1.24	1.40	0.97	1.29	1.51
	1.47	0.88	1.32	2.21	0.66	1.11	1.66	0.99	2.32	2.10	0.77	1.44	1.88	0.88	2.10	1.77	0.99	1.22	1.55	1.21	1.99	1.88	1.33	1.44	1.66	1.10	1.55	1.77
	1.94	1.16	1.73	2.92	0.86	1.46	2.17	1.29	3.07	2.78	1.01	1.90	2.47	1.15	2.77	2.34	1.31	1.60	2.03	1.59	2.63	2.48	1.75	1.89	2.19	1.45	2.04	2.33
	2.19	1.31	2.11	3.15	1.05	1.57	2.57	1.65	3.35	2.95	1.25	2.03	2.83	1.45	3.09	2.49	1.51	1.77	2.37	1.91	2.89	2.69	1.97	2.17	2.43	1.71	2.23	2.63
	0.66	0.40	1.19	0.40	0.60	0.20	1.19	1.19	0.60	0.20	0.80	0.20	0.99	0.99	0.80	0.20	0.60	0.40	0.99	0.99	0.60	0.40	0.60	0.80	0.60	0.80	0.40	0.80
	1.41	0.84	1.64	1.74	0.82	0.87	1.86	1.42	1.94	1.54	1.02	1.09	1.89	1.22	1.91	1.32	1.04	1.07	1.66	1.44	1.71	1.52	1.27	1.47	1.49	1.24	1.29	1.69
	0.01	0.01	0.02	0.01	0.01	0.00	0.02	0.02	0.01	0.00	0.01	0.00	0.02	0.02	0.01	0.00	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1.95	1.17	1.83	2.85	0.92	1.43	2.25	1.41	3.02	2.69	1.08	1.85	2.51	1.25	2.76	2.27	1.34	1.59	2.09	1.67	2.60	2.43	1.76	1.92	2.18	1.50	2.01	2.34
	0.01	0.01	0.02	0.01	0.01	0.00	0.02	0.02	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2.11	1.64	1.39	3.31	1.16	2.12	1.81	0.97	3.25	3.37	1.10	2.54	2.29	1.04	2.77	2.96	1.58	2.06	1.87	1.45	2.83	2.89	2.00	1.93	2.41	1.52	2.48	2.35
	2.07	1.65	1.39	3.16	1.21	2.09	1.77	1.02	3.09	3.22	1.15	2.47	2.21	1.08	2.65	2.84	1.59	2.03	1.84	1.46	2.72	2.78	1.96	1.90	2.34	1.52	2.40	2.28
	1.04	1.48	1.02	0.62	1.58	1.38	0.81	1.23	0.51	0.74	1.46	1.17	0.71	1.35	0.61	0.95	1.36	1.26	0.92	1.13	0.72	0.84	1.15	1.03	0.94	1.25	1.05	0.82
	0.94	1.20	1.06	0.57	1.33	1.08	0.90	1.22	0.53	0.60	1.29	0.92	0.78	1.25	0.65	0.76	1.17	1.04	0.94	1.10	0.69	0.72	1.01	0.97	0.85	1.13	0.88	0.81
	4.09	3.94	2.51	5.83	3.11	4.77	2.98	2.04	5.48	6.19	2.75	5.24	3.81	2.39	4.65	5.72	3.58	4.41	3.34	2.87	5.00	5.36	4.05	3.70	4.53	3.22	4.89	4.17
TOTAL VALUE	128.3	122.1	92.6	170.5	102.6	141.6	104.7	80.5	163.1	177.9	95.3	153.7	124.1	87.9	143.6	165.8	114.7	134.2	112.1	100.0	151.0	158.4	126.8	119.4	138.9	107.3	146.3	131.5
INCREMENT	0.00	-6.14	-35.71	42.23	-25.63	13.34	-23.61	-47.80	34.84	49.63	-33.02	25.44	-4.13	-40.41	15.36	37.53	-13.53	5.95	-16.22	-28.32	22.75	30.14	-1.44	-8.83	10.65	-20.92	18.05	3.26
%	0.00	-4.79	-27.84	32.92	-19.98	10.40	-18.41	-37.27	27.16	38.69	-25.74	19.83	-3.22	-31.50	11.97	29.26	-10.55	4.64	-12.65	-22.07	17.73	23.50	-1.12	-6.88	8.31	-16.31	14.07	2.54

better results | including extra conditions

N3	COMBINATION OF WEIGHTS																											
N31	3.33	6.00	2.00	2.00	6.00	6.00	1.00	3.00	1.00	3.00	5.00	5.00	1.00	4.00	1.00	4.00	5.00	5.00	2.00	3.00	2.00	3.00	4.00	3.00	3.00	4.00	4.00	2.00
N32	3.33	2.00	6.00	2.00	3.00	1.00	6.00	6.00	3.00	1.00	4.00	1.00	5.00	5.00	4.00	1.00	3.00	2.00	5.00	5.00	3.00	2.00	3.00	4.00	3.00	4.00	2.00	4.00
N33	3.33	2.00	2.00	6.00	1.00	3.00	3.00	1.00	6.00	6.00	1.00	4.00	4.00	1.00	5.00	5.00	2.00	3.00	3.00	2.00	5.00	5.00	3.00	3.00	4.00	2.00	4.00	4.00
	0.26	0.47	0.16	0.16	0.47	0.47	0.08	0.23	0.08	0.23	0.39	0.39	0.08	0.31	0.08	0.31	0.39	0.39	0.16	0.23	0.16	0.23	0.31	0.23	0.23	0.31	0.31	0.16
	0.19	0.34	0.11	0.11	0.34	0.34	0.06	0.17	0.06	0.17	0.28	0.28	0.06	0.23	0.06	0.23	0.28	0.28	0.11	0.17	0.11	0.17	0.23	0.17	0.17	0.23	0.23	0.11
	0.61	1.11	0.37	0.37	1.11	1.11	0.18	0.55	0.18	0.55	0.92	0.92	0.18	0.74	0.18	0.74	0.92	0.92	0.37	0.55	0.37	0.55	0.74	0.55	0.55	0.74	0.74	0.37
	0.36	0.65	0.22	0.22	0.65	0.65	0.11	0.33	0.11	0.33	0.54	0.54	0.11	0.43	0.11	0.43	0.54	0.54	0.22	0.33	0.22	0.33	0.43	0.33	0.33	0.43	0.43	0.22
	0.37	0.67	0.22	0.22	0.67	0.67	0.11	0.34	0.11	0.34	0.56	0.56	0.11	0.45	0.11	0.45	0.56	0.56	0.22	0.34	0.22	0.34	0.45	0.34	0.34	0.45	0.45	0.22
	0.48	0.87	0.29	0.29	0.87	0.87	0.14	0.43	0.14	0.43	0.72	0.72	0.14	0.58	0.14	0.58	0.72	0.72	0.29	0.43	0.29	0.43	0.58	0.43	0.43	0.58	0.58	0.29
	0.81	1.46	0.49	0.49	1.46	1.46	0.24	0.73	0.24	0.73	1.21	1.21	0.24	0.97	0.24	0.97	1.21	1.21	0.49	0.73	0.49	0.73	0.97	0.73	0.73	0.97	0.97	0.49
	0.53	0.95	0.32	0.32	0.95	0.95	0.16	0.47	0.16	0.47	0.79	0.79	0.16	0.63	0.16	0.63	0.79	0.79	0.32	0.47	0.32	0.47	0.63	0.47	0.47	0.63	0.63	0.32
	0.65	1.17	0.39	0.39	1.17	1.17	0.19	0.58	0.19	0.58	0.97	0.97	0.19	0.78	0.19	0.78	0.97	0.97	0.39	0.58	0.39	0.58	0.78	0.58	0.58	0.78	0.78	0.39
	0.59	1.05	0.35	0.35	1.05	1.05	0.18	0.53	0.18	0.53	0.88	0.88	0.18	0.70	0.18	0.70	0.88	0.88	0.35	0.53	0.35	0.53	0.70	0.53	0.53	0.70	0.70	0.35
	0.80	1.45	0.48	0.48	1.45	1.45	0.24	0.73	0.24	0.73	1.21	1.21	0.24	0.97	0.24	0.97	1.21	1.21	0.48	0.73	0.48	0.73	0.97	0.73	0.73	0.97	0.97	0.48
	0.78	1.40	0.47	0.47	1.40	1.40	0.23	0.70	0.23	0.70	1.17	1.17	0.23	0.94	0.23	0.94	1.17	1.17	0.47	0.70	0.47	0.70	0.94	0.70	0.70	0.94	0.94	0.47
	0.64	1.16	0.39	0.39	1.16	1.16	0.19	0.58	0.19	0.58	0.96	0.96	0.19	0.77	0.19	0.77	0.96	0.96	0.39	0.58	0.39	0.58	0.77	0.58	0.58	0.77	0.77	0.39
	0.64	1.16	0.39	0.39	1.16	1.16	0.19	0.58	0.19	0.58	0.96	0.96	0.19	0.77	0.19	0.77	0.96	0.96	0.39	0.58	0.39	0.58	0.77	0.58	0.58	0.77	0.77	0.39
	0.50	0.90	0.30	0.30	0.90	0.90	0.15	0.45	0.15	0.45	0.75	0.75	0.15	0.60	0.15	0.60	0.75	0.75	0.30	0.45	0.30	0.45	0.60	0.45	0.45	0.60	0.60	0.30
	0.13	0.24	0.08	0.08	0.24	0.24	0.04	0.12	0.04	0.12	0.20	0.20	0.04	0.16	0.04	0.16	0.20	0.20	0.08	0.12	0.08	0.12	0.16	0.12	0.12	0.16	0.16	0.08
	0.13	0.24	0.08	0.08	0.24	0.24	0.04	0.12	0.04	0.12	0.20	0.20	0.04	0.16	0.04	0.16	0.20	0.20	0.08	0.12	0.08	0.12	0.16	0.12	0.12	0.16	0.16	0.08
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3.41	2.15	2.05	6.05	1.15	3.15	3.02	1.07	6.02	6.07	1.12	4.12	4.02	1.10	5.02	5.10	2.12	3.12	3.05	2.07	5.05	5.07	3.10	3.07	4.07	2.10	4.10	4.05
	3.63	2.55	2.18	6.18	1.55	3.55	3.09	1.27	6.09	6.27	1.46	4.46	4.09	1.36	5.09	5.36	2.46	3.46	3.18	2.27	5.18	5.27	3.36	3.27	4.27	2.36	4.36	4.18
	1.66	1.65	0.99	2.33	1.32	1.98	1.16	0.82	2.16	2.49	1.15	2.15	1.50	0.99	1.83	2.32	1.49	1.82	1.33	1.16	1.99	2.16	1.65	1.49	1.82	1.32	1.99	1.66
	1.66	1.67	1.00	2.33	1.33	2.00	1.17	0.83	2.17	2.50	1.17	2.17	1.50	1.00	1.83	2.33	1.50	1.83	1.33	1.17	2.00	2.17	1.67	1.50	1.83	1.33	2.00	1.67
	1.67	1.67	1.00	2.34	1.34	2.01	1.17	0.84	2.17	2.50	1.17	2.17	1.50	1.00	1.83	2.34	1.51	1.84	1.34	1.17	2.00	2.17	1.67	1.50	1.84	1.34	2.00	1.67
	1.71	1.75	1.03	2.36	1.42	2.09	1.18	0.88	2.18	2.54	1.24	2.24	1.51	1.06	1.85	2.39	1.57	1.91	1.36	1.21	2.03	2.21	1.72	1.54	1.88	1.39	2.06	1.70
	0.53	0.95	0.32	0.32	0.95	0.95	0.16	0.48	0.16	0.48	0.79	0.79	0.16	0.63	0.16	0.63	0.79	0.79	0.32	0.48	0.32	0.48	0.63	0.48	0.48	0.63	0.63	0.32
	2.83	5.10	1.70	1.70	5.10	5.10	0.85	2.55	0.85	2.55	4.25	4.25	0.85	3.40	0.85	3.40	4.25	4.25	1.70	2.55	1.70	2.55	3.40	2.55	2.55	3.40	3.40	1.70
	6.66	8.00	8.00	4.00	9.00	7.00	7.00	9.00	4.00	4.00	9.00	6.00	6.00	9.00	5.00	5.00	8.00	7.00	7.00	8.00	5.00	5.00	7.00	7.00	6.00	8.00	6.00	6.00
	5.80	5.11	7.48	4.82	5.78	4.45	7.41	7.56	5.41	4.22	6.37	4.37	6.74	6.97	6.07	4.30	5.71	5.04	6.82	6.89	5.48	4.89	5.63	6.22	5.56	6.30	4.97	6.15
	3.87	2.97	6.32	2.32	3.97	1.97	6.16	6.48	3.16	1.48	4.80	1.80	5.16	5.64	4.16	1.64	3.80	2.80	5.32	5.48	3.32	2.48	3.64	4.48	3.48	4.64	2.64	4.32
	5.01	3.69	7.01	4.34	4.36	3.02	7.17	6.85	5.17	3.51	5.19	3.19	6.50	6.02	5.84	3.35	4.52	3.85	6.34	6.18	5.01	4.18	4.68	5.51	4.85	5.35	4.02	5.67
	5.40	4.39	7.24	4.58	5.06	3.73	7.29	7.20	5.29	3.86	5.77	3.77	6.62	6.48	5.95	3.82	5.11	4.44	6.58	6.53	5.24	4.53	5.15	5.86	5.20	5.82	4.48	5.91
	4.78	3.28	6.87	4.20	3.94	2.61	7.10	6.64	5.10	3.30	4.84	2.84	6.43	5.74	5.77	3.07	4.17	3.51	6.20	5.97	4.87	3.97	4.41	5.30	4.64	5.07	3.74	5.54
	5.12	3.89	7.07	4.41	4.56	3.22	7.20	6.95	5.20	3.61	5.35	3.35	6.54	6.15	5.87	3.48	4.69	4.02	6.41	6.28	5.07	4.28	4.82	5.61	4.95	5.48	4.15	5.74
	1.68	1.70	1.01	2.34	1.36	2.03	1.17	0.85	2.17	2.52	1.19	2.19	1.51	1.02	1.84	2.35	1.53	1.86	1.34	1.18	2.01	2.18	1.69	1.52	1.85	1.35	2.02	1.68
	1.72	1.76	1.03	2.37	1.43	2.10	1.18	0.88	2.18	2.55	1.25	2.25	1.52	1.06	1.85	2.40	1.58	1.91	1.37	1.22	2.03	2.22	1.73	1.55	1.88	1.40	2.06	1.70
	1.71	1.75	1.03	2.36	1.42	2.09	1.18	0.88	2.18	2.54	1.24	2.24	1.51	1.06	1.85	2.39	1.57	1.91	1.36	1.21	2.03	2.21	1.73	1.54	1.88	1.39	2.06	1.70
	1.40	1.18	0.84	2.17	0.85	1.52	1.09	0.59	2.09	2.26	0.76	1.76	1.42	0.68	1.75	2.01	1.10	1.43	1.17	0.93	1.84	1.93	1.34	1.26	1.59	1.01	1.68	1.51
	0.18	0.32	0.11	0.11	0.32	0.32	0.05	0.16	0.05	0.16	0.26	0.26	0.05	0.21	0.05	0.21	0.26	0.26	0.11	0.16	0.11	0.16	0.21	0.16	0.16	0.21	0.21	0.11
	0.52	0.93	0.31	0.31	0.93	0.93	0.16	0.47	0.16	0.47	0.78	0.78	0.16	0.62	0.16	0.62	0.78	0.78	0.31	0.47	0.31	0.47	0.62	0.47	0.47	0.62	0.62	0.31
	0.68	1.23	0.41	0.41	1.23	1.23	0.21	0.62	0.21	0.62	1.03	1.03	0.21	0.82	0.21	0.82	1.03	1.03	0.41	0.62	0.41	0.62	0.82	0.62	0.62	0.82	0.82	0.41
	0.73	1.32	0.44	0.44	1.32	1.32	0.22	0.66	0.22	0.66	1.10	1.10	0.22	0.88	0.22	0.88	1.10	1.10	0.44	0.66	0.44	0.66	0.88	0.66	0.66	0.88	0.88	0.44
	6.06	4.25	7.64	6.31	4.58	3.92	8.15	7.12	7.15	5.46	5.43	4.43	7.82	6.28	7.49	4.94	5.10	4.76	7.31	6.79	6.64	5.79	5.61	6.46	6.12	5.94	5.28	6.97
	5.03	3.73	7.02	4.35	4.40	3.06	7.18	6.86	5.18	3.53	5.22	3.22	6.51	6.04	5.84	3.37	4.55	3.88	6.35	6.20	5.02	4.20	4.71	5.53	4.86	5.37	4.04	5.69
	4.98	3.65	6.99	4.33	4.31	2.98	7.16	6.82	5.16	3.49	5.15	3.15	6.50	5.99	5.83	3.32	4.48	3.82	6.33	6.16	4.99	4.16	4.65	5.49	4.82	5.32	3.99	5.66
	4.91	3.52	6.95	4.28	4.18	2.85	7.14	6.76	5.14	3.43	5.04	3.04	6.48	5.90	5.81	3.23	4.38	3.71	6.28	6.09	4.95	4.09	4.57	5.43	4.76	5.23	3.90	5.62
	0.60	1.08	0.36	0.36	1.08	1.08	0.18	0.54	0.18	0.54	0.90	0.90	0.18	0.72	0.18	0.72	0.90	0.90	0.36	0.54	0.36	0.54	0.72	0.54	0.54	0.72	0.72	0.36
	0.64	1.15	0.38	0.38	1.15	1.15	0.19	0.57	0.19	0.57	0.96	0.96	0.19	0.77	0.19	0.77	0.96	0.96	0.38	0.57	0.38	0.57	0.77	0.57	0.57	0.77	0.77	0.38
	0.64	1.15	0.38	0.38	1.15	1.15	0.19	0.58	0.19	0.58	0.96	0.96	0.19	0.77	0.19	0.77	0.96	0.96	0.38	0.58	0.38	0.58	0.77	0.58	0.58	0.77	0.77	0.38
	0.61	1.10	0.37	0.37	1.10	1.10	0.18	0.55	0.18	0.55	0.92	0.92	0.18	0.73	0.18	0.73	0.92	0.92	0.37	0.55	0.37	0.55	0.73	0.55	0.55	0.73	0.73	0.37
	0.54	0.97	0.32	0.32	0.97	0.97	0.16	0.48	0.16	0.48	0.81	0.81	0.16	0.64	0.16	0.64	0.81	0.81	0.32	0.48	0.32	0.48	0.64	0.48	0.48	0.64	0.64	0.32
	0.56	1.00	0.33	0.33	1.00	1.00	0.17	0.50	0.17	0.50	0.83	0.83	0.17	0.67	0.17	0.67	0.83	0.83	0.33	0.50	0.33	0.50	0.67	0.50	0.50	0.67	0.67	0.33
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.30	0.54	0.18	0.18	0.54	0.54	0.09	0.27	0.09	0.27	0.45	0.45	0.09	0.36	0.09	0.36	0.45	0.45	0.18	0.27	0.18	0.27	0.36	0.27	0.27	0.36	0.36	0.18
	3.54	2.37	6.12	2.12	3.37	1.37	6.06	6.19	3.06	1.19	4.31	1.31	5.06	5.25	4.06	1.25	3.31	2.31	5.12	5.19	3.12	2.19	3.25	4.19	3.19	4.25	2.25	4.12
TOTAL VALUE	99.2	98.8	107.6	91.6	102.8	94.8	105.8	109.4	93.8	89.4	105.0	93.0	101.8	107.2	97.8	91.2	101.0	97.0	103.6	105.4	95.6	93.4	99.2	101.4	97.4	103.2	95.2	99.6
INCREMENT	0.00	-0.44	8.37	-7.63	3.56	-4.44	6.57	10.17	-5.43	-9.83	5.76	-6.24	2.57	7.97	-1.43	-8.03	1.76	-2.24	4.37	6.17	-3.63	-5.83	-0.03	2.17	-1.83	3.97	-4.03	0.37
%	0.00	-0.44	8.43	-7.69	3.59	-4.47	6.62	10.25	-5.47	-9.91	5.81	-6.28	2.59	8.03	-1.44	-8.10	1.78	-2.25	4.40	6.21	-3.66	-5.88	-0.03	2.18	-1.85	4.00	-4.07	0.37

better results | including extra conditions

U1	COMBINATION OF WEIGHTS																											
U11	3.33	6.00	2.00	2.00	6.00	6.00	1.00	3.00	1.00	3.00	5.00	5.00	1.00	4.00	1.00	4.00	5.00	5.00	2.00	3.00	2.00	3.00	4.00	3.00	3.00	4.00	4.00	2.00
U12	3.33	2.00	6.00	2.00	3.00	1.00	6.00	6.00	3.00	1.00	4.00	1.00	5.00	5.00	4.00	1.00	3.00	2.00	5.00	5.00	3.00	2.00	3.00	4.00	3.00	4.00	2.00	4.00
U13	3.33	2.00	2.00	6.00	1.00	3.00	3.00	1.00	6.00	6.00	1.00	4.00	4.00	1.00	5.00	5.00	2.00	3.00	3.00	2.00	5.00	5.00	3.00	3.00	4.00	2.00	4.00	4.00
	0.73	0.64	0.48	1.07	0.49	0.79	0.59	0.37	1.03	1.11	0.45	0.90	0.74	0.41	0.89	1.00	0.60	0.75	0.63	0.52	0.92	0.96	0.71	0.67	0.82	0.56	0.86	0.78
	4.00	6.40	2.58	3.02	6.29	6.51	1.74	3.43	2.07	3.98	5.34	5.67	1.85	4.38	1.96	4.82	5.45	5.56	2.69	3.54	2.91	3.87	4.60	3.65	3.76	4.49	4.71	2.80
	0.27	0.21	0.18	0.42	0.15	0.27	0.23	0.13	0.41	0.42	0.14	0.32	0.29	0.14	0.35	0.37	0.20	0.26	0.24	0.19	0.36	0.37	0.25	0.25	0.31	0.20	0.31	0.30
	0.44	0.34	0.28	0.72	0.23	0.45	0.37	0.18	0.70	0.73	0.21	0.54	0.48	0.20	0.59	0.64	0.32	0.43	0.39	0.29	0.61	0.62	0.42	0.40	0.51	0.31	0.53	0.50
	4.87	6.93	3.32	4.39	6.66	7.19	2.69	3.96	3.49	5.29	5.76	6.56	2.95	4.86	3.22	5.92	6.03	6.29	3.59	4.22	4.12	5.02	5.39	4.49	4.76	5.12	5.66	3.85
	1.26	0.89	0.89	1.99	0.62	1.17	1.17	0.62	1.99	1.99	0.62	1.44	1.44	0.62	1.72	1.72	0.89	1.17	1.17	0.89	1.72	1.72	1.17	1.17	1.44	0.89	1.44	1.44
	0.37	0.27	0.22	0.62	0.17	0.36	0.31	0.14	0.61	0.63	0.16	0.45	0.41	0.15	0.51	0.54	0.26	0.35	0.32	0.23	0.52	0.53	0.34	0.33	0.43	0.24	0.44	0.42
	0.49	0.31	0.30	0.85	0.18	0.45	0.44	0.17	0.85	0.85	0.17	0.58	0.57	0.17	0.71	0.72	0.31	0.45	0.44	0.31	0.71	0.71	0.44	0.44	0.58	0.31	0.58	0.58
	0.92	0.75	0.64	1.36	0.58	0.93	0.80	0.49	1.33	1.39	0.55	1.09	0.97	0.52	1.15	1.24	0.73	0.91	0.82	0.67	1.18	1.21	0.88	0.85	1.03	0.70	1.06	1.00
	4.49	6.70	2.93	3.86	6.47	6.93	2.22	3.64	2.92	4.81	5.52	6.22	2.46	4.58	2.69	5.52	5.76	5.99	3.17	3.87	3.63	4.57	5.05	4.11	4.34	4.82	5.28	3.40
	5.57	7.34	3.99	5.39	6.99	7.69	3.50	4.48	4.55	6.23	6.15	7.21	3.85	5.32	4.20	6.72	6.51	6.86	4.34	4.83	5.04	5.88	6.02	5.18	5.53	5.67	6.37	4.69
	2.41	1.96	2.01	3.25	1.65	2.27	2.33	1.69	3.26	3.24	1.67	2.59	2.64	1.68	2.95	2.92	1.98	2.29	2.32	2.00	2.94	2.93	2.30	2.31	2.62	1.99	2.61	2.63
	4.34	6.61	2.78	3.65	6.39	6.83	2.04	3.52	2.69	4.61	5.43	6.09	2.26	4.47	2.48	5.35	5.65	5.87	3.00	3.73	3.43	4.39	4.91	3.95	4.17	4.69	5.13	3.21
	2.26	2.23	1.72	2.85	1.94	2.51	1.88	1.56	2.73	2.98	1.82	2.67	2.16	1.69	2.44	2.82	2.10	2.38	2.00	1.85	2.57	2.70	2.26	2.13	2.41	1.97	2.54	2.29
	1.48	1.78	1.02	1.65	1.62	1.94	0.99	1.05	1.46	1.84	1.43	1.91	1.14	1.24	1.30	1.87	1.59	1.75	1.18	1.21	1.49	1.68	1.56	1.37	1.53	1.40	1.72	1.34
	0.48	0.34	0.30	0.79	0.22	0.47	0.41	0.18	0.78	0.81	0.21	0.58	0.53	0.20	0.66	0.69	0.33	0.45	0.42	0.31	0.67	0.68	0.44	0.43	0.56	0.32	0.57	0.55
	0.58	0.41	0.36	0.97	0.26	0.56	0.50	0.22	0.96	0.98	0.25	0.70	0.65	0.23	0.81	0.84	0.40	0.55	0.51	0.37	0.82	0.83	0.54	0.53	0.68	0.39	0.69	0.67
	0.34	0.27	0.21	0.54	0.19	0.36	0.28	0.14	0.53	0.56	0.17	0.42	0.36	0.16	0.44	0.49	0.26	0.34	0.29	0.23	0.46	0.48	0.32	0.31	0.39	0.24	0.41	0.38
	0.23	0.17	0.14	0.37	0.12	0.23	0.19	0.09	0.36	0.38	0.11	0.28	0.24	0.10	0.30	0.33	0.17	0.22	0.20	0.15	0.31	0.32	0.21	0.20	0.26	0.16	0.27	0.25
	0.35	0.47	0.22	0.34	0.44	0.50	0.19	0.25	0.28	0.41	0.38	0.47	0.22	0.32	0.25	0.44	0.41	0.44	0.25	0.28	0.31	0.38	0.38	0.31	0.35	0.35	0.41	0.28
	0.19	0.21	0.11	0.24	0.18	0.24	0.12	0.11	0.21	0.26	0.15	0.24	0.15	0.13	0.18	0.25	0.18	0.21	0.14	0.14	0.21	0.23	0.19	0.17	0.20	0.16	0.22	0.18
	0.37	0.22	0.22	0.66	0.11	0.33	0.33	0.11	0.66	0.66	0.11	0.44	0.44	0.11	0.55	0.55	0.22	0.33	0.33	0.22	0.55	0.55	0.33	0.33	0.44	0.22	0.44	0.44
	0.97	0.58	0.58	1.73	0.30	0.87	0.87	0.29	1.73	1.74	0.29	1.16	1.16	0.29	1.45	1.45	0.58	0.87	0.87	0.58	1.45	1.45	0.87	0.87	1.16	0.58	1.16	1.16
	2.00	2.10	1.21	2.70	1.73	2.47	1.36	1.07	2.47	2.92	1.51	2.62	1.73	1.29	2.10	2.77	1.88	2.25	1.58	1.44	2.33	2.55	2.03	1.81	2.18	1.66	2.40	1.96
	1.49	1.49	0.90	2.10	1.19	1.79	1.05	0.75	1.95	2.24	1.04	1.94	1.35	0.90	1.65	2.09	1.34	1.64	1.20	1.05	1.80	1.94	1.49	1.35	1.65	1.19	1.79	1.50
	1.49	1.63	0.91	1.93	1.38	1.89	0.98	0.83	1.75	2.11	1.19	1.96	1.24	1.01	1.49	2.03	1.45	1.70	1.16	1.09	1.67	1.85	1.52	1.34	1.60	1.27	1.78	1.42
	8.40	9.05	7.14	9.05	8.57	9.52	7.14	7.14	8.57	9.52	8.09	9.52	7.61	7.61	8.09	9.52	8.57	9.05	7.61	7.61	8.57	9.05	8.57	8.09	8.57	8.09	9.05	8.09
	8.82	9.30	7.89	9.30	8.94	9.65	7.89	7.89	8.94	9.65	8.59	9.65	8.24	8.24	8.59	9.65	8.94	9.30	8.24	8.24	8.94	9.30	8.94	8.59	8.94	8.59	9.30	8.59
	3.23	2.42	2.72	4.54	1.97	2.88	3.25	2.19	4.62	4.47	2.04	3.41	3.71	2.12	4.16	3.94	2.50	2.95	3.18	2.65	4.09	4.01	3.03	3.10	3.56	2.57	3.48	3.63
	2.12	3.33	1.28	1.76	3.21	3.45	0.88	1.67	1.24	2.27	2.70	3.06	1.00	2.18	1.12	2.66	2.82	2.94	1.40	1.79	1.64	2.15	2.42	1.91	2.03	2.30	2.54	1.52
	2.39	4.07	1.44	1.68	4.01	4.13	0.84	2.04	1.02	2.33	3.36	3.53	0.90	2.70	0.96	2.93	3.41	3.47	1.50	2.10	1.62	2.28	2.82	2.16	2.22	2.76	2.87	1.56
	1.49	2.38	0.90	1.21	2.30	2.45	0.61	1.19	0.84	1.58	1.93	2.16	0.69	1.56	0.76	1.87	2.01	2.08	0.98	1.27	1.13	1.50	1.72	1.35	1.42	1.64	1.79	1.06
	1.34	1.73	0.81	1.48	1.57	1.90	0.75	0.88	1.25	1.71	1.34	1.83	0.92	1.11	1.08	1.77	1.50	1.67	0.98	1.04	1.31	1.54	1.44	1.21	1.37	1.27	1.60	1.15
	3.51	6.11	2.11	2.32	6.06	6.16	1.16	3.06	1.32	3.31	5.06	5.21	1.21	4.06	1.27	4.26	5.11	5.16	2.16	3.11	2.26	3.26	4.16	3.16	3.21	4.11	4.21	2.21
	3.51	6.11	2.11	2.33	6.06	6.16	1.17	3.06	1.33	3.33	5.06	5.22	1.22	4.06	1.27	4.27	5.11	5.16	2.17	3.11	2.27	3.27	4.17	3.17	3.22	4.11	4.22	2.22
	0.43	0.64	0.26	0.39	0.61	0.67	0.20	0.32	0.30	0.48	0.51	0.61	0.23	0.42	0.26	0.55	0.54	0.58	0.29	0.35	0.36	0.45	0.48	0.39	0.42	0.45	0.51	0.32
	0.32	0.45	0.19	0.31	0.42	0.48	0.16	0.23	0.25	0.37	0.35	0.44	0.19	0.29	0.22	0.41	0.38	0.41	0.22	0.26	0.28	0.34	0.35	0.29	0.32	0.32	0.38	0.25
	0.23	0.25	0.14	0.29	0.21	0.29	0.15	0.13	0.26	0.32	0.18	0.30	0.18	0.16	0.22	0.31	0.22	0.26	0.18	0.17	0.25	0.28	0.23	0.20	0.24	0.19	0.27	0.21
	0.15	0.17	0.09	0.20	0.14	0.20	0.10	0.08	0.18	0.22	0.12	0.20	0.12	0.10	0.15	0.21	0.15	0.18	0.12	0.11	0.17	0.19	0.16	0.14	0.16	0.13	0.18	0.14
	0.70	0.97	0.44	0.70	0.91	1.03	0.38	0.51	0.57	0.83	0.77	0.97	0.44	0.64	0.51	0.90	0.84	0.90	0.51	0.58	0.64	0.77	0.77	0.64	0.70	0.71	0.84	0.57
	3.65	6.19	2.21	2.56	6.10	6.28	1.30	3.11	1.56	3.56	5.11	5.37	1.39	4.11	1.48	4.46	5.20	5.28	2.29	3.20	2.47	3.47	4.29	3.29	3.38	4.20	4.38	2.38
	0.58	0.84	0.35	0.56	0.78	0.89	0.28	0.42	0.44	0.68	0.66	0.82	0.33	0.54	0.38	0.75	0.71	0.77	0.40	0.47	0.51	0.63	0.65	0.52	0.58	0.59	0.70	0.45
	1.80	2.89	1.09	1.43	2.81	2.98	0.73	1.46	0.98	1.88	2.36	2.61	0.81	1.91	0.90	2.25	2.44	2.53	1.18	1.54	1.35	1.80	2.08	1.63	1.71	1.99	2.16	1.26
	0.78	0.68	0.51	1.16	0.52	0.84	0.63	0.39	1.11	1.20	0.47	0.96	0.79	0.43	0.95	1.08	0.64	0.80	0.67	0.55	0.99	1.04	0.76	0.71	0.87	0.59	0.92	0.83
	0.97	1.22	0.62	1.07	1.11	1.34	0.58	0.65	0.92	1.23	0.96	1.30	0.69	0.81	0.81	1.26	1.07	1.19	0.73	0.77	0.96	1.11	1.03	0.88	1.00	0.92	1.15	0.85
	0.28	0.33	0.18	0.35	0.29	0.37	0.18	0.17	0.31	0.39	0.25	0.38	0.23	0.21	0.27	0.38	0.29	0.33	0.22	0.22	0.31	0.34	0.30	0.26	0.30	0.25	0.34	0.26
	0.77	0.87	0.47	0.97	0.74	0.99	0.49	0.44	0.87	1.07	0.64	1.02	0.62	0.54	0.74	1.04	0.77	0.89	0.59	0.57	0.84	0.94	0.79	0.69	0.82	0.67	0.92	0.72
	0.39	0.30	0.23	0.64	0.20	0.40	0.32	0.15	0.63	0.66	0.18	0.48	0.42	0.16	0.52	0.57	0.28	0.38	0.34	0.25	0.54	0.56	0.37	0.35	0.45	0.27	0.47	0.44
	1.42	2.24	0.86	1.15	2.17	2.32	0.59	1.13	0.81	1.50	1.82	2.04	0.66	1.48	0.73	1.77	1.90	1.97	0.93	1.20	1.08	1.43	1.62	1.28	1.35	1.55	1.70	1.01
	0.41	0.37	0.25	0.61	0.28	0.46	0.31	0.18	0.58	0.64	0.25	0.52	0.40	0.22	0.49	0.58	0.34	0.43	0.34	0.28	0.52	0.55	0.40	0.37	0.46	0.31	0.49	0.43
	3.86	6.32	2.33	2.93	6.17	6.46	1.49	3.18	1.93	3.92	5.17	5.62	1.64	4.18	1.78	4.77	5.32	5.47	2.48	3.33	2.78	3.78	4.47	3.48	3.63	4.32	4.62	2.63
	3.81	6.29	2.31	2.86	6.15	6.43	1.45	3.17	1.86	3.85	5.16	5.57	1.59	4.16	1.72	4.71	5.30	5.43	2.44	3.30	2.72	3.71	4.44	3.44	3.58	4.30	4.57	2.58
	1.11	0.93	0.67	1.74	0.66	1.19	0.87	0.47	1.68	1.80	0.59	1.40	1.14	0.53	1.41	1.60	0.86	1.13	0.94	0.73	1.47	1.54	1.07	1.00	1.27	0.80	1.33	1.21
	1.97	3.13	1.19	1.59	3.03	3.23	0.80	1.58	1.10	2.08	2.55	2.85	0.90	2.06	1.00	2.46	2.65	2.75	1.29	1.68	1.49	1.98	2.26	1.78	1.88	2.16	2.36	1.39
	5.25	7.15	3.48	5.13	6.74	7.56	2.97	3.98	4.21	6.04	5.82	7.06	3.38	4.90	3.79	6.55	6.23	6.64	3.89	4.39	4.71	5.63	5.73	4.81	5.22	5.31	6.14	4.30
TOTAL VALUE	106.1	138.0	72.8	107.8	129.2	146.7	65.2	80.3	91.5	124.1	112.9	139.2	74.0	96.6	82.7	131.6	121.7	130.4	81.5	89.1	99.0	115.3	114.1	97.8	106.6	105.4	122.9	90.3
INCREMENT	0.00	31.91	-33.28	1.69	23.17	40.65	-40.83	-25.72	-14.61	17.98	6.87	33.10	-32.09	-9.42	-23.35	25.54	15.61	24.35	-24.54	-16.98	-7.05	9.24	8.06	-8.24	0.50	-0.68	16.80	-15.80
%	0.00	30.08	-31.37	1.59	21.84	38.33	-38.50	-24.25	-13.78	16.95	6.48	31.20	-30.26	-8.89	-22.02	24.08	14.72	22.96	-23.13	-16.01	-6.65	8.71	7.60	-7.77	0.47	-0.64	15.84	-14.89

better results — including extra conditions

U3	COMBINATION OF WEIGHTS		
U_{31}	5.00	6.00	4.00
U_{32}	5.00	4.00	6.00
	2.79	3.34	2.23
	2.34	2.80	1.88
	3.59	4.30	2.88
	2.88	3.38	2.37
	1.54	1.82	1.26
	2.00	2.38	1.62
	3.22	3.85	2.58
	2.22	2.65	1.80
	1.44	1.71	1.17
	0.97	1.16	0.78
	1.84	2.16	1.51
	2.01	2.40	1.61
	1.85	2.22	1.49
	1.31	1.55	1.06
	2.59	3.04	2.14
	3.16	3.78	2.55
	2.81	3.36	2.27
	3.40	4.08	2.73
	3.94	4.68	3.21
	3.23	3.88	2.59
	3.69	4.43	2.95
	2.59	3.06	2.12
	1.83	2.06	1.60
	2.71	2.60	2.82
	4.18	3.45	4.92
	4.00	3.32	4.69
	0.00	0.00	0.00
	0.01	0.00	0.01
	2.34	1.91	2.76
	4.70	3.93	5.47
	5.23	4.40	6.05
	5.70	5.09	6.32
	4.56	3.84	5.28
	5.44	4.67	6.20
	5.14	4.25	6.04
	5.50	4.70	6.30
	7.22	6.88	7.56
	4.37	5.04	3.71
	3.06	3.48	2.64
	4.80	4.53	5.06
	5.84	5.54	6.13
	6.74	6.74	6.75
	6.39	6.09	6.69
	5.29	4.58	6.00
	5.01	4.21	5.81
	5.58	4.70	6.47
	6.60	5.99	7.22
	7.37	7.83	6.92
	6.67	6.18	7.15
	7.42	7.02	7.82
	5.66	5.06	6.25
	4.54	3.68	5.39
	6.33	5.85	6.81
	3.92	3.62	4.21
	1.83	1.81	1.85
TOTAL VALUE	211.4	209.1	213.7
INCREMENT	0.00	-2.32	2.32
%	0.00	-1.10	1.10
better results		including extra conditions	

C1	COMBINATION OF WEIGHTS				
C_{11}	2.00	1.75	1.50	1.25	1.00
C_{12}	2.00	1.75	1.50	1.25	1.00
C_{13}	2.00	1.75	1.50	1.25	1.00
C_{14}	2.00	1.75	1.50	1.25	1.00
C_{15}	2.00	3.00	4.00	5.00	6.00
	4.73	4.57	4.41	4.25	4.09
	4.96	4.99	5.02	5.05	5.08
	2.97	3.24	3.50	3.77	4.04
	3.17	3.35	3.53	3.71	3.89
	5.98	5.80	5.62	5.43	5.25
	4.95	4.90	4.86	4.81	4.76
	3.50	3.92	4.34	4.76	5.18
	3.94	4.24	4.54	4.84	5.14
	5.30	5.04	4.79	4.54	4.28
	6.07	5.85	5.62	5.40	5.18
	6.52	6.26	5.99	5.73	5.46
	6.02	5.80	5.59	5.38	5.17
	5.63	5.44	5.24	5.04	4.85
	5.84	5.64	5.44	5.24	5.04
	4.92	4.93	4.93	4.94	4.95
	2.53	2.86	3.20	3.54	3.88
	2.35	2.76	3.17	3.57	3.98
	2.00	2.74	3.48	4.22	4.96
	2.20	3.05	3.90	4.75	5.60
	2.85	3.49	4.14	4.78	5.43
	2.39	3.07	3.74	4.42	5.10
	2.53	3.03	3.54	4.04	4.55
	2.63	3.19	3.75	4.32	4.88
	3.35	3.60	3.85	4.10	4.35
	3.25	3.34	3.44	3.53	3.62
	4.30	4.34	4.38	4.42	4.47
	8.42	7.97	7.53	7.08	6.64
	8.22	7.80	7.39	6.97	6.56
	8.06	7.73	7.39	7.06	6.72
	2.39	3.04	3.70	4.35	5.01
	2.19	3.15	4.11	5.07	6.03
	2.75	3.20	3.65	4.10	4.56
	2.67	3.19	3.71	4.23	4.76
	2.90	3.07	3.23	3.40	3.56
	2.63	3.43	4.23	5.03	5.84
	2.02	3.01	4.01	5.01	6.01
	2.15	3.11	4.06	5.01	5.97
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	3.13	3.47	3.82	4.16	4.51
	3.50	3.71	3.93	4.15	4.36
	2.09	2.89	3.69	4.49	5.28
	2.43	3.29	4.15	5.01	5.87
	3.11	3.48	3.85	4.23	4.60
	3.92	4.06	4.19	4.32	4.46
	2.99	3.05	3.11	3.17	3.23
	2.30	3.19	4.09	4.99	5.89
	0.00	0.00	0.00	0.00	0.00
	2.41	2.96	3.50	4.05	4.59
	2.00	3.00	4.00	5.00	6.00
	3.36	3.86	4.36	4.86	5.36
	3.12	3.34	3.56	3.78	4.00
	2.36	3.21	4.07	4.92	5.77
	2.73	3.07	3.41	3.75	4.09
	6.11	5.88	5.64	5.40	5.16
TOTAL VALUE	194.8	210.6	226.4	242.2	258.0
INCREMENT	0.00	15.79	31.58	47.37	63.17
%	0.00	8.11	16.21	24.32	32.42
better results		including extra conditions			

C2	COMBINATION OF WEIGHTS		
C_{21}	5.00	6.00	4.00
C_{22}	5.00	4.00	6.00
	0.12	0.14	0.10
	1.97	1.60	2.35
	0.58	0.46	0.69
	0.58	0.46	0.69
	5.51	6.22	4.79
	0.55	0.51	0.60
	0.38	0.31	0.46
	0.22	0.18	0.25
	4.62	5.16	4.08
	5.48	6.04	4.93
	2.47	2.50	2.44
	2.30	2.38	2.23
	1.25	1.04	1.46
	3.12	2.97	3.26
	2.11	2.15	2.07
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	1.53	1.53	1.54
	0.65	0.55	0.75
	0.58	0.46	0.69
	0.38	0.31	0.46
	0.10	0.11	0.08
	0.02	0.03	0.02
	0.02	0.03	0.02
	9.54	9.61	9.48
	10.00	10.00	10.00
	1.37	1.11	1.63
	0.89	0.76	1.02
	0.19	0.15	0.23
	0.05	0.06	0.04
	0.26	0.24	0.29
	0.19	0.15	0.23
	0.38	0.31	0.46
	0.00	0.00	0.00
	0.38	0.31	0.46
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.58	0.46	0.69
	0.77	0.62	0.92
	0.58	0.46	0.69
	0.60	0.49	0.71
	0.41	0.34	0.48
	0.60	0.49	0.71
	0.77	0.62	0.92
	0.60	0.49	0.71
	0.19	0.15	0.23
	0.96	0.77	1.15
	0.38	0.31	0.46
	0.96	0.77	1.15
	0.77	0.62	0.92
	0.19	0.15	0.23
	0.77	0.62	0.92
	1.73	1.46	2.00
TOTAL VALUE	68.7	66.6	70.7
INCREMENT	0.00	-2.03	2.03
%	0.00	-2.96	2.96
better results		including extra conditions	

C3	COMBINATION OF WEIGHTS																												
C_{31}	2.50	6.00	6.00	6.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	5.00	5.00	5.00	3.00	1.00	1.00	3.00	1.00	1.00	3.00	1.00	1.00	5.00	5.00	5.00	1.00
C_{32}	2.50	2.00	1.00	1.00	6.00	6.00	6.00	1.00	2.00	1.00	1.00	2.00	1.00	3.00	1.00	1.00	5.00	5.00	5.00	1.00	3.00	1.00	1.00	3.00	1.00	2.00	2.00	1.00	5.00
C_{33}	2.50	1.00	2.00	1.00	1.00	2.00	1.00	6.00	6.00	6.00	2.00	1.00	1.00	1.00	3.00	1.00	1.00	3.00	1.00	5.00	5.00	5.00	1.00	1.00	3.00	2.00	1.00	2.00	2.00
C_{34}	2.50	1.00	1.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	6.00	6.00	6.00	1.00	1.00	3.00	1.00	1.00	3.00	1.00	1.00	3.00	5.00	5.00	5.00	1.00	2.00	2.00	2.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.05	0.02	0.04	0.02	0.02	0.04	0.02	0.11	0.11	0.11	0.04	0.02	0.02	0.02	0.06	0.02	0.02	0.06	0.02	0.09	0.09	0.09	0.02	0.02	0.06	0.04	0.02	0.04	0.04
	2.52	2.01	1.02	1.01	6.01	6.02	6.01	1.05	2.05	1.05	1.02	2.01	1.01	3.01	1.03	1.01	5.01	5.03	5.01	1.05	3.05	1.05	1.01	3.01	1.03	2.02	2.01	1.02	5.02
	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.04	0.04	0.04	0.01	0.01	0.02	0.01	0.01	0.01	0.01
	2.50	2.00	1.00	1.00	6.00	6.00	6.00	1.01	2.01	1.01	1.00	2.00	1.00	3.00	1.01	1.00	5.00	5.01	5.00	1.01	3.01	1.01	1.00	3.00	1.01	2.00	2.00	1.00	5.00
	2.51	2.01	1.01	1.01	6.01	6.01	6.01	1.03	2.03	1.03	1.01	2.01	1.01	3.01	1.02	1.01	5.01	5.02	5.01	1.03	3.03	1.03	1.01	3.01	1.02	2.01	2.01	1.01	5.01
	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.05	0.05	0.05	0.02	0.01	0.01	0.01	0.03	0.01	0.01	0.03	0.01	0.04	0.04	0.04	0.01	0.01	0.03	0.02	0.01	0.02	0.02
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.02	0.03	0.02	0.02	0.03	0.02	0.09	0.09	0.09	0.03	0.02	0.02	0.02	0.05	0.02	0.02	0.05	0.02	0.08	0.08	0.08	0.02	0.02	0.05	0.03	0.02	0.03	0.03
	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.03	0.03	0.03	0.01	0.01	0.02	0.01	0.01	0.01	0.01
	0.05	0.02	0.04	0.02	0.02	0.04	0.02	0.12	0.12	0.12	0.04	0.02	0.02	0.02	0.06	0.02	0.02	0.06	0.02	0.10	0.10	0.10	0.02	0.02	0.06	0.04	0.02	0.04	0.04
	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.03	0.03	0.03	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.00	0.00	0.01	0.01	0.00	0.01	0.01
	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.00	0.00	0.01	0.01	0.00	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.05	0.05	0.05	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.04	0.04	0.04	0.01	0.01	0.02	0.02	0.01	0.02	0.02
	1.25	3.00	3.00	3.00	1.00	0.50	0.50	0.50	0.50	1.00	0.50	0.50	1.00	2.50	2.50	2.50	1.50	0.50	0.50	1.50	0.50	0.50	1.50	0.50	0.50	2.50	2.50	2.50	0.50
	5.00	5.50	4.50	5.00	7.50	7.00	7.50	2.50	3.00	2.50	4.50	5.50	5.00	6.00	4.00	5.00	7.00	6.00	7.00	3.00	4.00	3.00	5.00	6.00	4.00	5.00	5.50	4.50	6.50
	5.03	5.51	4.53	5.01	7.51	7.03	7.51	2.58	3.08	2.58	4.53	5.51	5.01	6.01	4.04	5.01	7.01	6.04	7.01	3.07	4.07	3.07	5.01	6.01	4.04	5.03	5.51	4.53	6.53
	2.63	2.05	1.10	1.05	6.05	6.10	6.05	1.31	2.31	1.31	1.10	2.05	1.05	3.05	1.15	1.05	5.05	5.15	5.05	1.26	3.26	1.26	1.05	3.05	1.15	2.10	2.05	1.10	5.10
	4.43	2.77	2.04	2.27	6.77	7.04	7.27	3.62	4.12	3.12	4.54	5.27	4.27	3.77	2.31	2.77	5.77	6.31	6.77	2.85	4.85	3.85	3.77	5.77	4.31	3.04	3.27	2.54	6.54
	5.70	3.28	3.06	2.78	7.28	8.06	7.78	6.68	7.18	6.18	5.56	5.78	4.78	4.28	3.84	3.28	6.28	7.84	7.28	5.40	7.40	6.40	4.28	6.28	5.84	4.06	3.78	3.56	7.56
	5.58	3.23	2.97	2.73	7.23	7.97	7.73	6.40	6.90	5.90	5.47	5.73	4.73	4.23	3.70	3.23	6.23	7.70	7.23	5.17	7.17	6.17	4.23	6.23	5.70	3.97	3.73	3.47	7.47
	1.25	3.00	3.00	3.00	1.00	0.50	0.50	0.50	0.50	1.00	0.50	0.50	1.00	2.50	2.50	2.50	1.50	0.50	0.50	1.50	0.50	0.50	1.50	0.50	0.50	2.50	2.50	2.50	0.50
	1.25	3.00	3.00	3.00	1.00	0.50	0.50	0.51	0.51	1.01	0.50	0.50	1.00	2.50	2.50	2.50	1.50	0.50	0.50	1.51	0.51	0.51	1.50	0.50	0.50	2.50	2.50	2.50	0.50
	1.14	0.45	0.91	0.45	0.45	0.91	0.45	2.73	2.73	2.73	0.91	0.45	0.45	0.45	1.36	0.45	0.45	1.36	0.45	2.27	2.27	2.27	0.45	0.45	1.36	0.91	0.45	0.91	0.91
	5.80	3.32	3.14	2.82	7.32	8.14	7.82	6.92	7.42	6.42	5.64	5.82	4.82	4.32	3.96	3.32	6.32	7.96	7.32	5.60	7.60	6.60	4.32	6.32	5.96	4.14	3.82	3.64	7.64
	8.44	6.87	6.75	6.87	8.87	9.25	9.37	8.74	8.74	8.24	9.25	9.37	8.87	7.37	7.12	7.37	8.37	9.12	9.37	7.87	8.87	8.87	8.37	9.37	9.12	7.25	7.37	7.25	9.25
	7.97	6.69	6.37	6.69	8.69	8.87	9.19	7.62	7.62	7.12	8.87	9.19	8.69	7.19	6.56	7.19	8.19	8.56	9.19	6.93	7.93	7.93	8.19	9.19	8.56	6.87	7.19	6.87	8.87
	8.19	6.78	6.56	6.78	8.78	9.06	9.28	8.17	8.17	7.67	9.06	9.28	8.78	7.28	6.83	7.28	8.28	8.83	9.28	7.39	8.39	8.39	8.28	9.28	8.83	7.06	7.28	7.06	9.06
	8.30	6.82	6.64	6.82	8.82	9.14	9.32	8.42	8.42	7.92	9.14	9.32	8.82	7.32	6.96	7.32	8.32	8.96	9.32	7.60	8.60	8.60	8.32	9.32	8.96	7.14	7.32	7.14	9.14
	6.10	3.44	3.38	2.94	7.44	8.38	7.94	7.63	8.13	7.13	5.88	5.94	4.94	4.44	4.32	3.44	6.44	8.32	7.44	6.19	8.19	7.19	4.44	6.44	6.32	4.38	3.94	3.88	7.88
	5.88	3.35	3.20	2.85	7.35	8.20	7.85	7.11	7.61	6.61	5.70	5.85	4.85	4.35	4.05	3.35	6.35	8.05	7.35	5.76	7.76	6.76	4.35	6.35	6.05	4.20	3.85	3.70	7.70
	4.86	2.94	2.39	2.44	6.94	7.39	7.44	4.66	5.16	4.16	4.89	5.44	4.44	3.94	2.83	2.94	5.94	6.83	6.94	3.72	5.72	4.72	3.94	5.94	4.83	3.39	3.44	2.89	6.89
	2.57	2.03	1.06	1.03	6.03	6.06	6.03	1.18	2.18	1.18	1.06	2.03	1.03	3.03	1.09	1.03	5.03	5.09	5.03	1.15	3.15	1.15	1.03	3.03	1.09	2.06	2.03	1.06	5.06
	2.63	2.05	1.10	1.05	6.05	6.10	6.05	1.31	2.31	1.31	1.10	2.05	1.05	3.05	1.15	1.05	5.05	5.15	5.05	1.26	3.26	1.26	1.05	3.05	1.15	2.10	2.05	1.10	5.10
	7.32	6.43	5.86	6.43	8.43	8.36	8.93	6.07	6.07	5.57	8.36	8.93	8.43	6.93	5.78	6.93	7.93	7.78	8.93	5.64	6.64	6.64	7.93	8.93	7.78	6.36	6.93	6.36	8.36
	8.62	9.45	8.90	9.45	9.45	8.90	9.45	6.70	6.70	6.70	8.90	9.45	9.45	9.45	8.35	9.45	9.45	8.35	9.45	7.25	7.25	7.25	9.45	9.45	8.35	8.90	9.45	8.90	8.90
	6.90	8.76	8.02	8.26	8.76	8.02	8.26	4.55	5.05	5.05	5.52	6.26	6.26	8.76	7.27	7.76	8.76	7.27	7.76	5.79	5.79	4.79	6.76	6.76	5.27	8.02	8.26	7.52	7.52
	8.61	9.44	8.89	9.44	9.44	8.89	9.44	6.66	6.66	6.66	8.89	9.44	9.44	9.44	8.33	9.44	9.44	8.33	9.44	7.21	7.21	7.21	9.44	9.44	8.33	8.89	9.44	8.89	8.89
	5.68	3.27	3.05	2.77	7.27	8.05	7.77	6.64	7.14	6.14	5.55	5.77	4.77	4.27	3.82	3.27	6.27	7.82	7.27	5.37	7.37	6.37	4.27	6.27	5.82	4.05	3.77	3.55	7.55
	8.38	6.85	6.70	6.85	8.85	9.20	9.35	8.60	8.60	8.10	9.20	9.35	8.85	7.35	7.05	7.35	8.35	9.05	9.35	7.75	8.75	8.75	8.35	9.35	9.05	7.20	7.35	7.20	9.20
	8.57	6.93	6.86	6.93	8.93	9.36	9.43	9.07	9.07	8.57	9.36	9.43	8.93	7.43	7.29	7.43	8.43	9.29	9.43	8.15	9.15	9.15	8.43	9.43	9.29	7.36	7.43	7.36	9.36
	7.94	6.67	6.35	6.67	8.67	8.85	9.17	7.55	7.55	7.05	8.85	9.17	8.67	7.17	6.52	7.17	8.17	8.52	9.17	6.87	7.87	7.87	8.17	9.17	8.52	6.85	7.17	6.85	8.85
	5.12	5.55	4.59	5.05	7.55	7.09	7.55	2.78	3.28	2.78	4.59	5.55	5.05	6.05	4.14	5.05	7.05	6.14	7.05	3.23	4.23	3.23	5.05	6.05	4.14	5.09	5.55	4.59	6.59
	5.17	3.07	2.64	2.57	7.07	7.64	7.57	5.41	5.91	4.91	5.14	5.57	4.57	4.07	3.20	3.07	6.07	7.20	7.07	4.34	6.34	5.34	4.07	6.07	5.20	3.64	3.57	3.14	7.14
	4.95	2.98	2.46	2.48	6.98	7.46	7.48	4.88	5.38	4.38	4.96	5.48	4.48	3.98	2.94	2.98	5.98	6.94	6.98	3.90	5.90	4.90	3.98	5.98	4.94	3.46	3.48	2.96	6.96
	5.43	3.17	2.85	2.67	7.17	7.85	7.67	6.04	6.54	5.54	5.35	5.67	4.67	4.17	3.52	3.17	6.17	7.52	7.17	4.87	6.87	5.87	4.17	6.17	5.52	3.85	3.67	3.35	7.35
	6.00	3.40	3.30	2.90	7.40	8.30	7.90	7.39	7.89	6.89	5.80	5.90	4.90	4.40	4.19	3.40	6.40	8.19	7.40	5.99	7.99	6.99	4.40	6.40	6.19	4.30	3.90	3.80	7.80
	5.19	3.07	2.65	2.57	7.07	7.65	7.57	5.45	5.95	4.95	5.15	5.57	4.57	4.07	3.22	3.07	6.07	7.22	7.07	4.37	6.37	5.37	4.07	6.07	5.22	3.65	3.57	3.15	7.15
	4.83	2.93	2.37	2.43	6.93	7.37	7.43	4.60	5.10	4.10	4.87	5.43	4.43	3.93	2.80	2.93	5.93	6.80	6.93	3.66	5.66	4.66	3.93	5.93	4.80	3.37	3.43	2.87	6.87
	2.92	2.17	1.34	1.17	6.17	6.34	6.17	2.01	3.01	2.01	1.34	2.17	1.17	3.17	1.50	1.17	5.17	5.50	5.17	1.84	3.84	1.84	1.17	3.17	1.50	2.34	2.17	1.34	5.34
TOTAL VALUE	203.4	166.4	148.7	150.4	266.4	273.7	275.4	187.2	203.2	178.2	193.7	211.4	186.4	191.4	156.1	159.4	241.4	256.1	259.4	170.8	220.8	188.8	177.4	227.4	192.1	173.7	175.4	157.7	257.7
INCREMENT	0.00	-37.04	-54.68	-53.04	62.96	70.32	71.96	-16.24	-0.24	-25.24	-9.68	7.96	-17.04	-12.04	-47.32	-44.04	37.96	52.68	55.96	-32.60	17.40	-14.60	-26.04	23.96	-11.32	-29.68	-28.04	-45.68	54.32
%	0.00	-18.21	-26.88	-26.08	30.95	34.57	35.38	-7.98	-0.12	-12.41	-4.76	3.91	-8.38	-5.92	-23.26	-21.65	18.66	25.90	27.51	-16.03	8.55	-7.18	-12.80	11.78	-5.57	-14.59	-13.79	-22.46	26.71

better results | including extra conditions

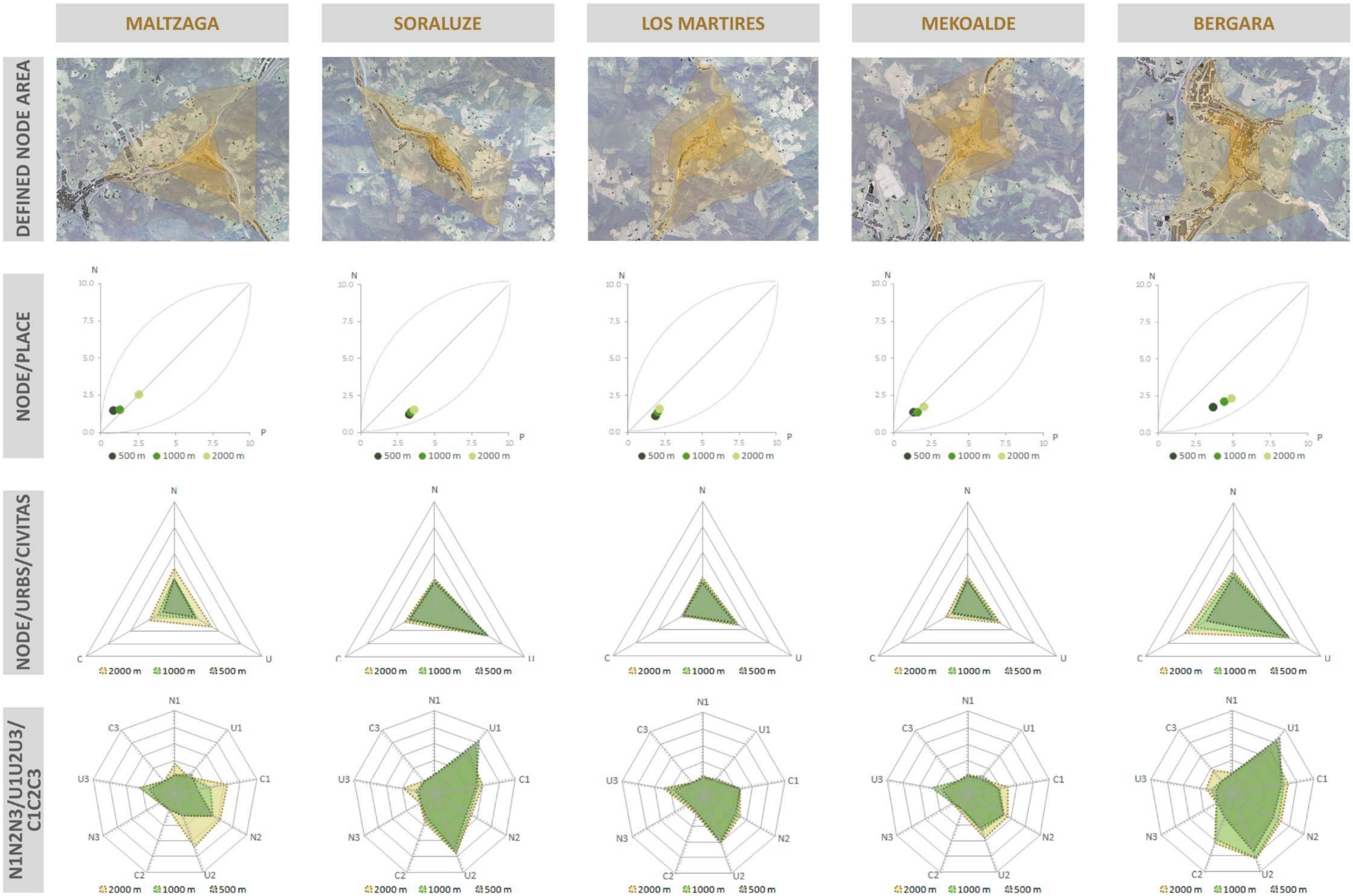
C3																												
C_{31}	2.00	2.00	1.00	2.00	2.00	1.00	2.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	2.00	2.00	1.00	1.00	1.00	2.00	1.00	3.00	2.00	3.00	1.00	2.00
C_{32}	5.00	5.00	2.00	1.00	2.00	2.00	1.00	2.00	3.00	3.00	2.00	2.00	1.00	1.00	4.00	4.00	4.00	4.00	4.00	4.00	2.00	1.00	3.00	1.00	3.00	2.00	2.00	1.00
C_{33}	1.00	2.00	5.00	5.00	5.00	2.00	2.00	1.00	2.00	1.00	3.00	1.00	2.00	3.00	2.00	1.00	3.00	1.00	2.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00
C_{34}	2.00	1.00	2.00	2.00	1.00	5.00	5.00	5.00	1.00	2.00	1.00	3.00	3.00	2.00	1.00	2.00	1.00	3.00	3.00	2.00	3.00	3.00	2.00	2.00	1.00	1.00	4.00	4.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	0.02	0.04	0.09	0.09	0.09	0.04	0.04	0.02	0.04	0.02	0.06	0.02	0.04	0.06	0.04	0.02	0.06	0.02	0.04	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06
	5.01	5.02	2.05	1.05	2.05	2.02	1.02	2.01	3.02	3.01	2.03	2.01	1.02	1.03	4.02	4.01	4.03	4.01	4.02	4.03	2.04	1.04	3.04	1.04	3.04	2.04	2.03	1.03
	0.01	0.01	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
	5.00	5.00	2.01	1.01	2.01	2.00	1.00	2.00	3.00	3.00	2.01	2.00	1.00	1.01	4.00	4.00	4.01	4.00	4.00	4.01	2.01	1.01	3.01	1.01	3.01	2.01	2.01	1.01
	5.01	5.01	2.03	1.03	2.03	2.01	1.01	2.01	3.01	3.01	2.02	2.01	1.01	1.02	4.01	4.01	4.02	4.01	4.01	4.02	2.02	1.02	3.02	1.02	3.02	2.02	2.02	1.02
	0.01	0.02	0.04	0.04	0.04	0.02	0.02	0.01	0.02	0.01	0.03	0.01	0.02	0.03	0.02	0.01	0.03	0.01	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.02	0.03	0.08	0.08	0.08	0.03	0.03	0.02	0.03	0.02	0.05	0.02	0.03	0.05	0.03	0.02	0.05	0.02	0.03	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05
	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.01	0.01	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	0.02	0.04	0.10	0.10	0.10	0.04	0.04	0.02	0.04	0.02	0.06	0.02	0.04	0.06	0.04	0.02	0.06	0.02	0.04	0.06	0.08	0.08	0.08	0.08	0.08	0.08	0.06	0.06
	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.01	0.02	0.04	0.04	0.04	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
	1.00	1.00	0.50	1.00	1.00	0.50	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50	0.50	0.50	1.00	0.50	1.50	1.00	1.50	0.50	1.00
	7.00	6.50	3.50	3.00	3.50	5.00	4.50	5.50	5.50	6.00	4.50	5.50	4.50	4.00	6.00	6.50	5.50	6.50	6.00	5.50	4.00	3.50	4.50	3.50	4.50	4.00	4.50	4.00
	7.01	6.53	3.57	3.07	3.57	5.03	4.53	5.51	5.53	6.01	4.54	5.51	4.53	4.04	6.03	6.51	5.54	6.51	6.03	5.54	4.06	3.56	4.56	3.56	4.56	4.06	4.54	4.04
	5.05	5.10	2.26	1.26	2.26	2.10	1.10	2.05	3.10	3.05	2.15	2.05	1.10	1.15	4.10	4.05	4.15	4.05	4.10	4.15	2.20	1.20	3.20	1.20	3.20	2.20	2.15	1.15
	6.27	6.04	4.35	3.35	3.85	5.04	4.04	4.77	4.04	4.27	3.31	3.77	3.04	2.81	5.04	5.27	5.31	5.77	6.04	5.81	4.58	3.58	5.08	3.08	4.58	3.58	4.81	3.81
	6.78	7.06	6.90	5.90	6.40	6.06	5.06	5.28	5.06	4.78	4.84	4.28	4.06	4.34	6.06	5.78	6.84	6.28	7.06	7.34	6.62	5.62	7.12	5.12	6.62	5.62	6.34	5.34
	6.73	6.97	6.67	5.67	6.17	5.97	4.97	5.23	4.97	4.73	4.70	4.23	3.97	4.20	5.97	5.73	6.70	6.23	6.97	7.20	6.43	5.43	6.93	4.93	6.43	5.43	6.20	5.20
	1.00	1.00	0.50	1.00	1.00	0.50	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50	0.50	0.50	1.00	0.50	1.50	1.00	1.50	0.50	1.00
	1.00	1.00	0.51	1.01	1.01	0.50	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50	0.50	0.50	1.00	0.50	1.50	1.00	1.50	0.50	1.00
	0.45	0.91	2.27	2.27	2.27	0.91	0.91	0.45	0.91	0.45	1.36	0.45	0.91	1.36	0.91	0.45	1.36	0.45	0.91	1.36	1.82	1.82	1.82	1.82	1.82	1.82	1.36	1.36
	6.82	7.14	7.10	6.10	6.60	6.14	5.14	5.32	5.14	4.82	4.96	4.32	4.14	4.46	6.14	5.82	6.96	6.32	7.14	7.46	6.78	5.78	7.28	5.28	6.78	5.78	6.46	5.46
	8.87	8.75	8.87	8.37	8.37	9.25	8.75	8.87	7.75	7.87	7.62	7.87	7.75	7.62	8.25	8.37	8.62	8.87	9.25	9.12	9.00	8.50	9.00	8.00	8.50	8.00	9.12	8.62
	8.69	8.37	7.93	7.43	7.43	8.87	8.37	8.69	7.37	7.69	7.06	7.69	7.37	7.06	7.87	8.19	8.06	8.69	8.87	8.56	8.25	7.75	8.25	7.25	7.75	7.25	8.56	8.06
	8.78	8.56	8.39	7.89	7.89	9.06	8.56	8.78	7.56	7.78	7.33	7.78	7.56	7.33	8.06	8.28	8.33	8.78	9.06	8.83	8.61	8.11	8.61	7.61	8.11	7.61	8.83	8.33
	8.82	8.64	8.60	8.10	8.10	9.14	8.64	8.82	7.64	7.82	7.46	7.82	7.64	7.46	8.14	8.32	8.46	8.82	9.14	8.96	8.78	8.28	8.78	7.78	8.28	7.78	8.96	8.46
	6.94	7.38	7.69	6.69	7.19	6.38	5.38	5.44	5.38	4.94	5.32	4.44	4.38	4.82	6.38	5.94	7.32	6.44	7.38	7.82	7.25	6.25	7.75	5.75	7.25	6.25	6.82	5.82
	6.85	7.20	7.26	6.26	6.76	6.20	5.20	5.35	5.20	4.85	5.05	4.35	4.20	4.55	6.20	5.85	7.05	6.35	7.20	7.55	6.90	5.90	7.40	5.40	6.90	5.90	6.55	5.55
	6.44	6.39	5.22	4.22	4.72	5.39	4.39	4.94	4.39	4.44	3.83	3.94	3.39	3.33	5.39	5.44	5.83	5.94	6.39	6.33	5.27	4.27	5.77	3.77	5.27	4.27	5.33	4.33
	5.03	5.06	2.15	1.15	2.15	2.06	1.06	2.03	3.06	3.03	2.09	2.03	1.06	1.09	4.06	4.03	4.09	4.03	4.06	4.09	2.12	1.12	3.12	1.12	3.12	2.12	2.09	1.09
	5.05	5.10	2.26	1.26	2.26	2.10	1.10	2.05	3.10	3.05	2.15	2.05	1.10	1.15	4.10	4.05	4.15	4.05	4.10	4.15	2.21	1.21	3.21	1.21	3.21	2.21	2.15	1.15
	8.43	7.86	6.64	6.14	6.14	8.36	7.86	8.43	6.86	7.43	6.28	7.43	6.86	6.28	7.36	7.93	7.28	8.43	8.36	7.78	7.21	6.71	7.21	6.21	6.71	6.21	7.78	7.28
	9.45	8.90	7.25	7.25	7.25	8.90	8.90	9.45	8.90	9.45	8.35	9.45	8.90	8.35	8.90	9.45	8.35	9.45	8.90	8.35	7.80	7.80	7.80	7.80	7.80	7.80	8.35	8.35
	8.26	8.02	5.29	5.29	5.79	6.02	6.02	6.76	8.02	8.26	7.27	7.76	7.02	6.77	8.02	8.26	7.27	7.76	7.02	6.77	5.53	5.53	6.03	6.03	6.53	6.53	5.77	5.77
	9.44	8.89	7.21	7.21	7.21	8.89	8.89	9.44	8.89	9.44	8.33	9.44	8.89	8.33	8.89	9.44	8.33	9.44	8.89	8.33	7.77	7.77	7.77	7.77	7.77	7.77	8.33	8.33
	6.77	7.05	6.87	5.87	6.37	6.05	5.05	5.27	5.05	4.77	4.82	4.27	4.05	4.32	6.05	5.77	6.82	6.27	7.05	7.32	6.59	5.59	7.09	5.09	6.59	5.59	6.32	5.32
	8.85	8.70	8.75	8.25	8.25	9.20	8.70	8.85	7.70	7.85	7.55	7.85	7.70	7.55	8.20	8.35	8.55	8.85	9.20	9.05	8.90	8.40	8.90	7.90	8.40	7.90	9.05	8.55
	8.93	8.86	9.15	8.65	8.65	9.36	8.86	8.93	7.86	7.93	7.79	7.93	7.86	7.79	8.36	8.43	8.79	8.93	9.36	9.29	9.22	8.72	9.22	8.22	8.72	8.22	9.29	8.79
	8.67	8.35	7.87	7.37	7.37	8.85	8.35	8.67	7.35	7.67	7.02	7.67	7.35	7.02	7.85	8.17	8.02	8.67	8.85	8.52	8.20	7.70	8.20	7.20	7.70	7.20	8.52	8.02
	7.05	6.59	3.73	3.23	3.73	5.09	4.59	5.55	5.59	6.05	4.64	5.55	4.59	4.14	6.09	6.55	5.64	6.55	6.09	5.64	4.19	3.69	4.69	3.69	4.69	4.19	4.64	4.14
	6.57	6.64	5.84	4.84	5.34	5.64	4.64	5.07	4.64	4.57	4.20	4.07	3.64	3.70	5.64	5.57	6.20	6.07	6.64	6.70	5.77	4.77	6.27	4.27	5.77	4.77	5.70	4.70
	6.48	6.46	5.40	4.40	4.90	5.46	4.46	4.98	4.46	4.48	3.94	3.98	3.46	3.44	5.46	5.48	5.94	5.98	6.46	6.44	5.42	4.42	5.92	3.92	5.42	4.42	5.44	4.44
	6.67	6.85	6.37	5.37	5.87	5.85	4.85	5.17	4.85	4.67	4.52	4.17	3.85	4.02	5.85	5.67	6.52	6.17	6.85	7.02	6.19	5.19	6.69	4.69	6.19	5.19	6.02	5.02
	6.90	7.30	7.49	6.49	6.99	6.30	5.30	5.40	5.30	4.90	5.19	4.40	4.30	4.69	6.30	5.90	7.19	6.40	7.30	7.69	7.09	6.09	7.59	5.59	7.09	6.09	6.69	5.69
	6.57	6.65	5.87	4.87	5.37	5.65	4.65	5.07	4.65	4.57	4.22	4.07	3.65	3.72	5.65	5.57	6.22	6.07	6.65	6.72	5.80	4.80	6.30	4.30	5.80	4.80	5.72	4.72
	6.43	6.37	5.16	4.16	4.66	5.37	4.37	4.93	4.37	4.43	3.80	3.93	3.37	3.30	5.37	5.43	5.80	5.93	6.37	6.30	5.23	4.23	5.73	3.73	5.23	4.23	5.30	4.30
	5.17	5.34	2.84	1.84	2.84	2.34	1.34	2.17	3.34	3.17	2.50	2.17	1.34	1.50	4.34	4.17	4.50	4.17	4.34	4.50	2.67	1.67	3.67	1.67	3.67	2.67	2.50	1.50
TOTAL VALUE	250.4	248.7	204.8	179.8	195.8	209.7	184.7	202.4	198.7	200.4	181.1	184.4	166.7	165.1	223.7	225.4	231.1	234.4	241.7	240.1	206.4	181.4	222.4	172.4	213.4	188.4	208.1	183.1
INCREMENT	46.96	45.32	1.40	-23.60	-7.60	6.32	-18.68	-1.04	-4.68	-3.04	-22.32	-19.04	-36.68	-38.32	20.32	21.96	27.68	30.96	38.3	36.68	3.04	-21.96	19.04	-30.96	10.04	-14.96	4.68	-20.32
%	23.09	22.28	0.69	-11.60	-3.74	3.11	-9.18	-0.51	-2.30	-1.49	-10.97	-9.36	-18.03	-18.84	9.99	10.80	13.61	15.22	18.84	18.03	1.49	-10.80	9.36	-15.22	4.94	-7.35	2.30	-9.99

better resu

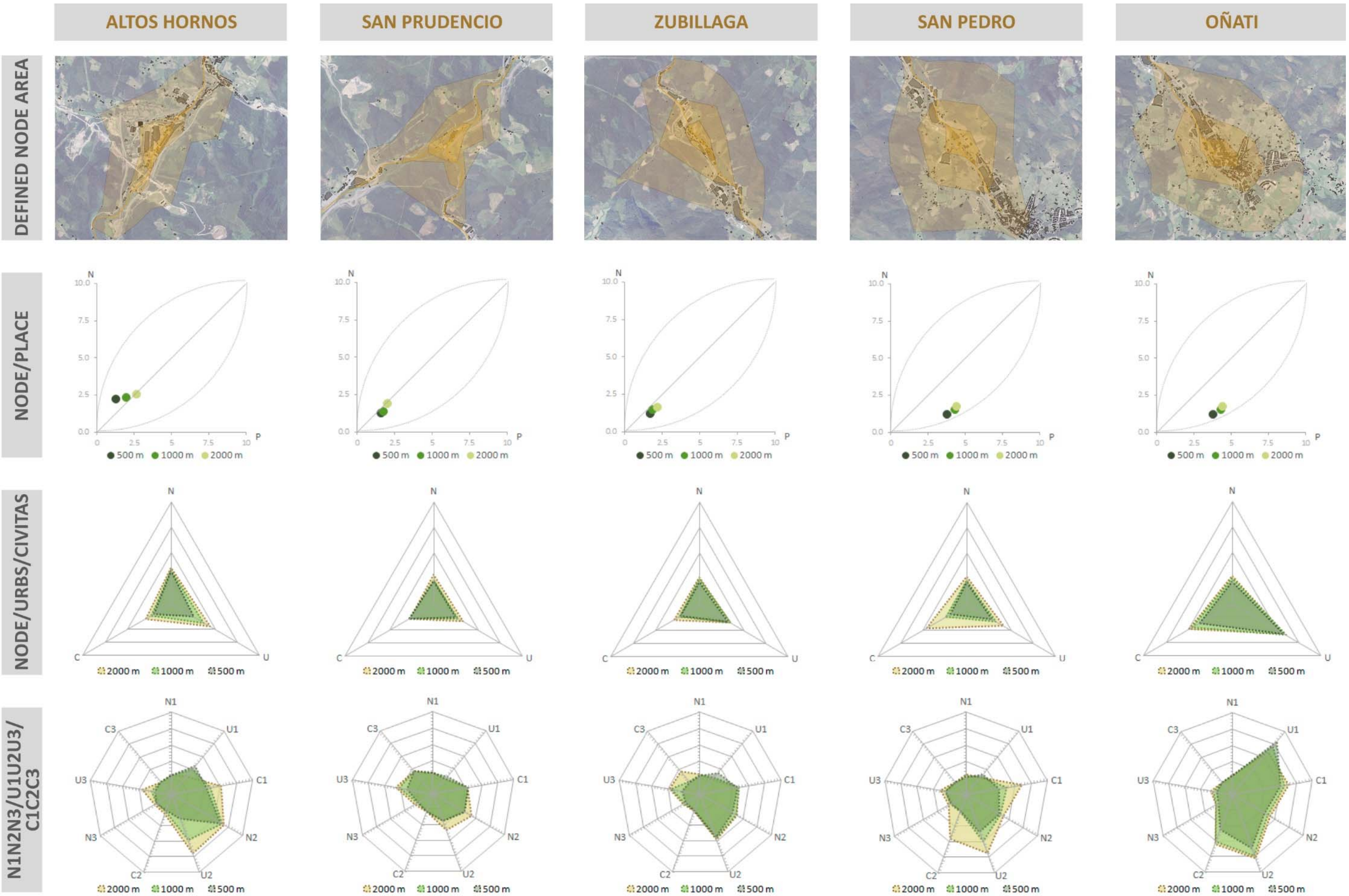
C3																		
C_{31}	1.00	3.00	2.00	3.00	4.00	2.00	2.00	2.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	2.00	2.00	2.00
C_{32}	3.00	1.00	3.00	2.00	2.00	4.00	2.00	2.00	3.00	3.00	1.00	3.00	3.00	2.00	2.00	3.00	3.00	2.00
C_{33}	2.00	2.00	1.00	1.00	2.00	2.00	4.00	2.00	3.00	1.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00
C_{34}	4.00	4.00	4.00	4.00	2.00	2.00	2.00	4.00	1.00	3.00	3.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.04	0.04	0.02	0.02	0.04	0.04	0.07	0.04	0.06	0.02	0.06	0.06	0.04	0.06	0.04	0.06	0.04	0.06
	3.02	1.02	3.01	2.01	2.02	4.02	2.04	2.02	3.03	3.01	1.03	1.03	3.02	2.03	2.02	3.03	3.02	2.03
	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02
	3.00	1.00	3.00	2.00	2.00	4.00	2.01	2.00	3.01	3.00	1.01	1.01	3.00	2.01	2.00	3.01	3.00	2.01
	3.01	1.01	3.01	2.01	2.01	4.01	2.02	2.01	3.02	3.01	1.02	1.02	3.01	2.02	2.01	3.02	3.01	2.02
	0.02	0.02	0.01	0.01	0.02	0.02	0.03	0.02	0.03	0.01	0.03	0.03	0.02	0.03	0.02	0.03	0.02	0.03
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.03	0.03	0.02	0.02	0.03	0.03	0.06	0.03	0.05	0.02	0.05	0.05	0.03	0.05	0.03	0.05	0.03	0.05
	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02
	0.04	0.04	0.02	0.02	0.04	0.04	0.08	0.04	0.06	0.02	0.06	0.06	0.04	0.06	0.04	0.06	0.04	0.06
	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.02	0.02	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	0.50	1.50	1.00	1.50	2.00	1.00	1.00	1.00	1.50	1.50	1.50	0.50	1.50	1.50	1.50	1.00	1.00	1.00
	5.50	4.50	6.00	5.50	5.00	6.00	4.00	5.00	5.00	6.00	4.00	3.00	5.50	4.50	5.00	5.00	5.50	4.50
	5.53	4.53	6.01	5.51	5.03	6.03	4.06	5.03	5.04	6.01	4.04	3.04	5.53	4.54	5.03	5.04	5.53	4.54
	3.10	1.10	3.05	2.05	2.10	4.10	2.20	2.10	3.15	3.05	1.15	1.15	3.10	2.15	2.10	3.15	3.10	2.15
	5.54	3.54	5.27	4.27	3.54	5.54	4.08	4.54	4.31	4.77	3.31	3.31	4.54	3.81	4.04	4.81	5.04	4.31
	6.56	4.56	5.78	4.78	4.56	6.56	6.12	5.56	5.84	5.28	4.84	4.84	5.56	5.34	5.06	6.34	6.06	5.84
	6.47	4.47	5.73	4.73	4.47	6.47	5.93	5.47	5.70	5.23	4.70	4.70	5.47	5.20	4.97	6.20	5.97	5.70
	0.50	1.50	1.00	1.50	2.00	1.00	1.00	1.00	1.50	1.50	1.50	0.50	1.50	1.50	1.50	1.00	1.00	1.00
	0.50	1.50	1.00	1.50	2.00	1.00	1.00	1.00	1.50	1.50	1.50	0.50	1.50	1.50	1.50	1.00	1.00	1.00
	0.91	0.91	0.45	0.45	0.91	0.91	1.82	0.91	1.36	0.45	1.36	1.36	0.91	1.36	0.91	1.36	0.91	1.36
	6.64	4.64	5.82	4.82	4.64	6.64	6.28	5.64	5.96	5.32	4.96	4.96	5.64	5.46	5.14	6.46	6.14	5.96
	9.25	8.25	8.87	8.37	7.75	8.75	8.50	8.75	8.12	8.37	8.12	7.12	8.25	8.12	8.25	8.62	8.75	8.62
	8.87	7.87	8.69	8.19	7.37	8.37	7.75	8.37	7.56	8.19	7.56	6.56	7.87	7.56	7.87	8.06	8.37	8.06
	9.06	8.06	8.78	8.28	7.56	8.56	8.11	8.56	7.83	8.28	7.83	6.83	8.06	7.83	8.06	8.33	8.56	8.33
	9.14	8.14	8.82	8.32	7.64	8.64	8.28	8.64	7.96	8.32	7.96	6.96	8.14	7.96	8.14	8.46	8.64	8.46
	6.88	4.88	5.94	4.94	4.88	6.88	6.75	5.88	6.32	5.44	5.32	5.32	5.88	5.82	5.38	6.82	6.38	6.32
	6.70	4.70	5.85	4.85	4.70	6.70	6.40	5.70	6.05	5.35	5.05	5.05	5.70	5.55	5.20	6.55	6.20	6.05
	5.89	3.89	5.44	4.44	3.89	5.89	4.77	4.89	4.83	4.94	3.83	3.83	4.89	4.33	4.39	5.33	5.39	4.83
	3.06	1.06	3.03	2.03	2.06	4.06	2.12	2.06	3.09	3.03	1.09	1.09	3.06	2.09	2.06	3.09	3.06	2.09
	3.10	1.10	3.05	2.05	2.10	4.10	2.21	2.10	3.15	3.05	1.15	1.15	3.10	2.15	2.10	3.15	3.10	2.15
	8.36	7.36	8.43	7.93	6.86	7.86	6.71	7.86	6.78	7.93	6.78	5.78	7.36	6.78	7.36	7.28	7.86	7.28
	8.90	8.90	9.45	9.45	8.90	8.90	7.80	8.90	8.35	9.45	8.35	6.35	8.90	8.35	8.90	8.35	8.90	8.35
	6.52	6.52	7.26	7.26	7.52	7.52	6.03	6.52	7.27	7.76	6.27	4.27	7.52	6.77	7.02	6.77	7.02	6.27
	8.89	8.89	9.44	9.44	8.89	8.89	7.77	8.89	8.33	9.44	8.33	6.33	8.89	8.33	8.89	8.33	8.89	8.33
	6.55	4.55	5.77	4.77	4.55	6.55	6.09	5.55	5.82	5.27	4.82	4.82	5.55	5.32	5.05	6.32	6.05	5.82
	9.20	8.20	8.85	8.35	7.70	8.70	8.40	8.70	8.05	8.35	8.05	7.05	8.20	8.05	8.20	8.55	8.70	8.55
	9.36	8.36	8.93	8.43	7.86	8.86	8.72	8.86	8.29	8.43	8.29	7.29	8.36	8.29	8.36	8.79	8.86	8.79
	8.85	7.85	8.67	8.17	7.35	8.35	7.70	8.35	7.52	8.17	7.52	6.52	7.85	7.52	7.85	8.02	8.35	8.02
	5.59	4.59	6.05	5.55	5.09	6.09	4.19	5.09	5.14	6.05	4.14	3.14	5.59	4.64	5.09	5.14	5.59	4.64
	6.14	4.14	5.57	4.57	4.14	6.14	5.27	5.14	5.20	5.07	4.20	4.20	5.14	4.70	4.64	5.70	5.64	5.20
	5.96	3.96	5.48	4.48	3.96	5.96	4.92	4.96	4.94	4.98	3.94	3.94	4.96	4.44	4.46	5.44	5.46	4.94
	6.35	4.35	5.67	4.67	4.35	6.35	5.69	5.35	5.52	5.17	4.52	4.52	5.35	5.02	4.85	6.02	5.85	5.52
	6.80	4.80	5.90	4.90	4.80	6.80	6.59	5.80	6.19	5.40	5.19	5.19	5.80	5.69	5.30	6.69	6.30	6.19
	6.15	4.15	5.57	4.57	4.15	6.15	5.30	5.15	5.22	5.07	4.22	4.22	5.15	4.72	4.65	5.72	5.65	5.22
	5.87	3.87	5.43	4.43	3.87	5.87	4.73	4.87	4.80	4.93	3.80	3.80	4.87	4.30	4.37	5.30	5.37	4.80
	3.34	1.34	3.17	2.17	2.34	4.34	2.67	2.34	3.50	3.17	1.50	1.50	3.34	2.50	2.34	3.50	3.34	2.50
TOTAL VALUE	225.7	175.7	218.4	193.4	182.7	232.7	197.4	200.7	206.1	209.4	174.1	154.1	207.7	190.1	191.7	215.1	216.7	199.1
INCREMENT	22.32	-27.68	14.96	-10.04	-20.68	29.32	-5.96	-2.68	2.68	5.96	-29.32	-49.32	4.32	-13.32	-11.68	11.68	13.32	-4.32
%	10.97	-13.61	7.35	-4.94	-10.17	14.41	-2.93	-1.32	1.32	2.93	-14.41	-24.25	2.12	-6.55	-5.74	5.74	6.55	-2.12

better resu

4.2.5. Defined node areas and their results related to the three models



MALTZAGA
SORALUZE
LOS MARTIRES
MEKOALDE
BERGARA
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
10.0
7.5
5.0
2.5
0.0
0
2.5
5
7.5
10
500 m
1000 m
2000 m
U
C
N1
U1
C1
N2
U2
C2
N3
U3
C3


ALTOS HORNOS
SAN PRUDENCIO
ZUBILLAGA
SAN PEDRO
OÑATI
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
500 m
1000 m
2000 m
N
U
C
N1
U1
C1
N2
U2
C2
N3
U3
C3

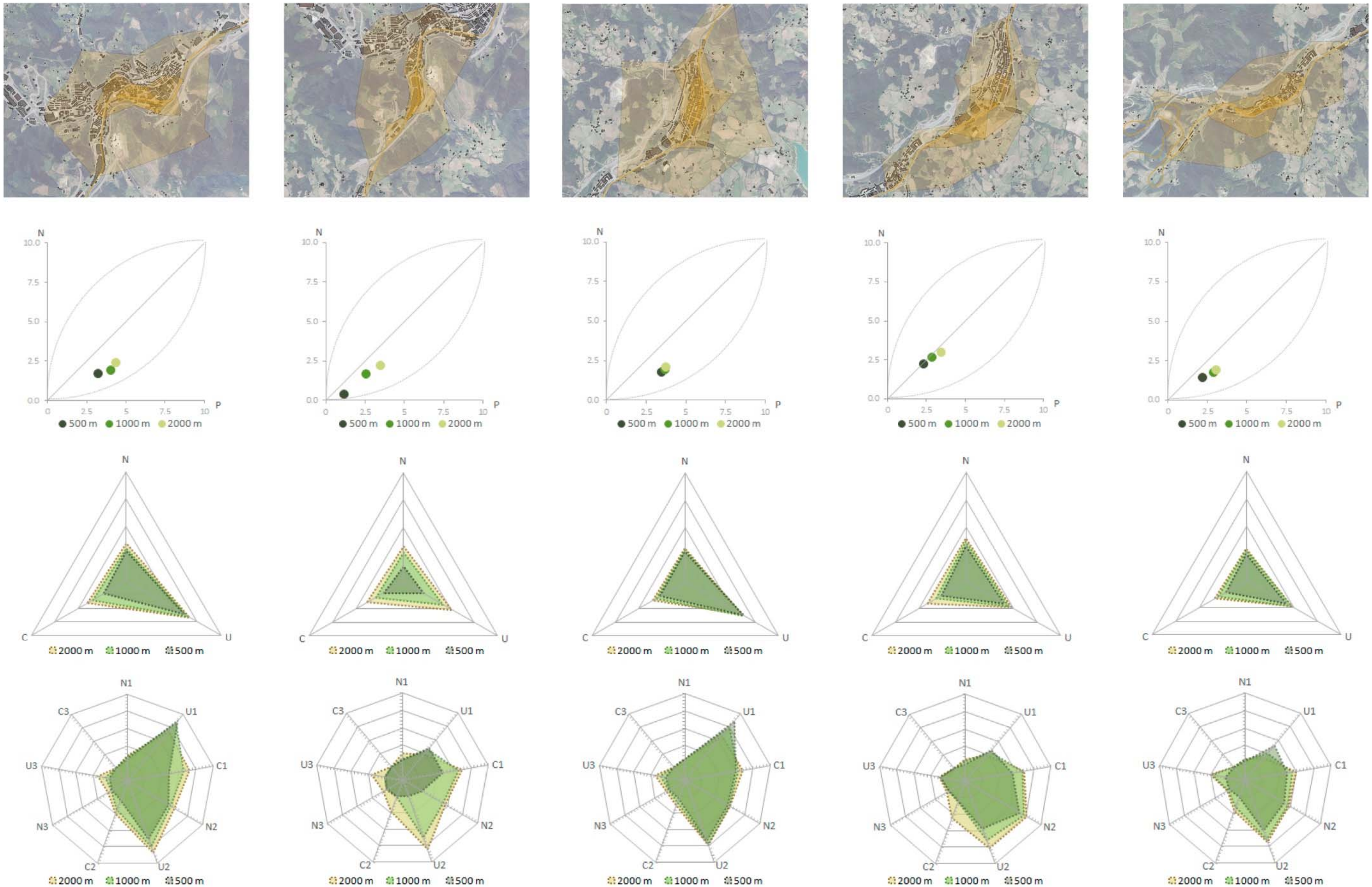
ARRASATE | ULGOR | ARETXABALETA | LANDETA-MARIANISTAS | ESKORIATZA

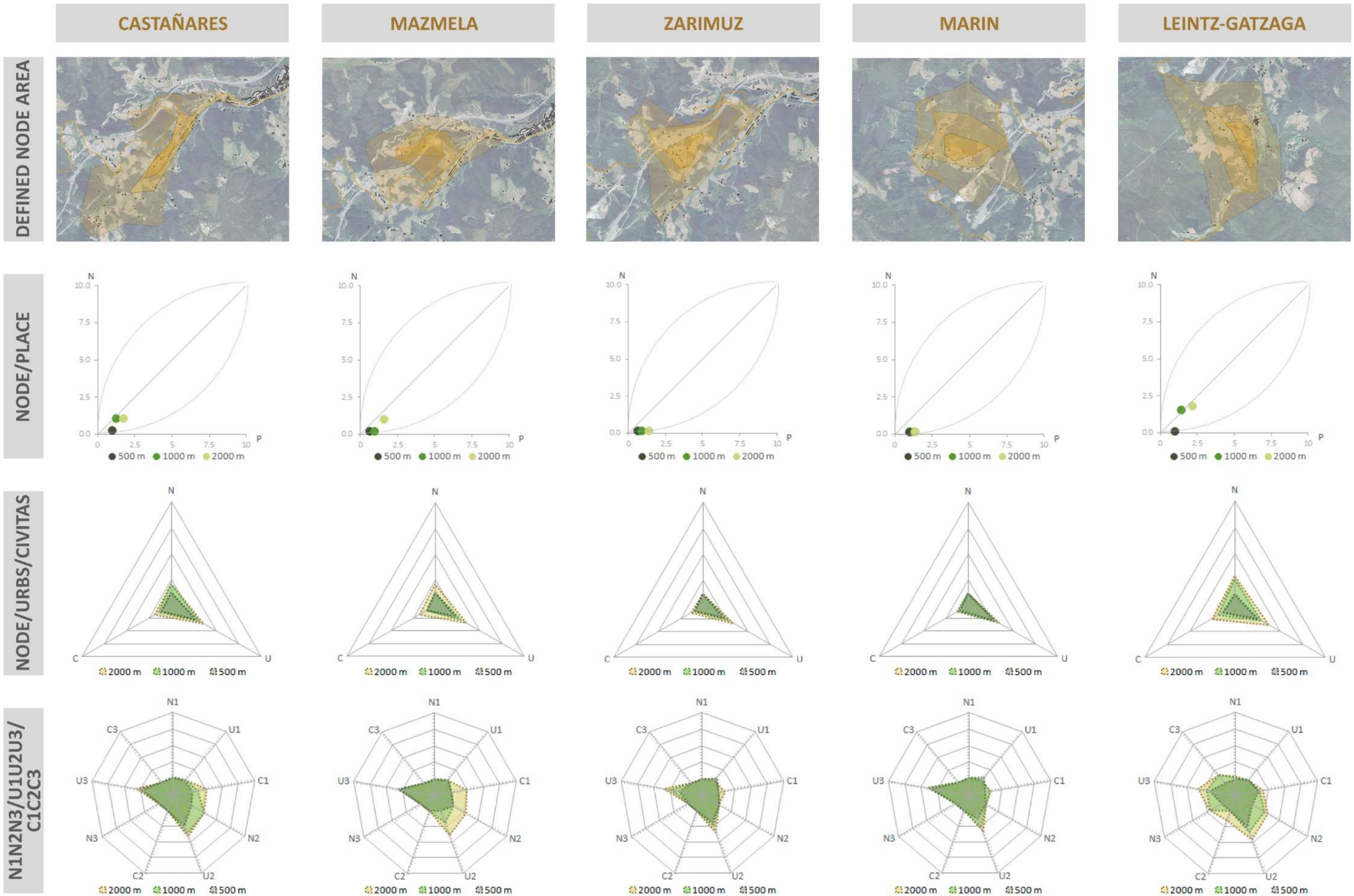
DEFINED NODE AREA

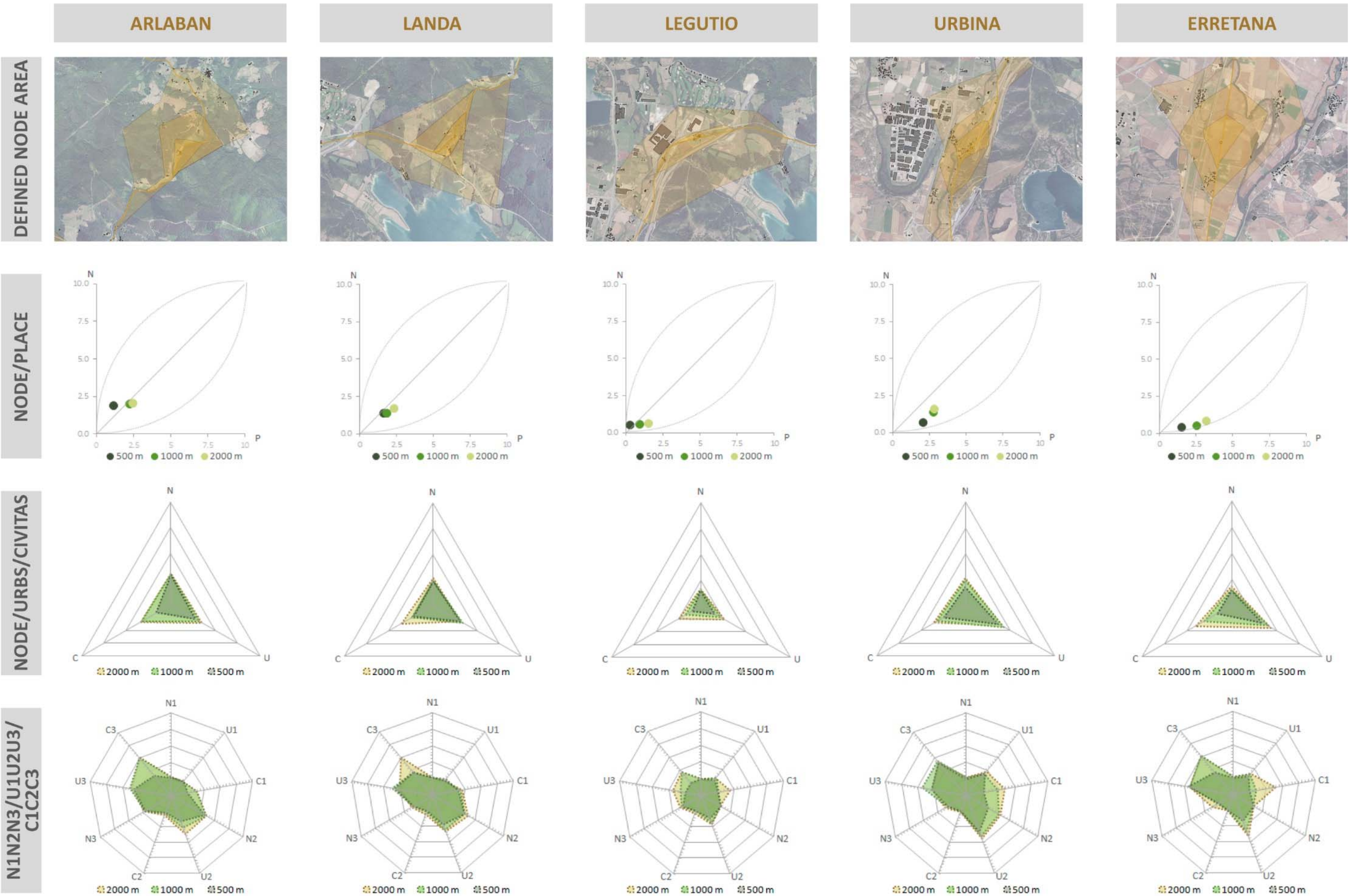
NODE/PLACE

NODE/URBS/CIVITAS

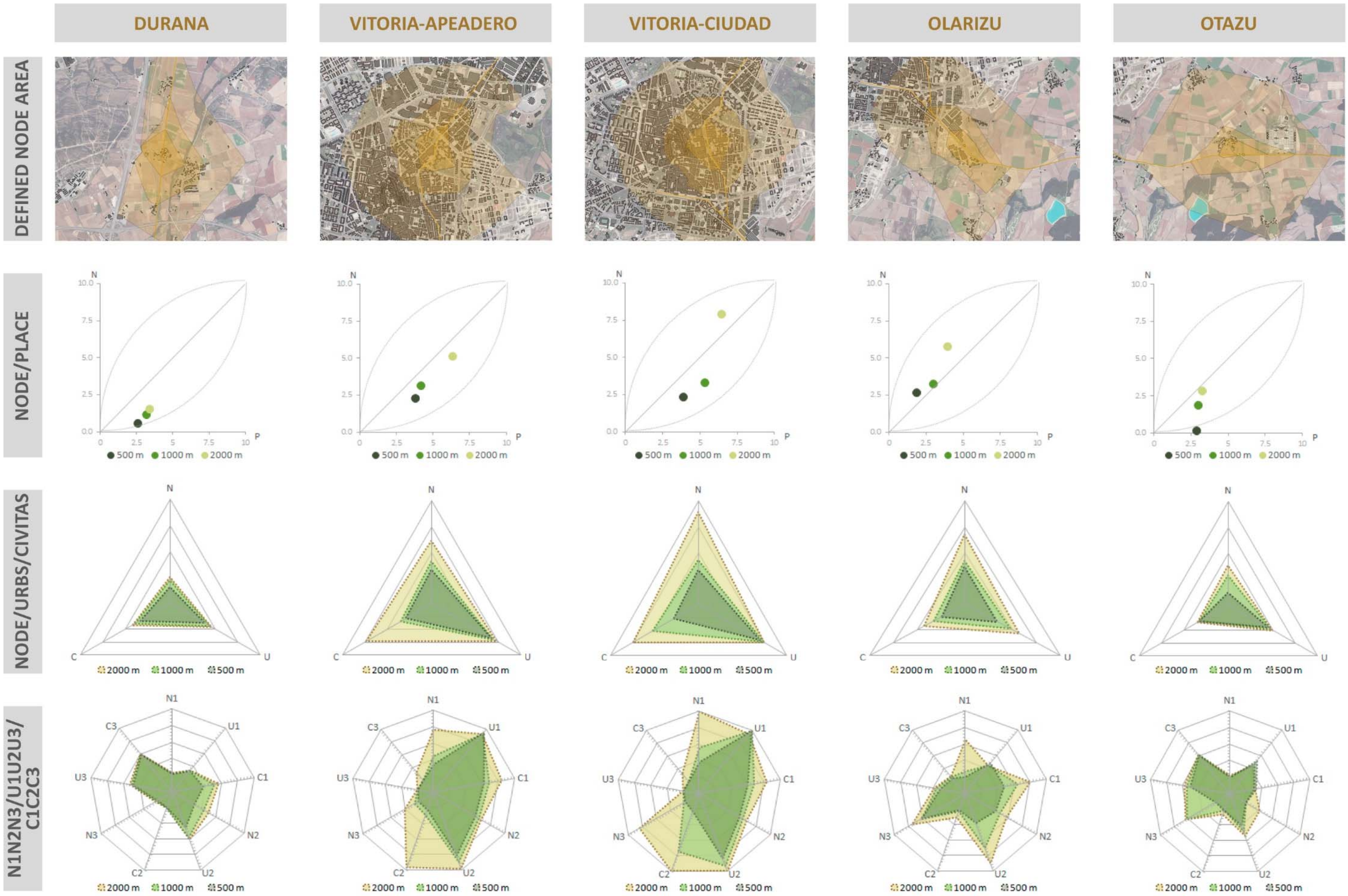
N1N2N3/U1U2U3/C1C2C3

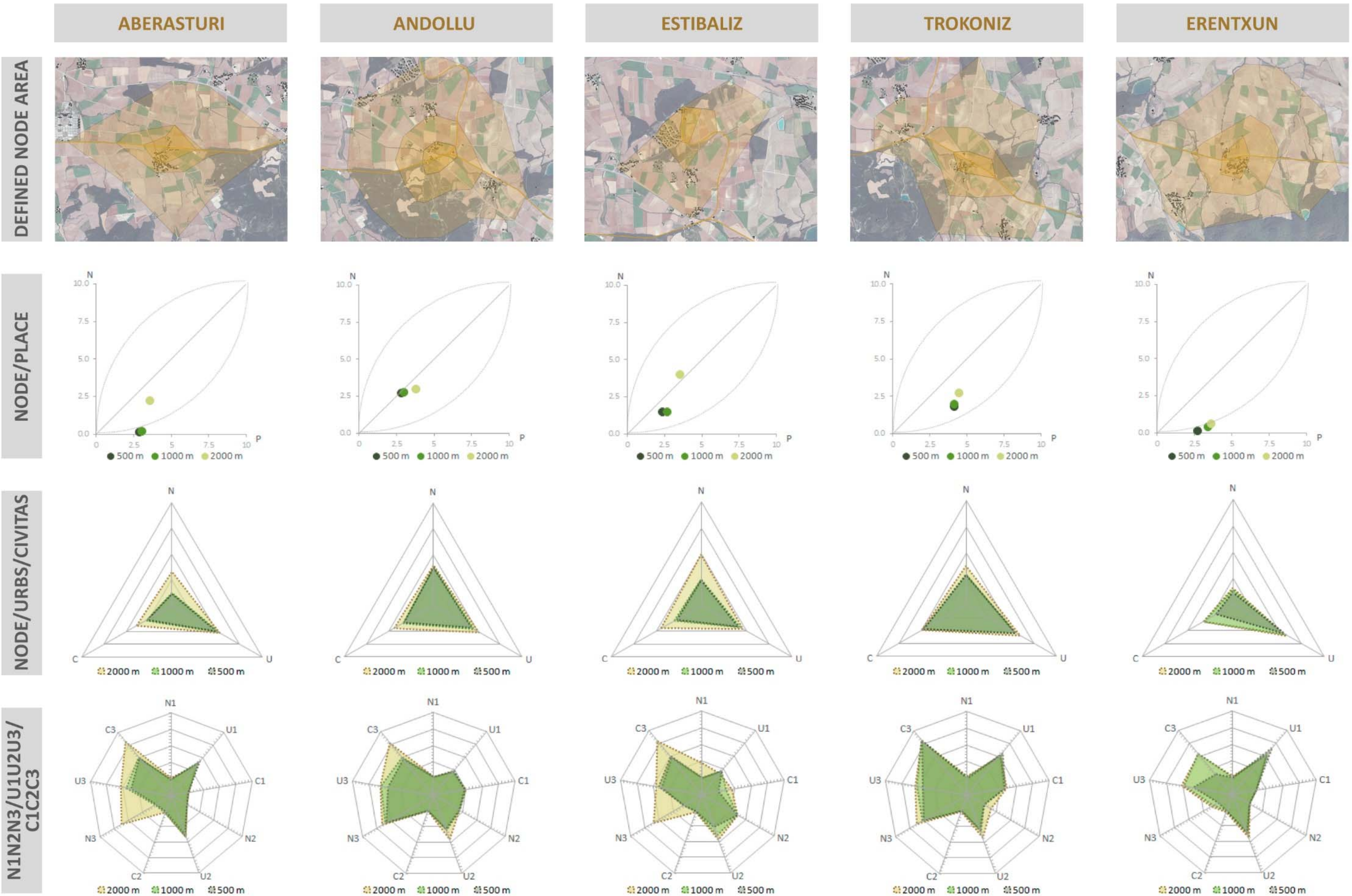


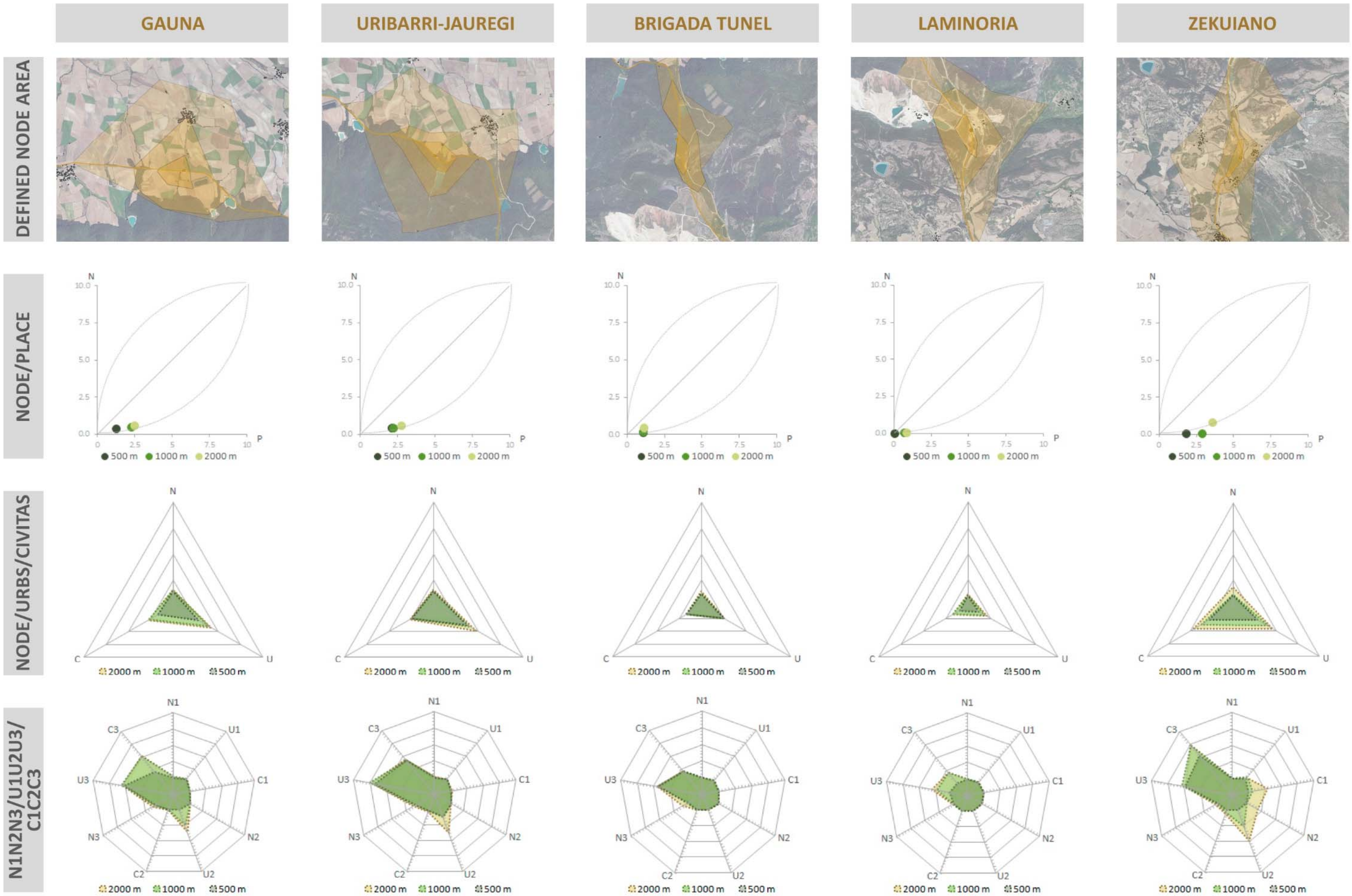

CASTAÑARES
MAZMELA
ZARIMUZ
MARIN
LEINTZ-GATZAGA
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
500 m
1000 m
2000 m
N
U
C
2000 m
1000 m
500 m
N1
U1
C1
N2
U2
C2
N3
U3
C3

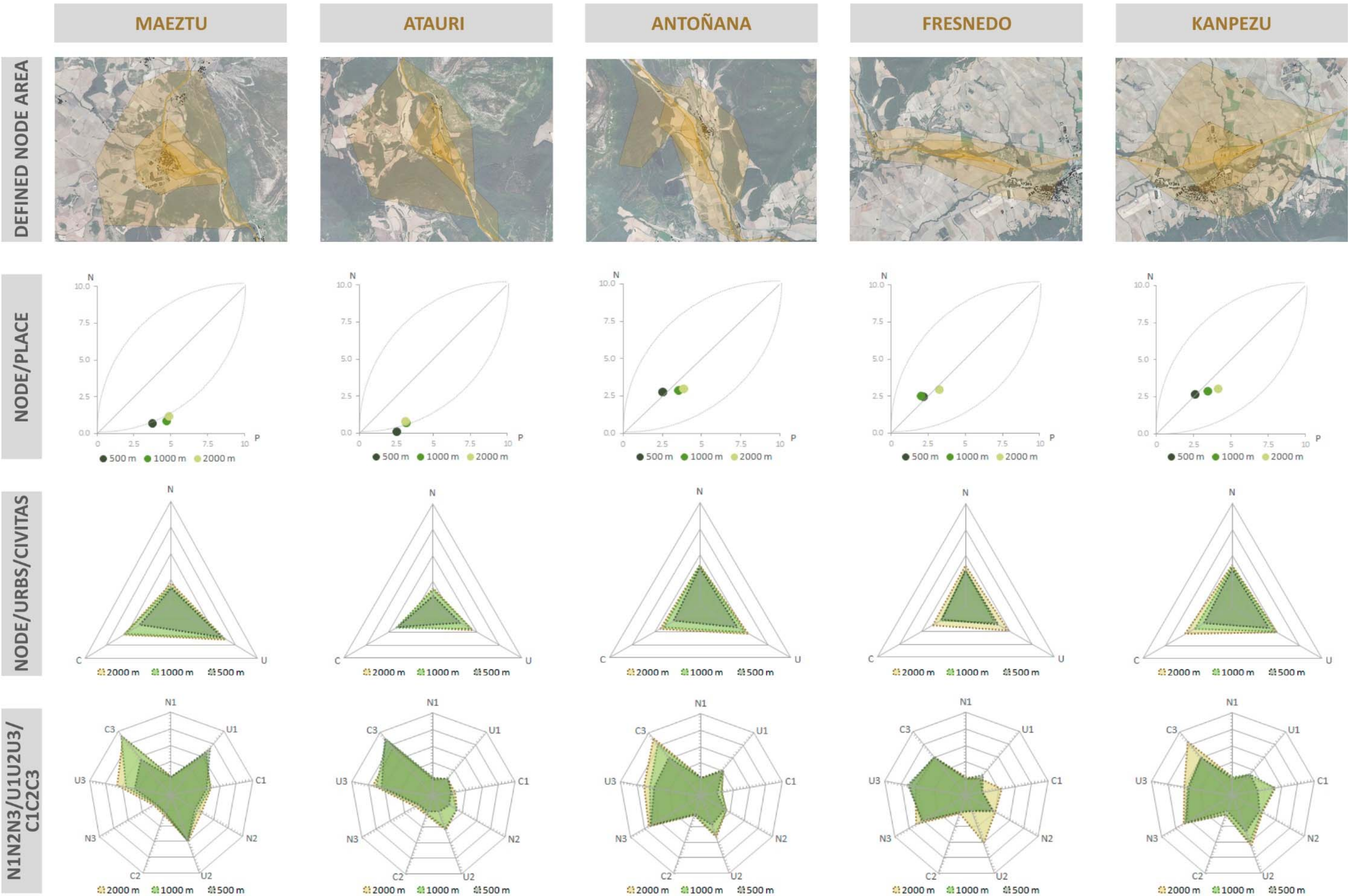


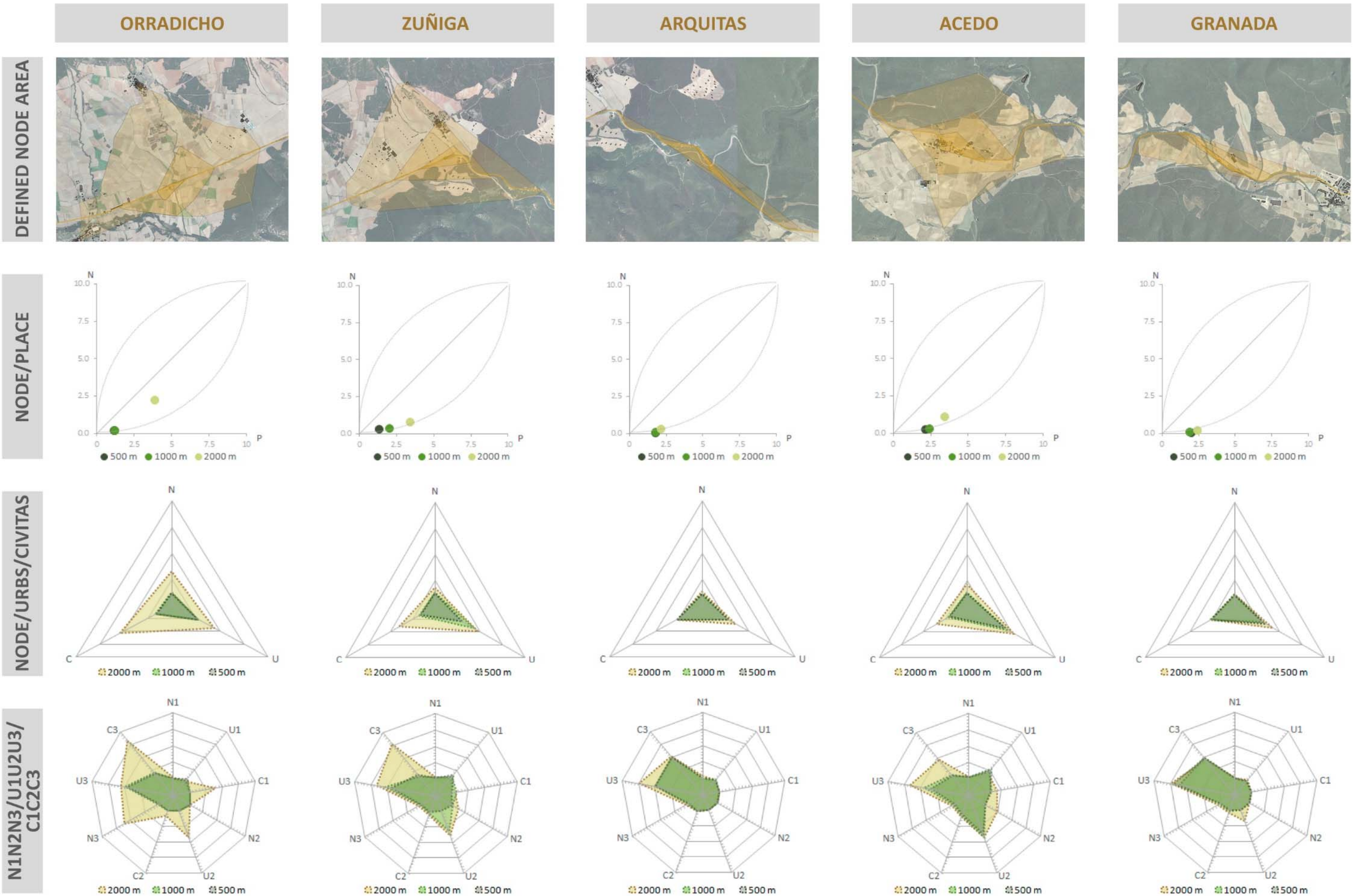
ARLABAN
LANDA
LEGUTIO
URBINA
ERRETANA
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
0.0
2.5
5.0
7.5
10.0
0
2.5
5
7.5
10
500 m
1000 m
2000 m
N
U
C
2000 m
1000 m
500 m
N1
U1
C1
N2
U2
C2
N3
U3
C3


DURANA
VITORIA-APEADERO
VITORIA-CIUDAD
OLARIZU
OTAZU
DEFINED NODE AREA
NODE/PLACE
N
P
0.0
2.5
5.0
7.5
10.0
0
2.5
5
7.5
10
500 m
1000 m
2000 m
NODE/URBS/CIVITAS
N
U
C
2000 m
1000 m
500 m
N1N2N3/U1U2U3/C1C2C3
N1
U1
C1
N2
U2
C2
N3
U3
C3
2000 m
1000 m
500 m


ABERASTURI
ANDOLLU
ESTIBALIZ
TROKONIZ
ERENTXUN
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
500 m
1000 m
2000 m
C
U
N1
U1
C1
N2
U2
C2
N3
U3
C3


GAUNA
URIBARRI-JAUREGI
BRIGADA TUNEL
LAMINORIA
ZEKUIANO
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
10.0
7.5
5.0
2.5
0.0
0
2.5
5
7.5
10
500 m
1000 m
2000 m
N
C
U
2000 m
1000 m
500 m
N1
U1
C1
N2
U2
C2
N3
U3
C3


MAEZTU
ATAURI
ANTOÑANA
FRESNEDO
KANPEZU
DEFINED NODE AREA
NODE/PLACE
NODE/URBS/CIVITAS
N1N2N3/U1U2U3/C1C2C3
N
P
500 m
1000 m
2000 m
C
U
N1
U1
C1
N2
U2
C2
N3
U3
C3


ORRADICHO
ZUÑIGA
ARQUITAS
ACEDO
GRANADA
DEFINED NODE AREA
NODE/PLACE
N
P
500 m 1000 m 2000 m
NODE/URBS/CIVITAS
N
U
C
2000 m 1000 m 500 m
N1N2N3/U1U2U3/C1C2C3
N1
U1
C1
N2
U2
C2
N3
U3
C3
2000 m 1000 m 500 m

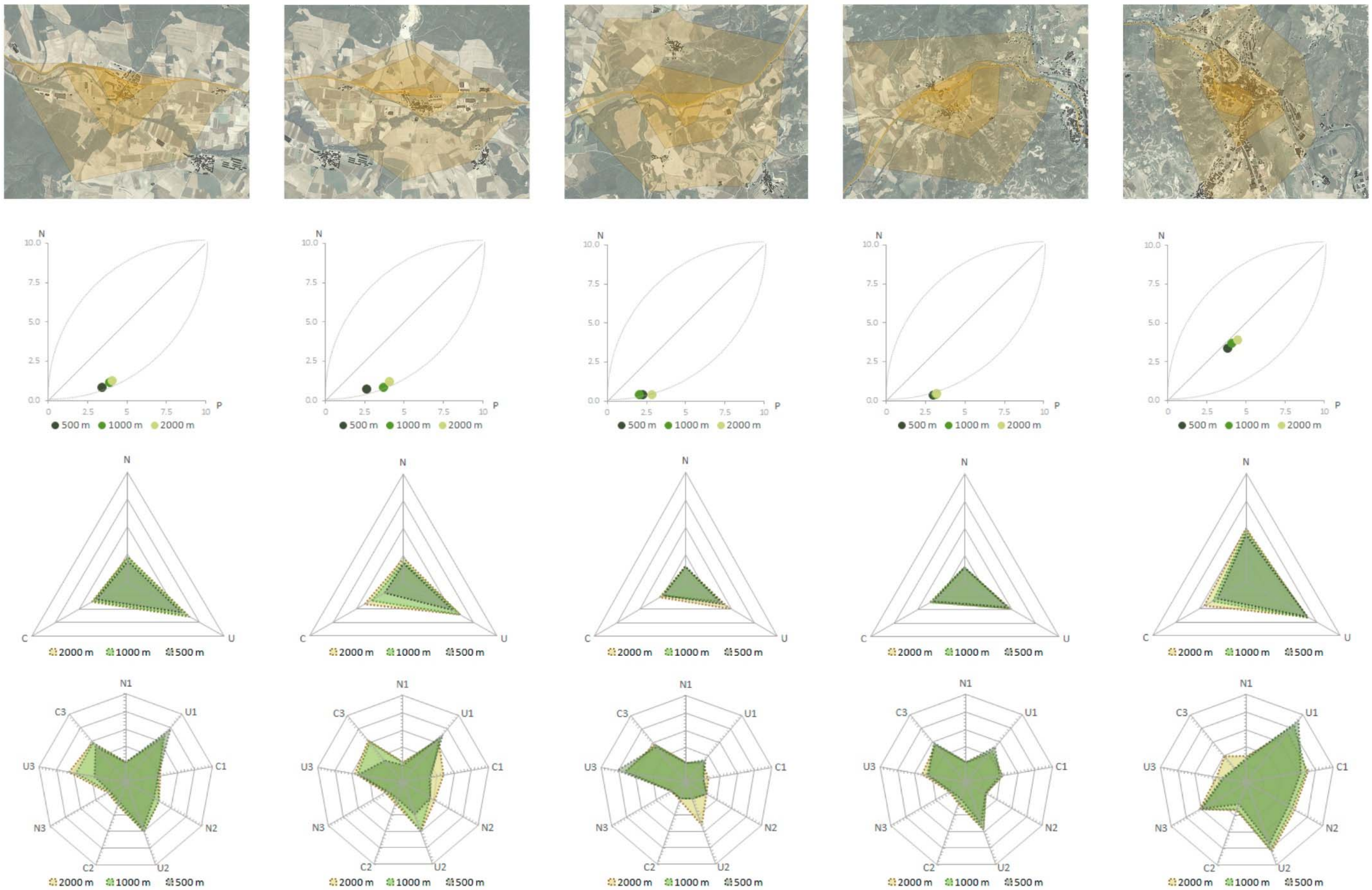
	ANCIN	MURIETA	ZUFIA	ZUBIELQUI	LIZARRA

DEFINED NODE AREA

NODE/PLACE

NODE/URBS/CIVITAS

N1N2N3/U1U2U3/C1C2C3



4.2.6. Ranking

RANKING OF 2000 m NODE AREAS (cycling non-round-trips)	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
MALTZAGA	14	38	14	38	39	5	37	12	11	19	48	52	41	55	19	19	50	29	35
SORALUZE	33	17	33	11	35	18	8	15	18	11	10	49	41	50	9	14	50	24	23
LOS MARTIRES	30	46	30	41	49	20	51	26	19	18	26	34	29	51	34	17	40	41	44
MEKOALDE	27	47	27	43	48	19	43	20	13	27	28	46	35	41	29	16	44	42	45
BERGARA	16	3	16	7	3	12	5	10	3	6	3	45	50	33	6	3	39	6	5
ALTOS HORNOS	13	37	13	34	37	17	29	13	2	12	31	44	45	45	19	11	52	23	29
SAN PRUDENCIO	23	48	23	51	43	9	47	29	14	47	35	24	32	35	33	26	34	39	43
ZUBILLAGA	29	43	29	48	38	16	41	23	17	24	39	41	43	34	30	19	37	40	42
SAN PEDRO	26	27	26	40	10	15	31	9	16	13	5	29	51	43	17	7	53	26	24
OÑATI	25	7	25	13	8	14	6	6	15	8	4	37	53	54	7	5	55	14	12
ARRASATE	15	8	15	3	19	7	3	4	8	4	7	25	47	42	4	6	49	10	8
ULGOR	19	22	19	19	23	6	20	7	12	5	8	26	44	49	10	9	48	20	22
ARETXABALETA	20	16	20	8	32	11	7	11	9	10	14	31	46	52	8	13	51	19	16
LANDETA-MAR.	7	23	7	25	18	10	19	8	1	9	6	30	52	46	11	4	54	12	15
ESKORIATZA	22	33	22	27	33	13	24	14	10	14	9	43	40	40	18	12	45	27	26
CASTAÑARES	38	49	38	44	50	44	40	31	27	36	49	51	33	47	38	34	43	47	49
MAZMELA	39	59	39	49	51	52	39	33	26	41	50	52	36	48	40	35	47	48	50
ZARIMUZ	54	53	54	50	54	55	48	43	45	46	52	54	30	53	48	49	42	54	53
MARIN	53	52	53	47	55	48	53	47	50	48	53	55	26	44	40	50	41	52	52
LEINTZ-GATZAGA	24	45	24	42	46	28	42	39	25	28	12	15	31	38	43	18	33	36	39
ARLABAN	21	40	21	46	34	27	54	41	23	44	22	14	28	20	45	28	20	30	36
LANDA	28	42	28	52	28	45	50	35	21	49	29	22	39	19	42	31	29	35	38
LEGUTIO	44	51	44	53	47	51	34	37	43	51	36	21	49	31	41	51	36	51	51
URBINA	31	35	31	39	29	33	21	25	24	31	45	20	38	28	23	30	31	31	33
ERRETANA	41	31	41	35	20	43	27	19	41	37	48	18	24	17	24	43	23	37	34
DURANA	32	26	32	30	16	21	25	16	20	19	47	40	25	21	20	20	28	28	25
VITORIA APEAD.	3	2	3	2	2	2	2	1	4	2	2	13	55	37	2	2	38	2	2
VITORIA-CIUDAD	1	1	1	1	1	1	1	2	5	1	1	1	54	36	1	1	26	1	1
OLARIZU	2	12	2	14	15	3	15	3	11	3	13	2	42	39	3	10	24	3	3
OTAZU	11	29	11	20	31	41	16	40	29	32	17	11	20	15	31	27	9	17	21
ABERASTURI	17	20	17	17	22	38	14	49	52	38	41	7	16	4	37	46	5	18	18
ANDOLLU	10	15	10	18	13	26	22	34	35	29	46	4	10	8	27	36	2	11	13
ESTIBALIZ	4	21	4	29	12	4	26	36	22	26	38	10	21	7	21	23	7	5	9
TROKONIZ	12	6	12	10	7	32	13	22	38	33	40	5	14	6	14	38	4	7	6
ERENTXUN	45	18	45	12	36	42	12	42	49	30	33	19	17	12	22	44	18	34	30
GAUNA	46	39	46	36	42	46	38	51	47	45	51	16	13	14	51	48	17	46	46
URIBARRI-JAUR.	47	36	47	24	44	47	45	50	48	43	34	17	3	26	50	47	15	44	40

RANKING OF 2000 m NODE AREAS (cycling non-round-trips)

	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
BRIGADA TUNEL	49	54	49	54	53	54	52	52	51	53	54	23	23	32	54	53	32	53	54
LAMINORIA	55	55	55	55	52	53	55	55	55	55	55	50	34	30	55	55	35	55	55
ZEKUIANO	42	19	42	31	9	49	32	27	36	22	27	42	19	10	36	33	14	32	27
MAEZTU	36	4	36	6	4	34	11	21	31	23	19	28	9	1	13	25	10	16	10
ATAURI	40	32	40	32	24	39	36	44	39	50	30	27	4	11	46	42	12	38	35
ANTOÑANA	9	14	9	15	14	37	18	46	37	39	24	3	7	2	39	37	1	9	11
FRESNEDO	8	28	8	28	25	40	35	28	33	18	32	6	15	18	35	29	8	13	17
KANPEZU	6	9	6	21	6	36	28	17	32	16	23	8	18	5	26	21	6	8	7
ORRADICHO	18	13	18	33	5	35	49	18	46	35	21	9	12	3	28	41	3	15	14
ZUÑIGA	43	25	43	22	21	23	33	48	40	42	25	36	6	9	47	40	11	33	32
ARQUITAS	51	44	51	45	41	31	46	54	53	54	43	33	2	16	52	54	13	50	48
ACEDO	37	24	37	16	30	30	23	38	34	34	16	32	5	24	32	32	19	29	28
GRANADA	52	41	52	41	45	50	44	53	54	52	37	35	1	25	53	52	16	49	47
ANCIN	34	11	34	5	26	24	9	32	28	21	15	39	11	22	16	22	21	21	19
MURIETA	35	10	35	9	17	22	10	24	30	20	18	38	22	13	12	24	25	22	20
ZUFIA	50	34	50	27	44	29	34	49	46	40	42	53	8	23	44	45	22	45	41
ZUBIELQUI	48	30	48	26	27	29	17	30	44	25	20	47	27	27	25	39	30	43	37
LIZARRA	5	5	5	4	11	8	4	5	6	7	11	12	48	29	5	8	27	4	4

0-13 | 14-27 | 28-41 | 42-55

RANKING OF 1000 m NODE AREAS (walking non-round-trips, running round-trips or cycling round-trips)

	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
MALTZAGA	21	49	21	52	44	16	35	22	11	48	51	48	34	49	26	32	40	41	45
SORALUZE	28	15	28	11	28	14	7	12	17	8	5	50	52	52	8	10	53	17	17
LOS MARTIRES	29	37	29	34	42	33	49	20	19	15	17	24	32	48	30	14	37	30	33
MEKOALDE	26	45	26	39	47	26	43	24	14	31	41	44	33	36	33	23	38	37	41
BERGARA	11	3	11	5	5	8	5	9	3	3	3	41	48	46	5	2	50	4	4
ALTOS HORNOS	10	38	10	35	40	13	21	17	2	18	26	45	50	41	17	11	51	22	29
SAN PRUDENCIO	30	44	30	51	31	6	45	21	23	44	24	20	35	27	27	31	33	35	40
ZUBILLAGA	22	41	22	37	41	15	38	18	12	21	29	33	42	40	23	16	43	31	34
SAN PEDRO	27	42	27	42	39	17	32	15	20	14	25	27	46	47	22	15	47	34	38
OÑATI	19	4	19	9	4	11	8	7	13	6	2	19	51	51	7	3	49	10	7
ARRASATE	15	8	15	4	14	4	3	6	8	5	4	47	49	50	4	7	52	9	8
ULGOR	18	28	18	29	29	9	17	5	10	12	39	43	53	53	9	12	54	24	25
ARETXABALETA	14	11	14	6	24	7	6	10	7	7	9	26	43	43	6	8	45	12	11
LANDETA-MAR.	8	25	8	23	23	12	18	4	1	9	13	28	44	42	11	5	46	14	15
ESKORIATZA	17	24	17	17	27	10	22	11	9	10	7	31	37	37	15	9	41	18	20
CASTAÑARES	33	48	33	45	52	35	44	31	25	29	40	49	39	38	38	26	44	46	48
MAZMELA	46	53	46	47	55	55	42	49	39	46	50	54	31	45	50	48	39	53	53
ZARIMUZ	51	54	51	49	54	54	39	50	40	43	48	53	36	44	48	45	42	54	54
MARIN	50	47	50	40	53	40	47	38	47	41	46	52	25	39	44	44	36	50	49
LEINTZ-GATZAGA	20	46	20	46	45	39	46	34	28	32	42	10	40	32	40	29	32	39	44
ARLABAN	12	32	12	43	19	25	52	30	18	40	23	9	26	14	39	25	12	23	28
LANDA	25	40	25	38	38	38	50	28	22	36	32	13	28	26	36	27	28	32	36
LEGUTIO	37	52	37	54	48	50	34	45	37	45	49	14	47	25	45	47	35	49	51
URBINA	24	26	24	25	21	34	27	26	21	26	37	16	21	23	28	22	21	25	23
ERRETANA	39	29	39	32	25	36	29	36	35	33	43	23	24	9	35	37	19	36	32
DURANA	31	17	31	24	9	24	26	13	24	20	38	30	27	17	19	20	23	21	19
VITORIA APEAD.	4	5	4	2	15	2	2	1	4	2	8	17	54	54	2	4	48	3	3
VITORIA-CIUDAD	2	1	2	1	2	1	1	3	5	1	1	38	55	55	1	1	55	1	1
OLARIZU	3	21	3	18	18	5	19	8	16	11	16	4	41	34	10	13	24	7	12
OTAZU	16	22	16	16	22	43	15	33	51	30	28	7	20	8	25	39	7	16	18
ABERASTURI	48	19	48	14	30	45	14	43	49	24	30	32	18	7	29	36	17	33	30
ANDOLLU	7	20	7	22	16	32	25	25	32	35	44	2	7	16	24	34	3	11	14
ESTIBALIZ	23	27	23	26	26	44	24	32	15	25	27	18	29	20	34	19	22	26	24
TROKONIZ	13	6	13	13	3	28	13	19	43	37	45	6	11	3	13	41	2	8	6
ERENTXUN	41	14	41	12	20	42	12	35	46	27	31	15	14	6	20	38	13	28	21
GAUNA	38	31	38	33	34	37	41	47	44	42	47	11	6	11	47	43	11	40	37
URIBARRI-JAUR.	40	33	40	30	37	49	48	51	45	47	33	12	1	24	51	49	10	43	39

RANKING OF 1000 m NODE AREAS (walking non-round-trips, running round-trips or cycling round-trips)

	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
BRIGADA TUNEL	49	51	49	53	50	52	53	52	48	52	54	42	23	28	53	52	30	52	52
LAMINORIA	55	55	55	55	51	53	55	55	55	55	55	51	38	29	55	55	34	55	55
ZEKUIANO	54	23	54	31	10	41	33	41	52	38	21	39	9	5	42	42	8	38	31
MAEZTU	34	2	34	8	1	27	10	16	30	19	19	35	19	1	12	21	8	13	5
ATAURI	36	16	36	28	7	30	36	42	34	39	22	34	3	2	43	35	6	27	22
ANTOÑANA	6	12	6	15	8	31	20	40	33	28	12	1	8	4	32	28	1	5	9
FRESNEDO	9	36	9	41	32	46	37	44	29	49	34	5	4	12	46	46	4	19	27
KANPEZU	5	13	5	19	6	29	28	14	27	13	14	3	17	15	21	18	5	6	10
ORRADICHO	47	50	47	50	49	51	51	46	42	50	52	36	13	30	52	51	26	51	50
ZUÑIGA	44	25	44	27	46	18	31	39	41	34	20	29	10	33	37	40	27	45	43
ARQUITAS	52	43	52	48	33	47	40	53	53	53	35	22	12	13	49	53	16	48	47
ACEDO	45	30	45	21	43	23	23	37	50	23	11	21	16	31	31	33	31	42	35
GRANADA	53	39	53	44	35	48	54	54	54	54	36	25	5	18	54	54	14	47	46
ANCIN	32	9	32	7	13	20	9	27	26	16	10	40	15	19	14	17	18	15	13
MURIETA	35	10	35	10	17	21	11	29	31	17	18	37	22	10	16	24	20	20	16
ZUFIA	43	34	43	36	36	22	30	48	36	51	53	55	2	22	41	50	15	44	42
ZUBIELQUI	42	18	42	20	11	19	16	23	38	22	15	46	30	21	18	30	25	29	26
LIZARRA	1	7	1	3	12	3	4	2	6	4	6	8	45	35	3	6	29	2	2

0-13	14-27	28-41	42-55

RANKING OF 500 m NODE AREAS (walking round-trips)

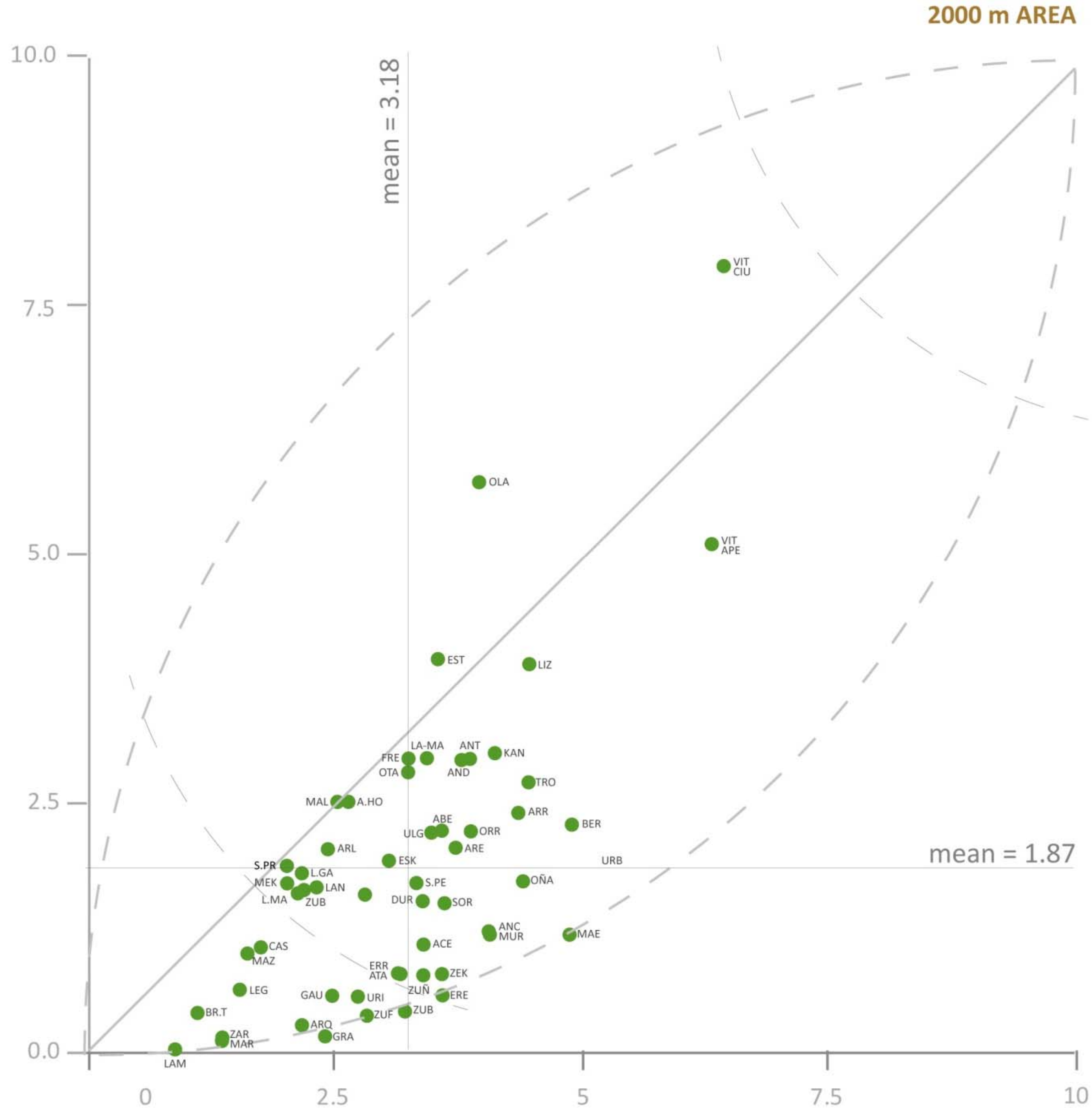
	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
MALTZAGA	16	51	16	51	49	13	24	31	9	42	45	44	36	39	31	24	38	39	43
SORALUZE	25	10	25	8	21	10	8	8	17	6	3	47	51	51	8	9	53	15	12
LOS MARTIRES	26	32	26	29	32	26	44	15	19	10	9	20	32	38	27	11	36	25	28
MEKOALDE	19	41	19	38	41	24	35	24	11	24	34	30	34	34	29	15	37	33	38
BERGARA	14	7	14	5	11	7	5	3	4	4	2	29	47	47	4	3	49	6	5
ALTOS HORNOS	9	43	9	48	36	9	21	17	2	38	42	31	50	50	19	12	52	20	30
SAN PRUDENCIO	21	37	21	49	17	5	40	18	20	34	13	25	35	23	23	22	32	30	30
ZUBILLAGA	22	35	22	33	34	11	28	13	16	14	19	34	44	44	20	13	45	29	33
SAN PEDRO	24	39	24	40	40	28	32	19	14	19	27	22	42	43	24	16	43	36	39
OÑATI	23	5	23	9	3	8	7	5	15	8	1	46	54	54	6	4	54	10	6
ARRASATE	15	11	15	6	30	4	4	9	7	7	6	40	48	48	7	8	51	11	9
ULGOR	33	46	33	53	35	12	18	12	34	45	47	32	49	49	14	45	50	46	46
ARETXABALETA	13	8	13	4	22	6	6	6	5	5	14	16	46	46	5	7	46	9	7
LANDETA-MAR.	10	23	10	23	24	40	20	7	1	12	10	23	39	41	12	6	40	13	15
ESKORIATZA	18	25	18	19	31	17	15	11	11	9	26	17	43	35	13	10	44	19	23
CASTAÑARES	40	49	40	45	50	29	52	33	37	30	38	50	31	32	43	36	35	49	49
MAZMELA	42	53	42	52	54	54	46	49	36	46	48	54	27	37	48	46	34	52	52
ZARIMUZ	47	52	47	50	53	53	39	47	38	35	40	51	40	42	44	40	41	53	53
MARIN	43	48	43	37	51	30	36	46	46	39	43	52	24	36	40	43	33	50	50
LEINTZ-GATZAGA	50	50	50	46	48	51	45	29	43	28	36	49	37	40	38	37	39	51	51
ARLABAN	11	45	11	43	47	25	50	37	13	37	21	8	26	28	45	23	21	24	36
LANDA	20	36	20	35	33	27	42	26	18	32	39	9	25	22	33	21	28	28	32
LEGUTIO	32	54	32	54	52	52	47	43	33	40	44	13	52	52	49	41	42	54	54
URBINA	29	29	29	27	27	43	26	34	29	22	33	11	30	19	34	26	18	32	29
ERRETANA	35	38	35	31	45	49	37	39	31	36	41	24	13	24	42	38	26	41	42
DURANA	31	19	31	25	6	20	31	22	30	23	28	33	21	11	26	29	15	23	24
VITORIA APEAD.	8	4	8	2	13	2	2	2	3	2	8	15	53	53	2	2	47	3	4
VITORIA-CIUDAD	7	2	7	1	15	1	1	4	6	1	7	48	55	55	1	1	55	2	3
OLARIZU	5	31	5	32	28	44	19	11	21	31	17	6	38	31	17	20	20	14	17
OTAZU	48	13	48	16	8	33	16	25	50	27	16	28	19	6	21	35	13	26	21
ABERASTURI	45	14	45	14	18	36	14	35	48	16	30	26	20	8	25	33	14	27	22
ANDOLLU	3	15	3	18	7	22	24	21	26	25	35	2	11	14	22	25	5	5	8
ESTIBALIZ	17	22	17	24	20	38	25	40	12	26	15	14	17	9	35	17	12	18	19
TROKONIZ	12	1	12	12	1	31	13	14	41	20	31	5	15	2	11	34	1	4	2
ERENTXUN	46	16	46	11	39	46	11	30	45	18	20	41	23	30	16	32	31	31	25
GAUNA	37	42	37	39	42	47	48	50	42	49	50	12	6	20	50	49	19	44	45
URIBARRI-JAUR.	34	27	34	26	26	42	49	51	44	41	22	10	3	16	51	42	8	37	31

RANKING OF 500 m NODE AREAS (walking round-trips)																			
	NODE/PLACE		NODUS/URBS/ CIVITAS			N1-N2-N3 / U1-U2-U3 / C1-C2-C3									URBAN/ GENER/RURAL			TOTAL	
	N	P	N	U	C	N1	U1	C1	N2	U2	C2	N3	U3	C3	urban	general	rural	N/P	N/U/C
URIBARRI-JAUR.	34	27	34	26	26	42	49	51	44	41	22	10	3	16	51	42	8	37	31
BRIGADA TUNEL	49	47	49	47	43	48	54	54	47	50	51	45	12	21	54	50	24	48	48
LAMINORIA	55	55	55	55	55	55	55	55	55	55	55	55	45	45	55	55	48	55	55
ZEKUIANO	54	33	54	41	16	35	43	48	52	52	53	37	8	3	47	53	10	42	40
MAEZTU	30	6	30	7	4	21	10	16	27	11	18	27	28	15	9	18	17	16	10
ATAURI	51	20	51	34	2	32	38	36	51	51	52	39	5	1	41	51	6	34	26
ANTOÑANA	2	21	2	20	14	23	23	42	28	33	12	1	9	4	32	31	2	8	13
FRESNEDO	6	26	6	28	23	39	33	38	23	43	23	4	4	10	39	39	3	12	16
KANPEZU	4	17	4	22	10	34	30	27	22	21	32	3	16	5	30	19	4	7	11
ORRADICHO	44	44	44	44	46	50	41	41	39	47	49	38	10	25	46	48	23	47	47
ZUÑIGA	39	40	39	36	44	19	29	45	40	48	24	19	14	26	37	47	27	45	44
ARQUITAS	53	34	53	42	19	37	51	52	53	53	25	21	7	7	52	52	11	43	41
ACEDO	41	32	41	17	38	18	22	32	49	17	5	36	22	29	28	27	30	38	34
GRANADA	52	30	52	30	25	45	53	53	54	54	54	22	2	12	53	54	7	40	37
ANCIN	27	9	27	10	9	15	9	23	24	13	11	42	33	18	10	14	22	17	14
MURIETA	28	18	28	13	37	45	12	28	25	29	37	35	18	27	15	28	29	22	20
ZUFIA	36	24	36	21	29	16	27	44	32	44	46	53	1	17	36	44	9	35	27
ZUBIELQUI	38	12	38	15	5	14	17	20	35	15	29	43	29	13	18	30	16	21	18
LIZARRA	1	3	1	3	12	3	3	1	8	3	4	7	41	33	3	5	25	1	1

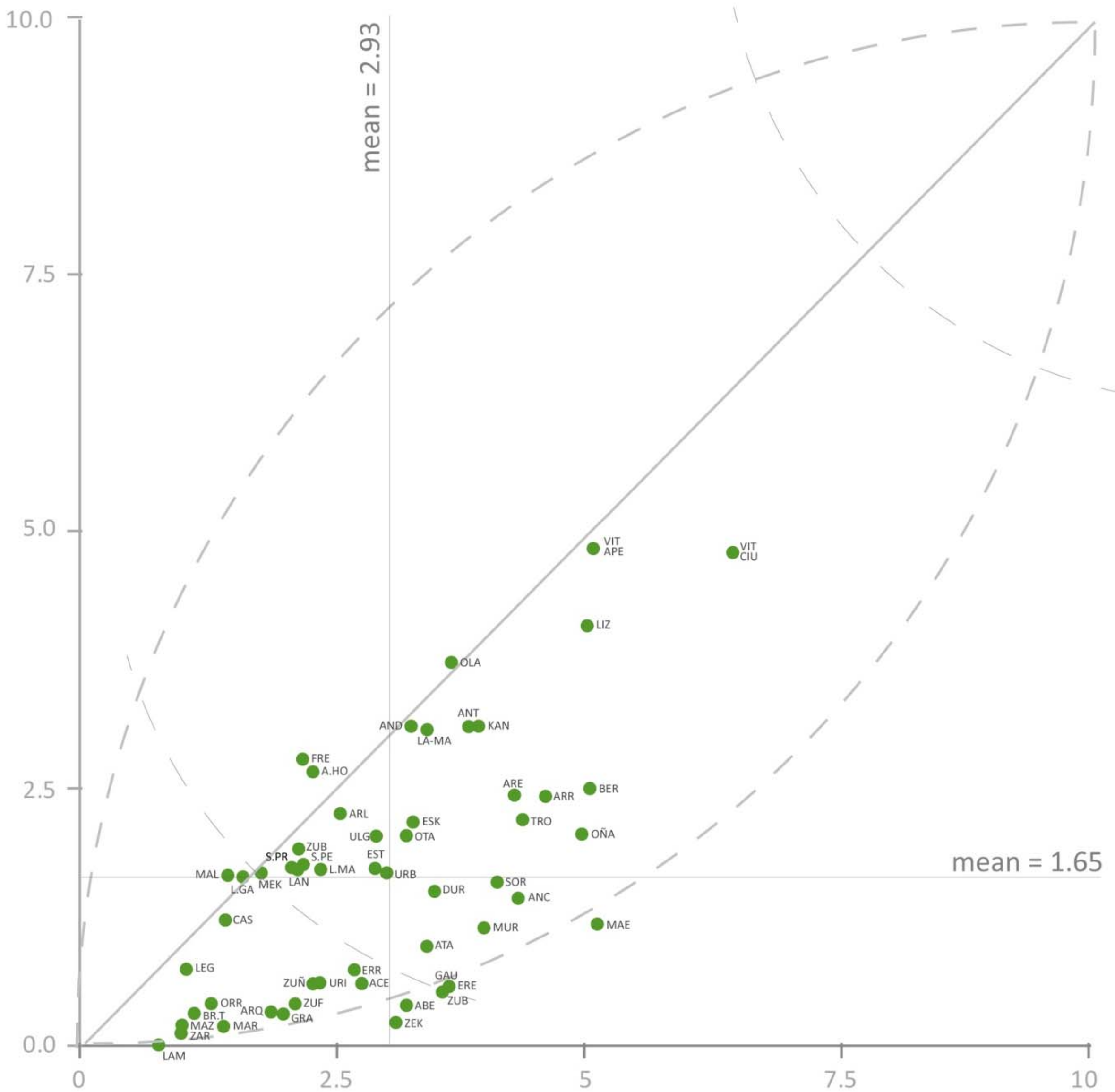
0-13	14-27	28-41	42-55

4.3. Comparison of results

4.3.1. Node/place model

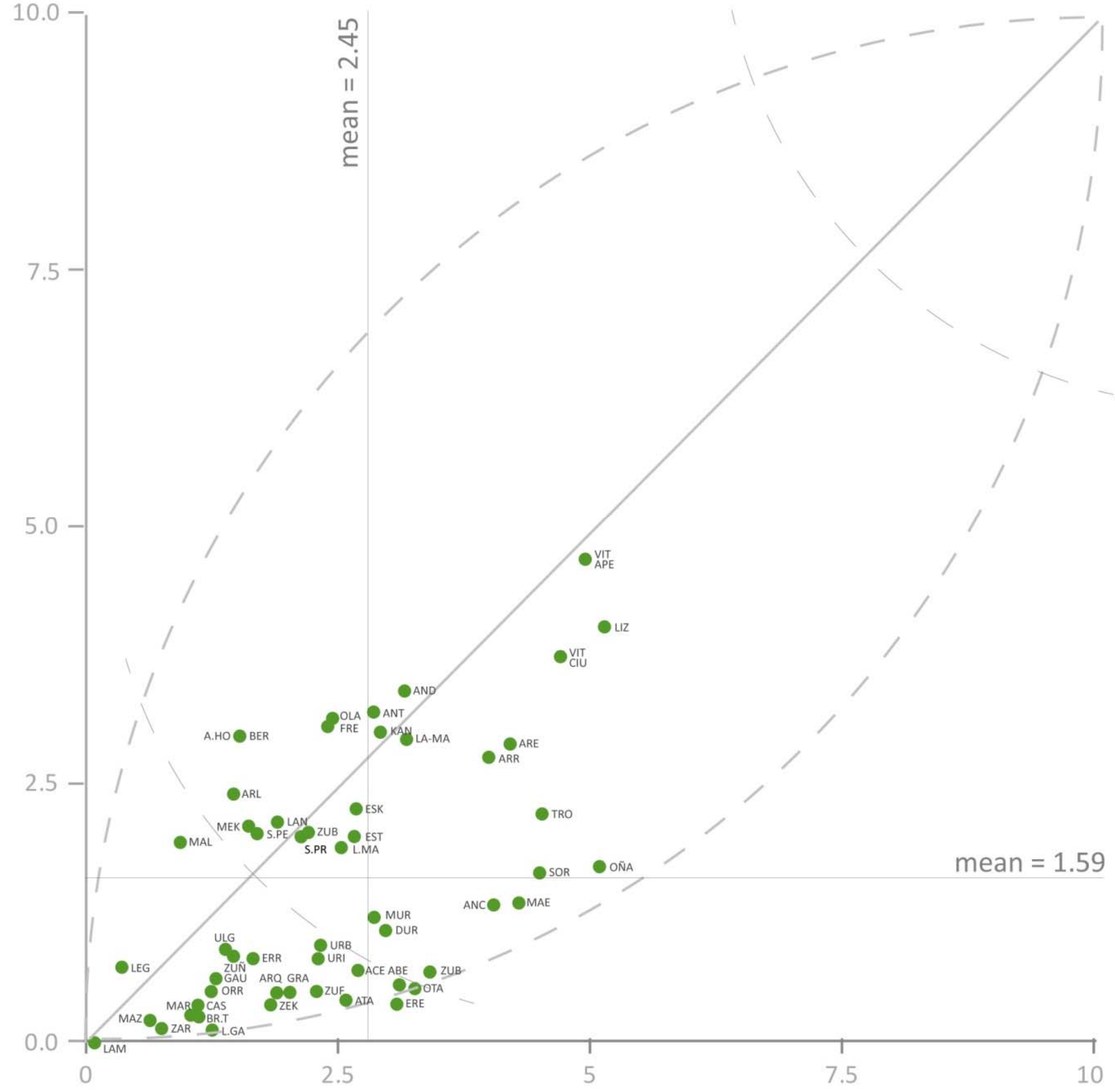


1000 m AREA



mean = 2.93
mean = 1.65
10.0
7.5
5.0
2.5
0.0
0
2.5
5
7.5
10
VIT APE
VIT CIU
LIZ
OLA
AND
LA-MA
ANT
KAN
FRE
A.HO
ARE
ARR
BER
ARL
ESK
TRO
ULG
OTA
OÑA
ZUB
S.PR
S.PE
EST
MAL
L.GA
MEK
LAN
L.MA
URB
SOR
DUR
ANC
CAS
MUR
MAE
ATA
LEG
ZUÑ
URI
ERR
ACE
GAU
ERE
ZUB
ORR
ARQ
ZUF
ABE
BR.T
GRA
MAZ
MAR
ZAR
ZEK
LAM

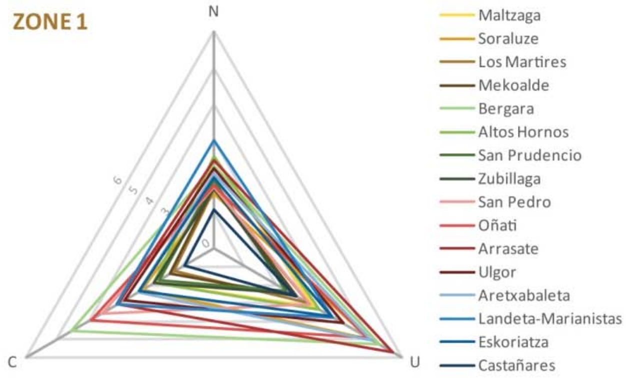
500 m AREA

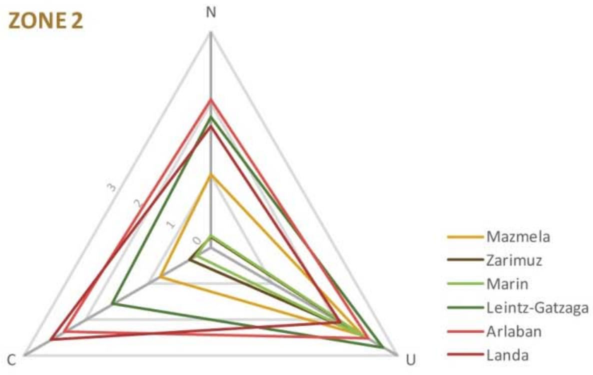


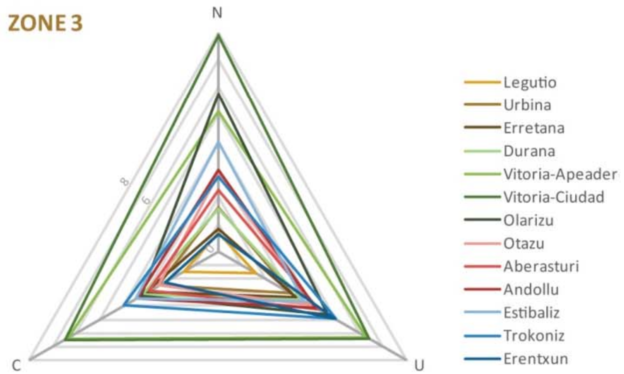
10.0
7.5
5.0
2.5
0.0
0
2.5
5
7.5
10
mean = 2.45
mean = 1.59
VIT APE
LIZ
VIT CIU
AND
ANT
OLA
FRE
KAN
LA-MA
A.HO
BER
ARE
ARR
ARL
ESK
TRO
MEK
LAN
S.PE
ZUB
EST
MAL
S.PR
L.MA
SOR
OÑA
ANC
MAE
MUR
DUR
ULG
URB
URI
ERR
LEG
ZUÑ
GAU
ACE ABE
ZUB
ARQ
GRA
ORR
OTA
ZUF
ATA
MAR
CAS
ZEK
ERE
MAZ
BR.T
ZAR
L.GA
LAM

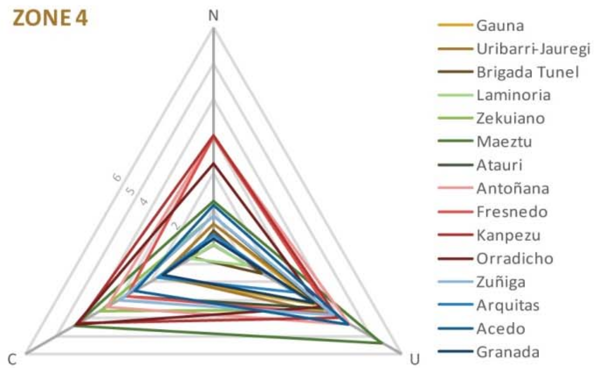
4.3.2. NCU model

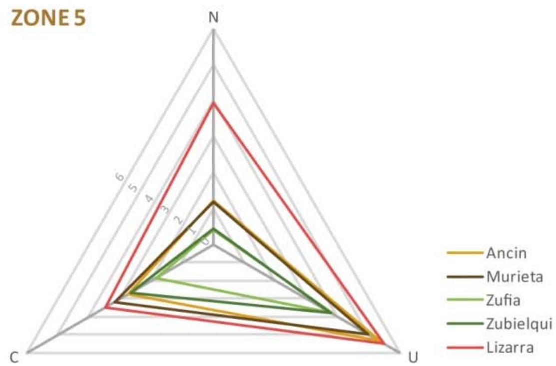
COMPARISON BY ZONES



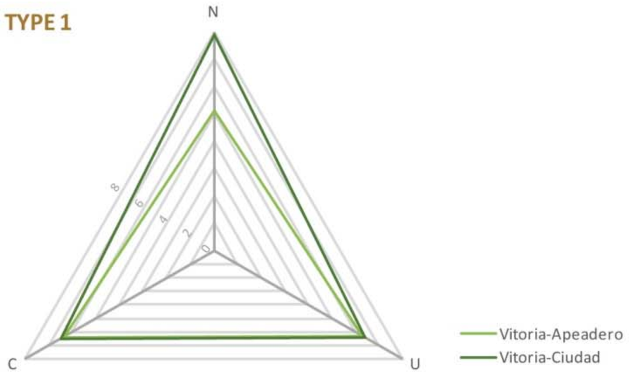


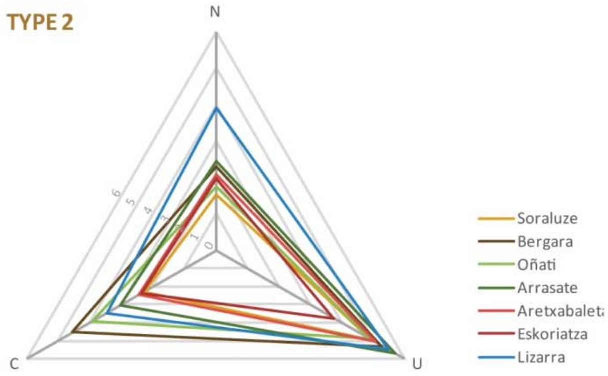


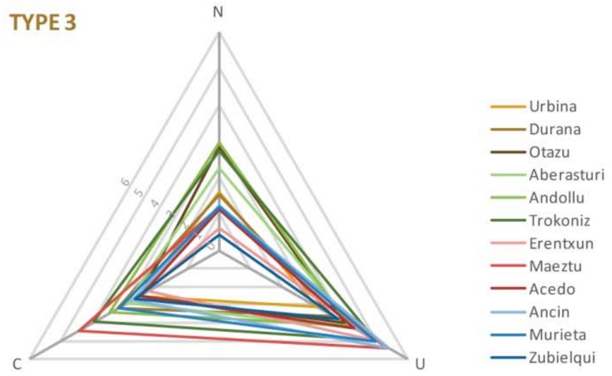


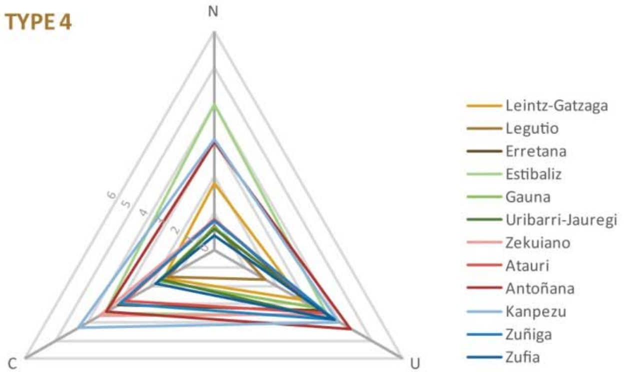


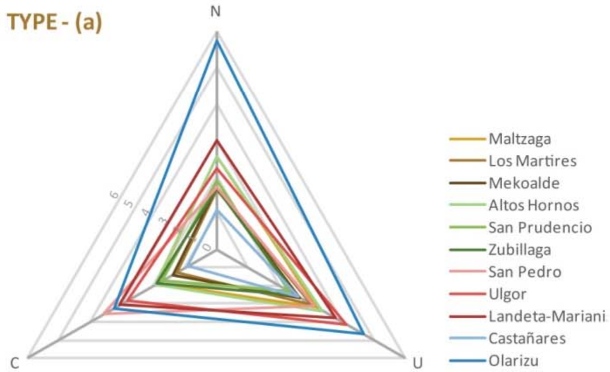
COMPARISON BY TYPES RESULTED FROM THE RELATIONS WITH URBAN CORES

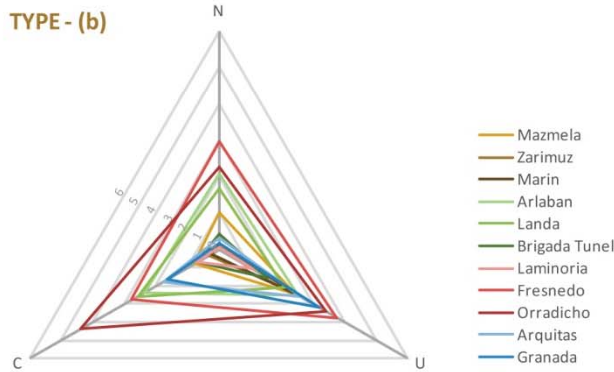






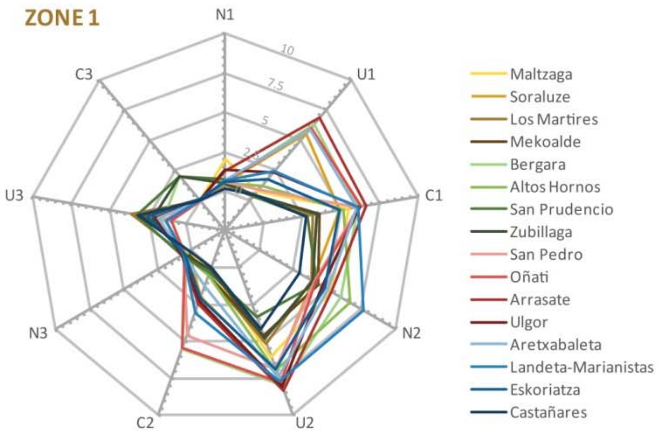


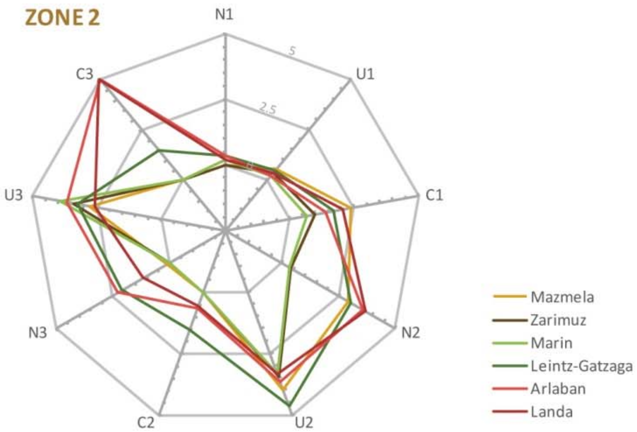


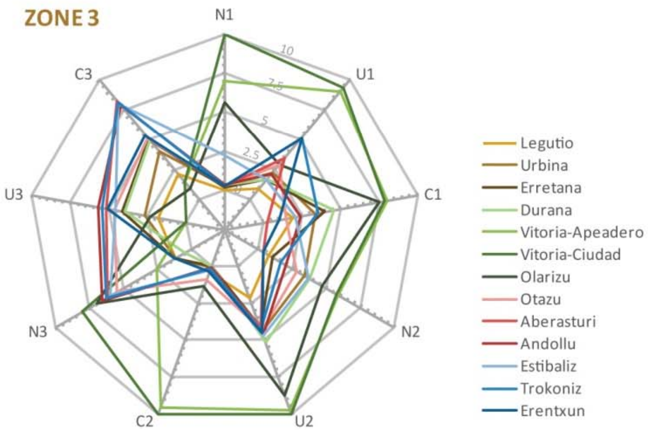


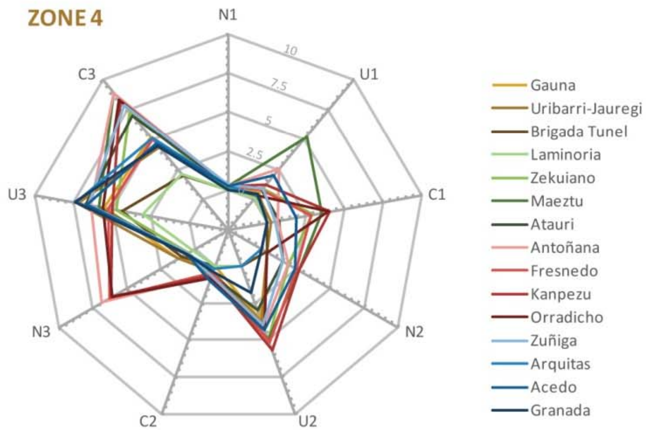
4.3.3. Multiaxialodel

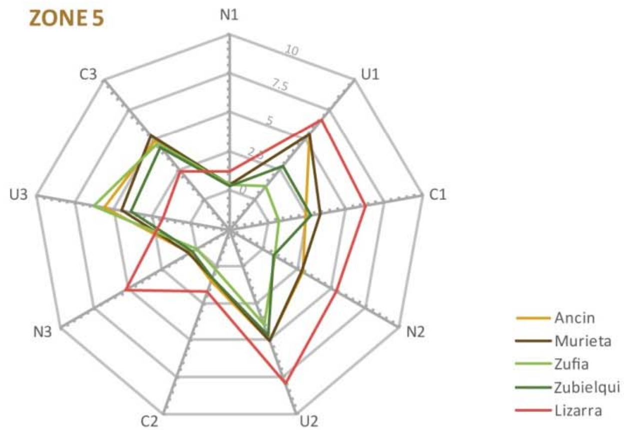
COMPARISON BY ZONES



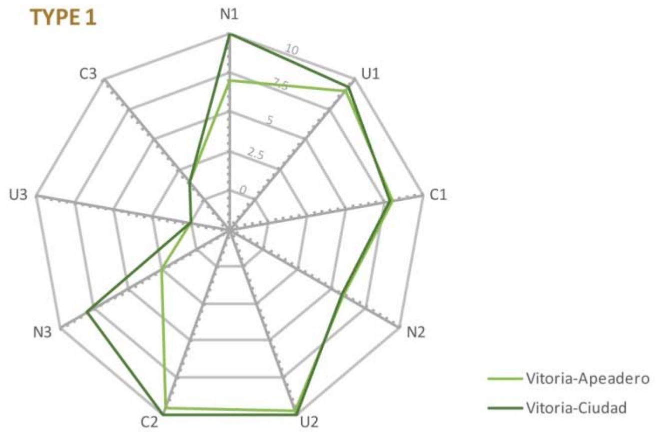


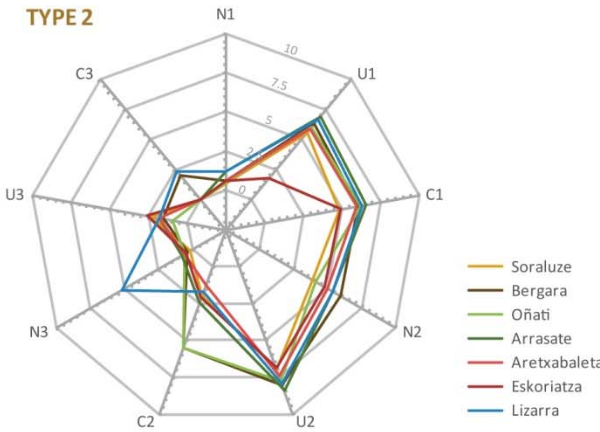


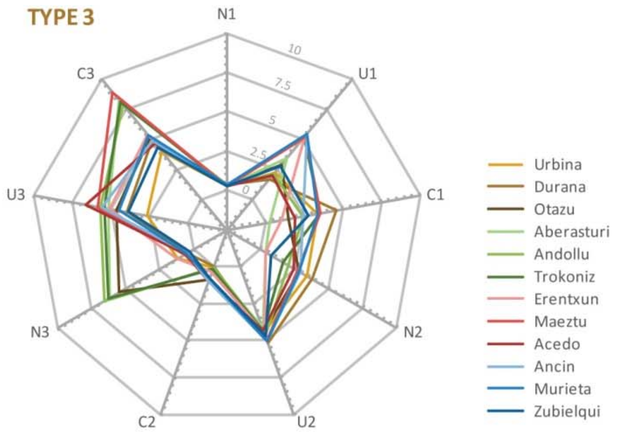


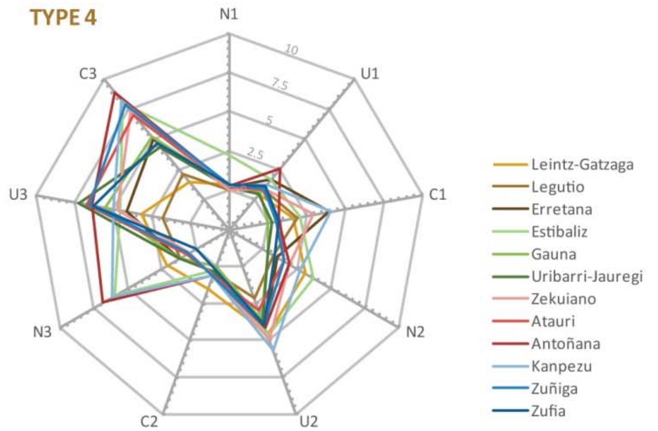


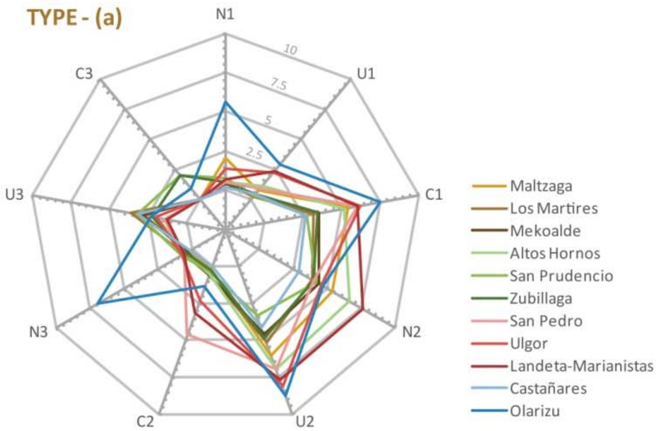
COMPARISON BY TYPES RESULTED FROM THE RELATIONS WITH URBAN CORES

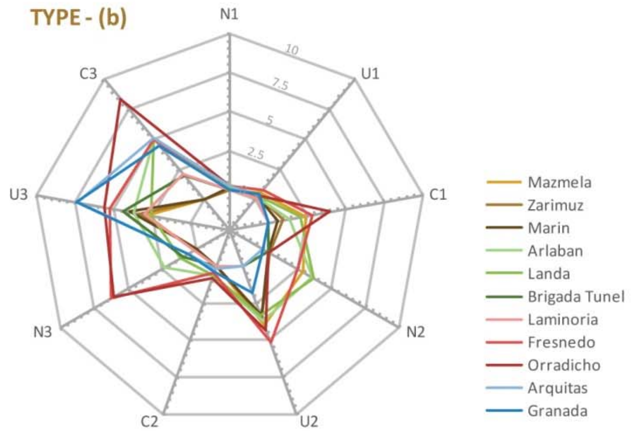






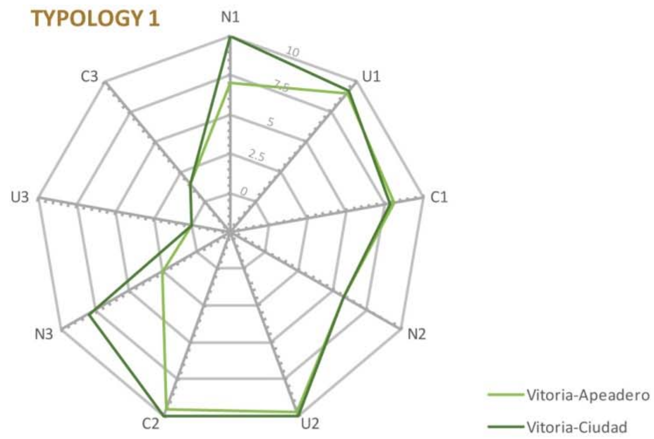


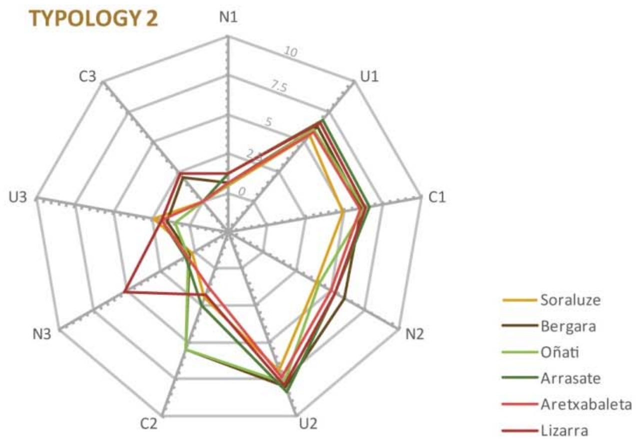


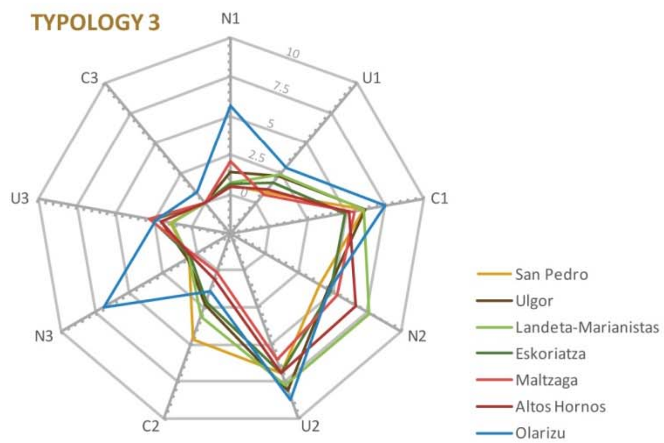


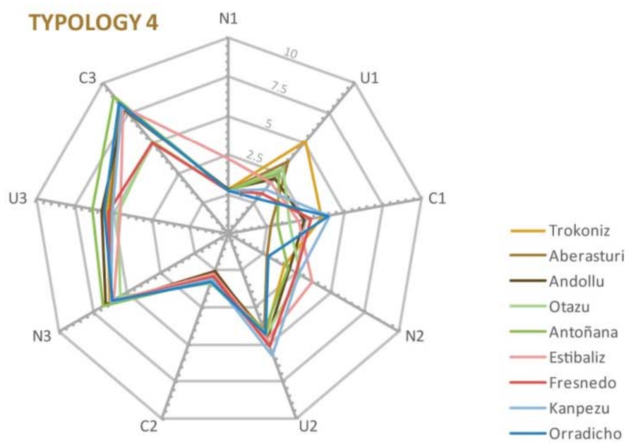
4.3.4. Multiaxial model based new typologies

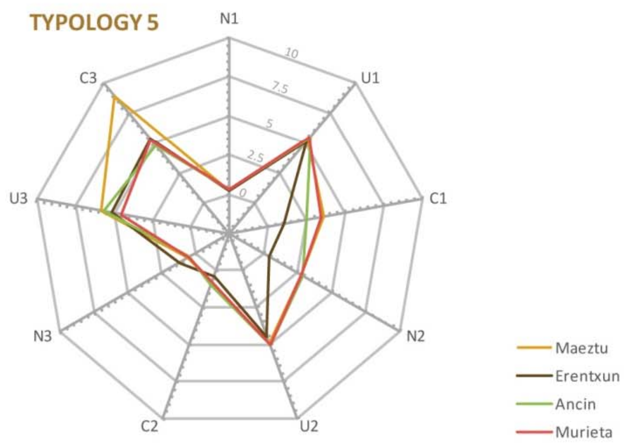
CREATED NEW TYPOLOGIES



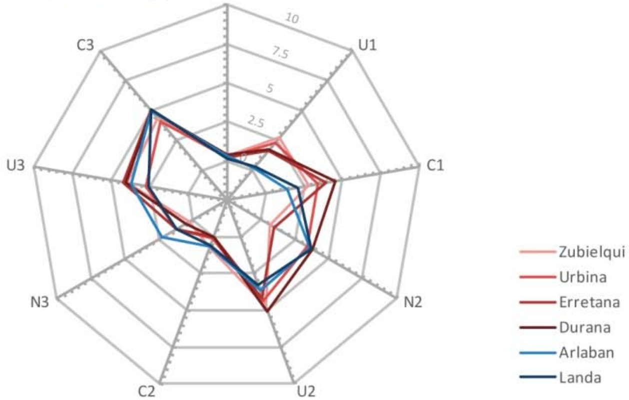




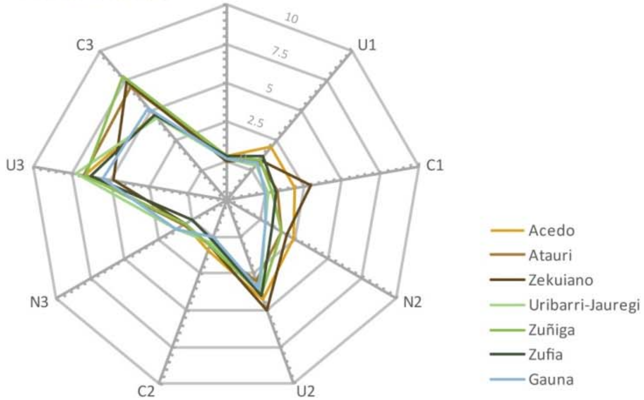




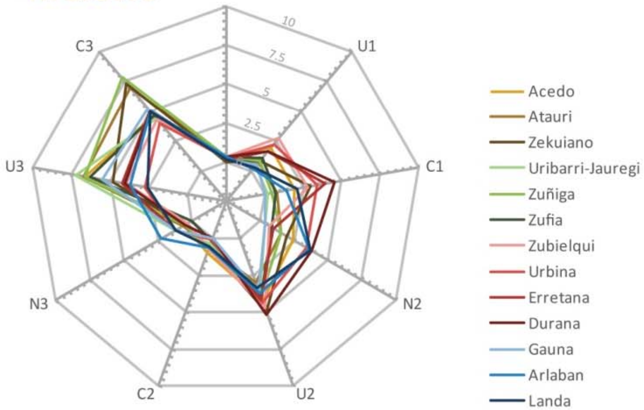
TYPOLOGY 6a



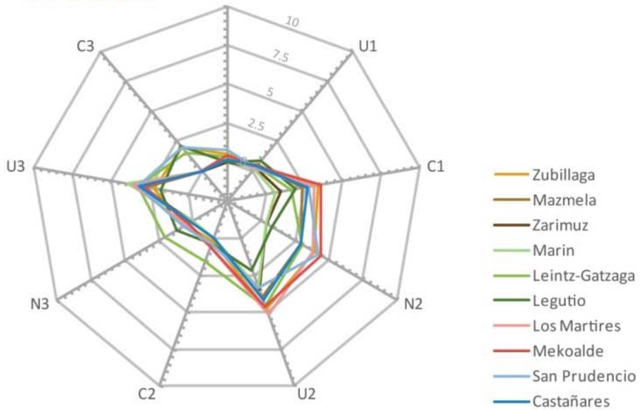
TYPOLOGY 6b



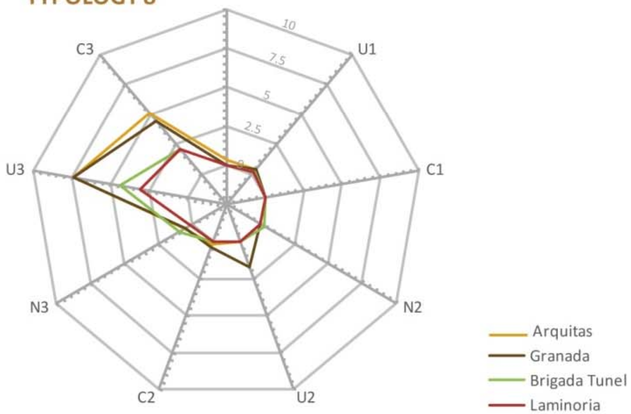
TYPOLOGY 6



TYPOLOGY 7

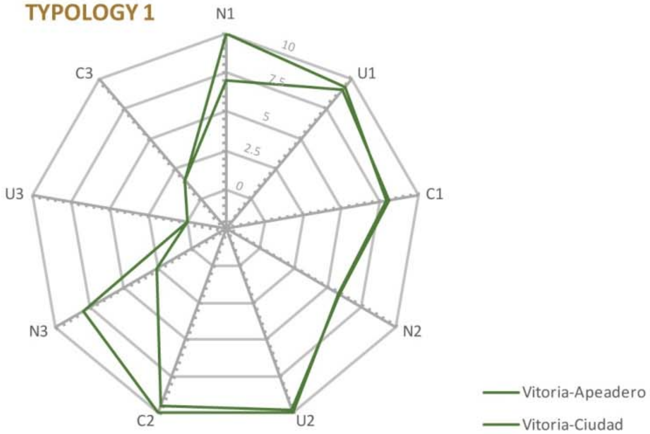


TYPOLOGY 8

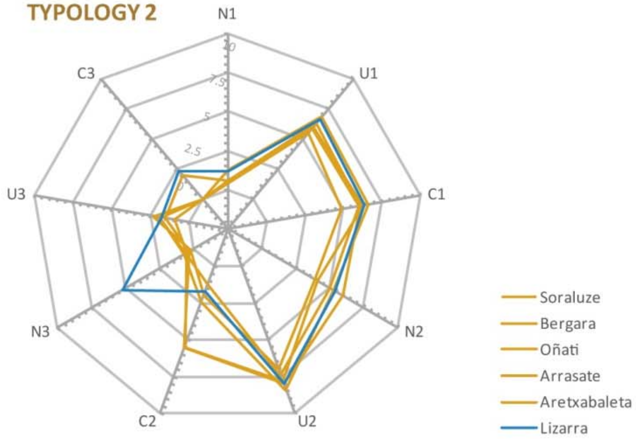


CREATED NEW TYPOLOGIES CONSIDERING ZONES

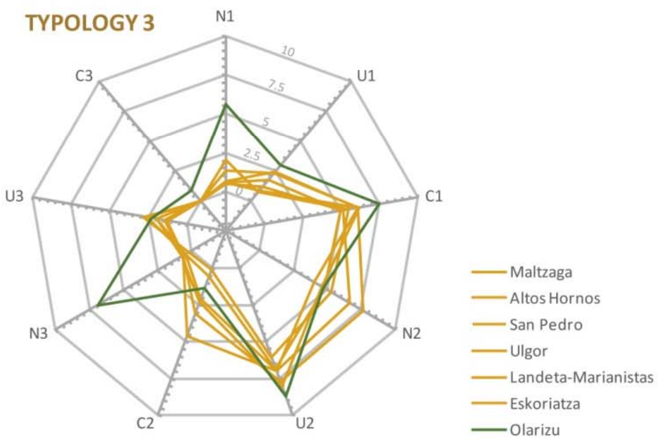
TYPOLOGY 1



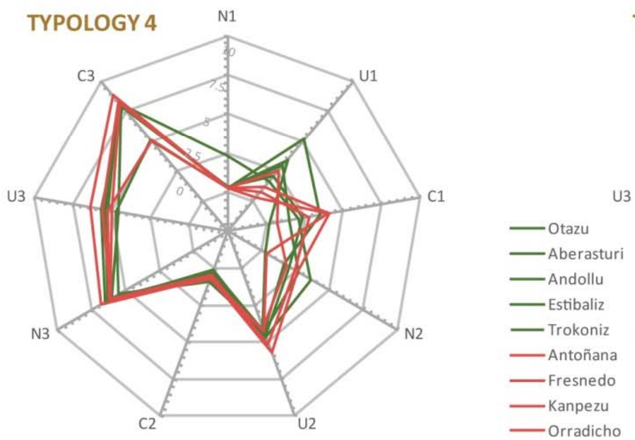
TYPOLOGY 2



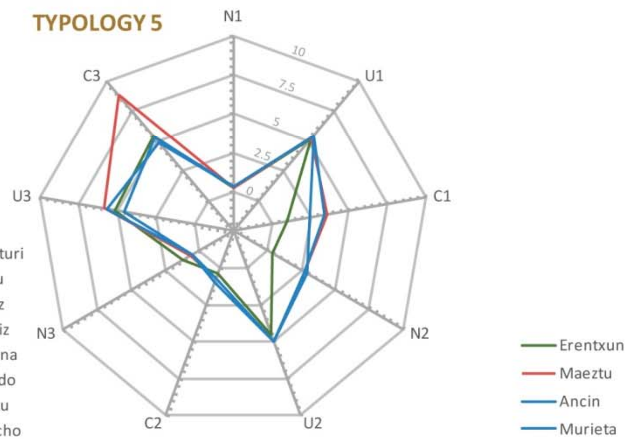
TYPOLOGY 3



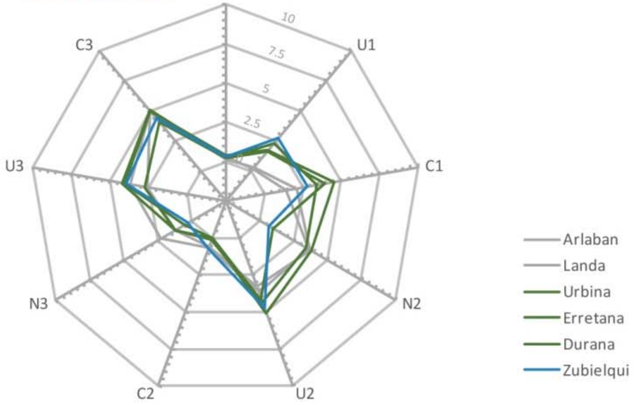
TYPOLOGY 4



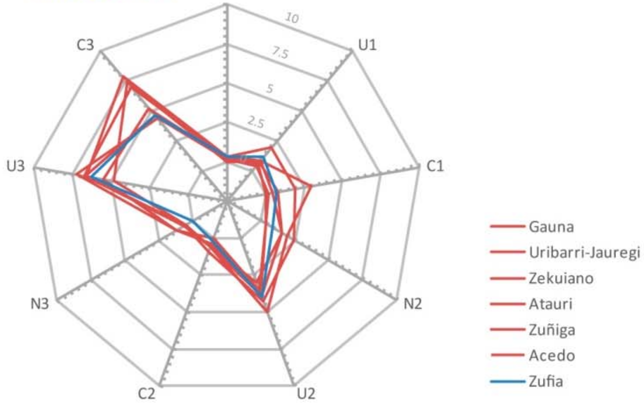
TYPOLOGY 5



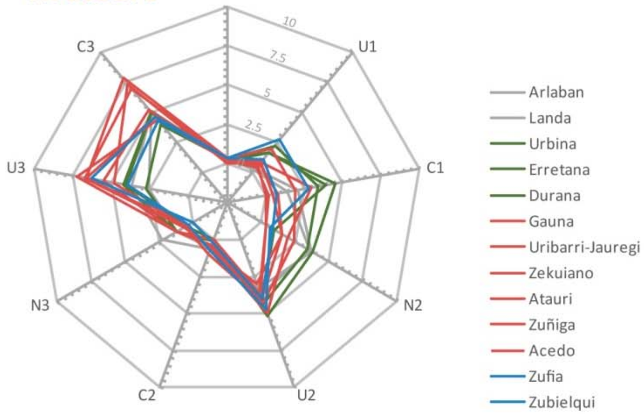
TYPOLOGY 6a



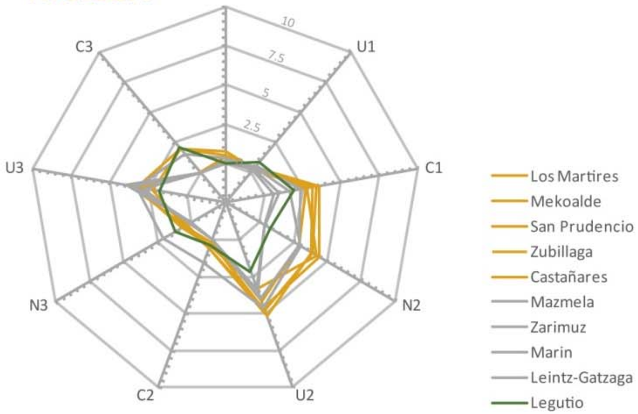
TYPOLOGY 6b



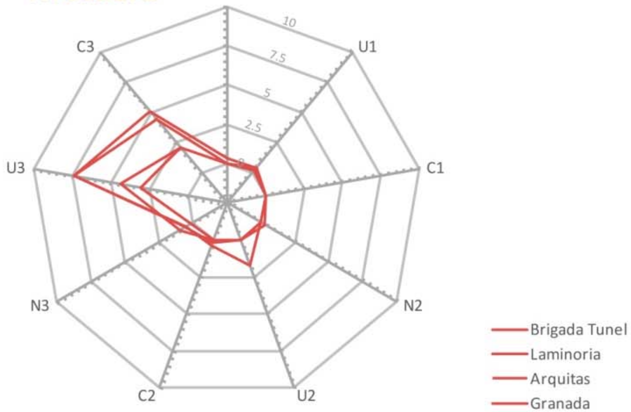
TYPOLOGY 6



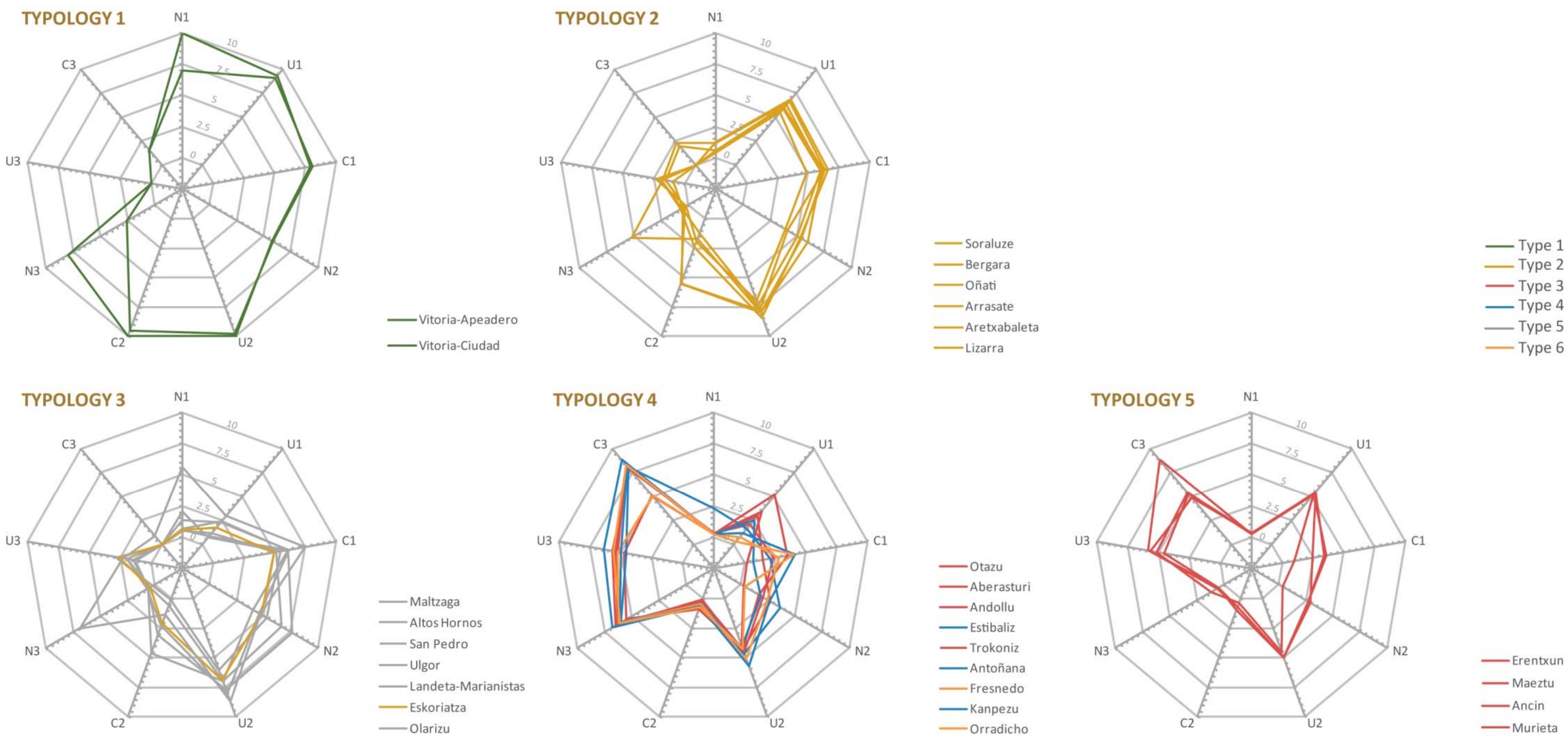
TYPOLOGY 7



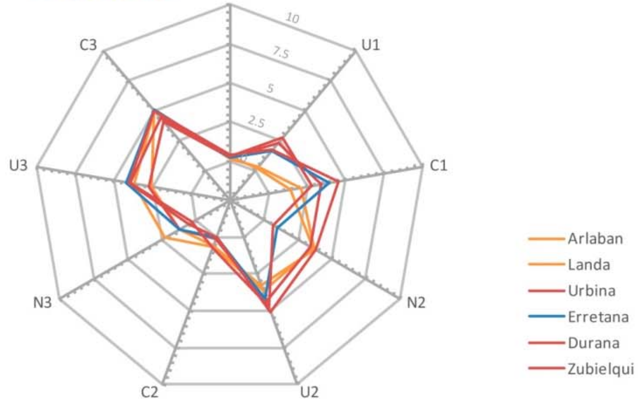
TYPOLOGY 8



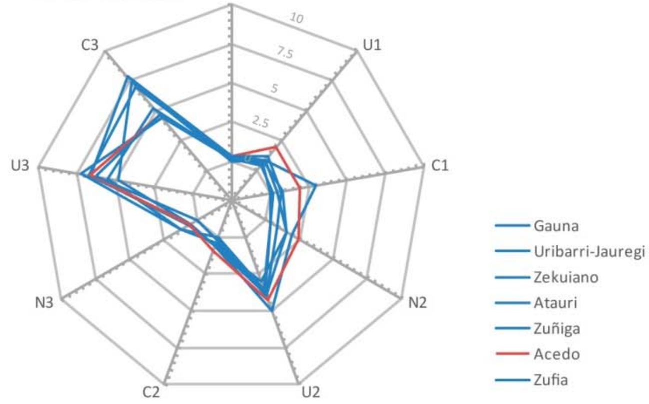
CREATED NEW TYPOLOGIES CONSIDERING TYPES RESULTED FROM THE RELATIONS WITH URBAN CORES



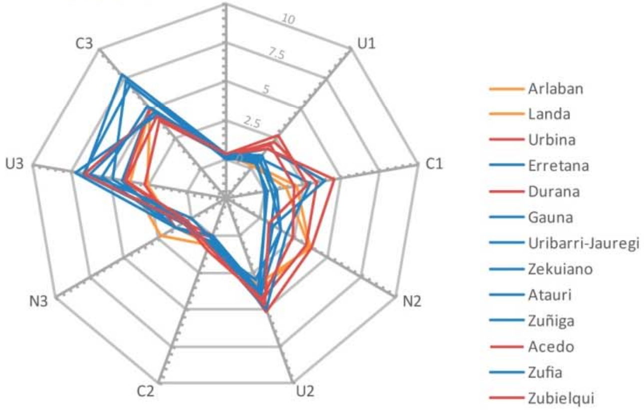
TYPOLOGY 6a



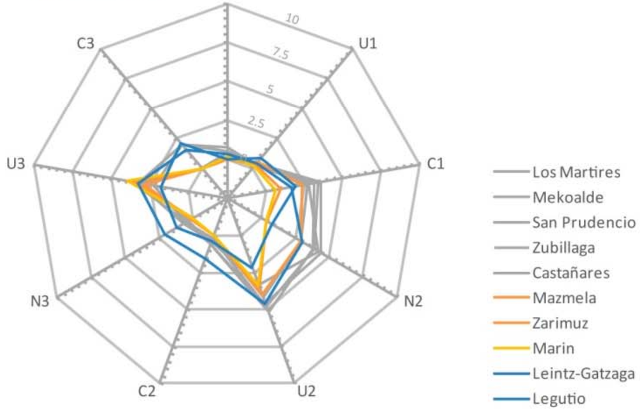
TYPOLOGY 6b



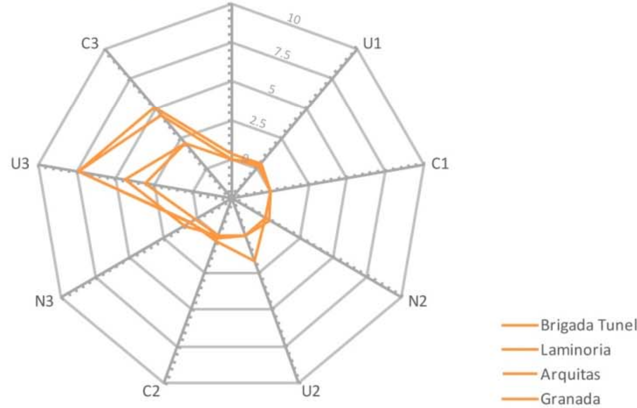
TYPOLOGY 6



TYPOLOGY 7



TYPOLOGY 8



4.3.5. K-means clustering

CHARACTERISATION OF GROUPS (10)

GR.	N	N1	U1	C1	N2	U2	C2	N3	U3	C3
1	2	8.50	8.34	7.89	5.12	9.89	9.77	4.77	0.00	1.50
2	5	0.70	4.96	5.66	4.43	7.71	3.34	0.47	1.71	0.41
3	6	0.97	1.25	5.15	5.31	7.11	2.14	0.50	2.02	0.01
4	8	0.51	1.69	3.31	1.66	4.64	0.38	5.65	5.40	7.85
5	6	0.24	3.30	3.48	1.68	4.86	0.71	0.64	4.98	6.02
6	6	0.26	1.13	3.40	2.87	4.17	0.38	2.13	3.64	4.87
7	7	0.22	0.67	3.05	0.95	3.48	0.44	0.77	6.64	5.46
8	10	0.29	0.31	3.28	2.55	3.98	0.37	0.69	3.03	0.77
9	3	0.10	0.20	0.00	0.15	0.00	0.06	0.66	4.94	3.09
10	2	3.44	3.94	6.80	4.45	8.35	1.55	5.21	2.08	1.62

GROUPING (10)

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8	GROUP 9	GROUP 10
Vitoria-Ciudad	Soraluze	Maltzaga	Aberasturi	Erentxun	Arlaban	Gauna	Los Martires	Brigada Tunel	Olarizu
Vitoria-Apeadero	Bergara	Altos Hornos	Andollu	Zekuiano	Landa	Uribarri-Jauregi	Mekoalde	Laminoria	Lizarra
	Oñati	San Pedro	Estibaliz	Maeztu	Urbina	Atauri	San Prudencio	Arquitas	
	Arrasate	Ulgor	Trokoniz	Ancin	Erretana	Zuñiga	Zugillaga		
	Aretxabaleta	Landeta-Marianistas	Antoñana	Murieta	Durana	Acedo	Castañares		
		Eskoriatza	Fresnedo	Zubielqui	Otazu	Granada	Mazmela		
			Kanpezu			Zufia	Zarimuz		
			Orradicho				Marin		
							Leintz-Gatzaga		
							Legutio		

CHARACTERISATION OF GROUPS (9)

GR.	N	N1	U1	C1	N2	U2	C2	N3	U3	C3
1	2	8.50	8.34	7.89	5.12	9.89	9.77	4.77	0.00	1.50
2	1	5.66	2.57	7.73	4.02	8.74	1.37	6.22	2.34	0.91
3	11	0.77	3.37	5.50	4.85	7.55	2.83	0.84	1.79	0.41
4	9	0.48	1.76	3.28	1.74	4.61	0.44	5.52	5.32	7.55
5	5	0.29	3.82	3.48	1.70	4.84	0.73	0.68	5.02	5.76
6	5	0.26	0.90	3.48	2.97	4.13	0.27	1.66	3.43	4.82
7	8	0.20	0.67	3.11	1.03	3.67	0.46	0.74	6.41	5.69
8	11	0.45	0.33	3.40	2.81	4.17	0.34	0.65	3.01	0.70
9	3	0.10	0.20	0.00	0.15	0.00	0.06	0.66	4.94	3.09

GROUPING (9)

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8	GROUP 9
Vitoria-Ciudad	Olarizu	Soraluze	Otazu	Erentxun	Arlaban	Gauna	Maltzaga	Brigada Tunel
Vitoria-Apeadero		Bergara	Aberasturi	Maeztu	Landa	Uribarri-Jauregi	Los Martires	Laminoria
		Altos Hornos	Andollu	Ancin	Urbina	Zekuiano	Mekoalde	Arquitas
		San Pedro	Estibaliz	Murieta	Erretana	Atauri	San Prudencio	
		Oñati	Trokoniz	Zubielqui	Durana	Zuñiga	Zubillaga	
		Arrasate	Antoñana			Acedo	Castañares	
		Ulgor	Fresnedo			Granada	Mazmela	
		Aretxabaleta	Kanpezu			Zufia	Zarimuz	
		Landeta-Marianistas	Orradicho				Marin	
		Eskoriatza					Leintz-Gatzaga	
		Lizarra					Legutio	

CHARACTERISATION OF GROUPS (8)

GR.	N	N1	U1	C1	N2	U2	C2	N3	U3	C3
1	2	8.50	8.34	7.89	5.12	9.89	9.77	4.77	0.00	1.50
2	3	0.58	3.55	5.56	4.22	7.57	5.20	0.48	1.32	0.68
3	10	1.45	2.95	5.61	5.02	7.52	1.70	1.43	2.09	0.34
4	9	0.48	1.76	3.28	1.74	4.61	0.44	5.52	5.32	7.55
5	4	0.29	4.23	3.59	1.90	4.87	0.72	0.78	5.29	6.10
6	6	0.27	1.11	3.41	2.62	4.23	0.36	1.43	3.51	4.74
7	9	0.21	0.63	2.76	0.92	3.26	0.43	0.72	6.52	5.63
8	12	0.24	0.28	2.74	2.16	3.32	0.31	0.69	3.14	0.99

GROUPING (8)

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
Vitoria-Ciudad	Bergara	Maltzaga	Otazu	Erentxun	Arlaban	Gauna	Los Martires
Vitoria-Apeadero	San Pedro	Soraluze	Aberasturi	Maeztu	Landa	Uribarri-Jauregi	Mekoalde
	Oñati	Altos Hornos	Andollu	Ancin	Urbina	Zekuiano	San Prudencio
		Arrasate	Estibaliz	Murieta	Erretana	Atauri	Zubillaga
		Ulgor	Trokoniz		Durana	Zuñiga	Castañares
		Aretxabaleta	Antoñana		Zubielqui	Acedo	Mazmela
		Landeta-Marianistas	Fresnedo			Granada	Zarimuz
		Eskoriatza	Kanpezu			Zufia	Marin
		Olarizu	Orradicho			Arquitas	Leintz-Gatzaga
		Lizarra					Legutio
							Brigada Tunel
							Laminoria