ARCHIVO DEL LABORATORIO DE DOCUMENTACIÓN GEOMÉTRICA DEL PATRIMONIO

ARCHIVE OF THE LABORATORY FOR THE GEOMETRIC DOCUMENTATION OF HERITAGE

Sección de informes de investigación / Research reports section

2

Información general / General information		
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TITULO:	Intensive Program ERASMUS: TOPCART. Geometric Documentation of the Heritage (administrative and academic documentation)	:TITLE
FECHA:	abril 2013 / April 2013	:DATE
NUMERO:	LDGP_inv_002	:NUMBER
IDIOMA:	español e inglés / Spanish and English	:LANGUAGE

Resumen	
TITULO:	Programa intensivo ERASMUS: TOPCART. Documentación Geométrica del Patrimonio (documentación administrativa y académica)
TITULO PROYECTO:	Intensive Program ERASMUS: TOPCART 2010 / 2011 Geometric Documentation of Heritage 2009-1-ES1-ERAIP-0013 / 2010-1-ES1-ERA10-0024
ENTIDAD FINANCIADORA:	Organismo Autónomo de Programas Educativos Europeos (OAPEE), Gobierno de La Rioja, Ayuntamiento de Clavijo, Ayuntamiento de Logroño, Ilustre Colegio de Ingenieros Técnicos en Topografía (delegación de La Rioja)
INVESTIGADOR PRINCIPAL:	José Manuel VALLE MELÓN
INVESTIGADORES:	10 profesores y 56 alumnos
PARTICIPANTES:	- Universidad del País Vasco (UPV-EHU) – Spain - National Technical University of Athens (NTUA) – Greece - HafenCity Universität Hamburg (HCU) – Germany - Universidad Politécnica de Madrid (UPM) – Spain - Università degli Studi di Siena – Italy - Vilniaus Gedimino Technikos Universitetas (VGTU) - Lithuania
RESUMEN DEL PROYECTO:	El objetivo principal que se persigue en este proyecto es el intercambio de metodológico práctico, en materias afines a la medida y la representación del patrimonio, entre profesores y fundamentalmente alumnos, de diferentes países. Para la consecución de este fin se ha contado con la participación de un grupo de 56 alumnos y 10 profesores de (Alemania, Italia, Grecia, Lituania y España). Las actividades se han centrado en el desarrollo de proyectos concretos de documentación dentro del Monasterio de San Prudencio (La Rioja, España). En él se han aplicado técnicas digitales de registro de información geométrica, constituidas por receptores GPS, estaciones totales topográficas, escáneres láser y sistemas fotogramétricos. Los datos obtenidos se han documentado y procesado con el fin de obtener las representaciones cartográficas y modelos virtuales de representación que pueden ser difundidas por medio de Internet. Como resultados se pretenden: un conjunto de registros métricos del momento de la intervención, modelos gráficos de difusión e informes técnicos sobre el monumento.
RESUMEN DE LA CONTRIBUCIÓN:	La Universidad del País Vasco ha ejercido de solicitante y coordinadora.
DESCRIPTORES NATURALES:	patrimonio, monasterio, topografía, fotogrametría, láser escáner, arqueología de la arquitectura, educación
DESCRIPTORES CONTROLADOS:	(Procedentes del Tesauro UNESCO [http://databases.unesco.org/thessp/]) Patrimonio Cultural, Reconocimiento Topográfico, Fotogrametría, Edificio Religioso, Arqueología, Movilidad Estudiantil, Docencia

Abstract	
TITLE:	Intensive Program ERASMUS: TOPCART. Geometric Documentation of the Heritage (administrative and academic documentation)
TITLE:	Intensive Program ERASMUS: TOPCART 2010 / 2011 Geometric Documentation of Heritage 2009-1-ES1-ERAIP-0013 / 2010-1-ES1-ERA10-0024
FUNDING AGENCY:	Organismo Autónomo de Programas Educativos Europeos (OAPEE), Government of La Rioja, Town council of Clavijo, City council of Logroño, Spanish Association of Surveyors
MAIN RESEARCHER:	José Manuel VALLE MELÓN
RESEARCHERS:	10 lecturers and 56 students
PARTNERS:	- Universidad del País Vasco (UPV-EHU) – Spain - National Technical University of Athens (NTUA) – Greece - HafenCity Universität Hamburg (HCU) – Germany - Universidad Politécnica de Madrid (UPM) – Spain - Università degli Studi di Siena – Italy - Vilniaus Gedimino Technikos Universitetas (VGTU) - Lithuania
ABSTRACT OF THE PROJECT:	The main objective this project is looking for is the exchange of practical methodologies, in topics related with the measure and representation of heritage, between teachers and specially students from different countries. For the achievement of this aim we counted with the participation of a group of 56 students and 10 lecturers from Germany, Italy, Greece, Lithuania and Spain. Activities focused on the development of concrete projects in documentation of heritage, at the San Prudencio's Monastery. In this site, digital techniques for the acquisition of geometric information from GPS equipment, surveying total stations, laser scanner and photogrammetric systems were put into practice. Obtained data were processed as follows: first of all, they were documented by adding necessary metadata in order to ensure their use in the future, then, processed to obtain cartographic representations and virtual models which can be distributed on the Internet. As results we present: documentation and metric data, graphic models, plans and technical reports on the monument.
ABSTRACT OF THE CONTRIBUTION:	The University of the Basque Country submitted the proposal and coordinated the activity.
NATURAL KEYWORDS:	heritage, monastery, surveying, photogrammetry, laser scanner, building archaeology, learning
CONTROLLED KEYWORDS:	(From the UNESCO's thesaurus [http://databases.unesco.org/thesaurus/]) Cultural Heritage, Surveying, Photogrammetry, Religious Buildings, Archaeology, Student Mobility, Teaching Profession

Reutilización / Re-use		
REUTILIZACION:	Los siguientes términos corresponden al Real Decreto 1495/2011, de 24 de octubre por el que se desarrolla la Ley 37/2007, de 16 de noviembre, sobre reutilización de la información del sector público, para el ámbito del sector público estatal. "Son de aplicación las siguientes condiciones generales para la reutilización de los documentos sometidos a ellas: 1. Está prohibido desnaturalizar el sentido de la información. 2. Debe citarse la fuente de los documentos objeto de la reutilización. Esta cita podrá realizarse de la siguiente manera: "Origen de los datos: [órgano administrativo, organismo o entidad del sector público estatal de que se trate]". 3. Debe mencionarse la fecha de la última actualización de los documentos objeto de la reutilización, siempre cuando estuviera incluida en el documento original. 4. No se podrá indicar, insinuar o sugerir que la [órgano administrativo, organismo o entidad del sector público estatal de que se trate] titular de la información reutilizada participa, patrocina o apoya la reutilización que se lleve a cabo con ella. 5. Deben conservarse, no alterarse ni suprimirse los metadatos sobre la fecha de actualización y las condiciones de reutilización aplicables incluidos, en su caso, en el documento puesto a disposición para su reutilización." / The following terms come from the Royal Decree 1495/2011, of 24th October 2011, whereby the Law 37/2007, of November 16, on the re-use of public sector information, is developed for the public state sector. "The following general terms shall apply to all re-usable document availability methods: 1. The information must not be distorted. 2. The original source of re-usable documents must be cited. 3. The date of the latest update of re-usable documents must be indicated when it appears in the original document. 4. It must not be mentioned or suggested that the public sector agencies, bodies or entities are involved in, sponsor or support the re-use of information being made. 5. Metadata indicating the latest update and the applicable terms of re-use included in re-usable documents made available by public agencies or bodies must not be deleted or altered."	:RE-USE

Estructura / **Framework**		
ID PERMANENTE:	http://hdl.handle.net/10810/9906	:PERMANENT ID
ESTRUCTURA:	• **ldgp_inf002_A1solicitud2009-10.pdf**: solicitud del proyecto para el curso 2009-10, en español con notas en inglés / application presented for the academic year 2009-10, in Spanish with notes in English. • **ldgp_inf002_A2informefinal2009-10.pdf**: informe final de la actividad realizada durante el curso 2009-10, en español / final report about the activity done during the year 2009-10, in Spanish. • **ldgp_inf002_A3cierre2009-10.pdf**: contestación de la OAPEE dando por válida la actividad académica 2009-10 e indicando los resultados de la evaluación externa, en español / answer of the OAPEE (Agency for European Educative Programs) where the final report 2009-10 is accepted, it includes the remarks done by the external referees, in Spanish. • **ldgp_inf002_A4solicitud2010-11.pdf**: solicitud del proyecto para el curso 2010-11, en español / application presented for the academic year 2010-11, in Spanish. • **ldgp_inf002_A5informefinal2010-11.pdf**: informe final de la actividad realizada durante el curso 2010-11, en español / final report about the activity done during the year 2010-11, in Spanish. • **ldgp_inf002_A6cierre2010-11.pdf**: contestación de la OAPEE dando por válida la actividad académica 2010-11 e indicando los resultados de la evaluación externa, en español / answer of the OAPEE (Agency for European Educative Programs) where the final report 2010-11 is accepted, it includes the remarks done by the external referees, in Spanish. • **ldgp_inf002_B1CoordinationMeeting.pdf**: este libreto contiene tres documentos relacionados con la visita preliminar realizada con el fin de preparar la actividad: un cuaderno de trabajo para ir repasando los diferentes aspectos a tratar, una encuesta y un resumen de las decisiones tomadas. Estos documentos están en inglés / this booklet is composed by three documents related with the coordination meeting done in order to prepare the activity: a workbook containing the different topic to be decided beforehand, a questionnaire and a summary with the principal decisions taken. These documents are in English. • **ldgp_inf002_B2folletos.pdf**: diversos carteles y folletos sobre la actividad, tanto en español como en inglés / some posters and leaflets about the activity, in Spanish and English. • **ldgp_inf002_B3entrevistaalumnos.pdf**: ejemplo de criterios de valoración de los alumnos candidatos para participar en la actividad, en español / example of the scale used in the selection of the students who would take part in the activity, in Spanish. • **ldgp_inf002_B4calendarios.pdf**: calendarios de la fase conjunta de ambos cursos, en inglés / detailed programs of the two-week activity for both years, in English. • **ldgp_inf002_B5certificates.pdf**: plantillas de los certificados de participación entregados a alumnos y	:FRAMEWORK

profesores, en inglés / certificates of participation for students and lecturers, in English.

- **ldgp_inf002_C1notebook.pdf**: ejemplo de cuaderno de campo entregado a cada grupo de alumnos para la realización del trabajo de campo, en inglés / example of the notebook handed out to each students' group for the fieldwork, in English.
- **ldgp_inf002_C2dataset.pdf**: (este documento) información sobre cómo prepara los datos una vez finalizado el trabajo de campo para que puedan ser archivados, en inglés / (this document) information about how to prepare the datasets in order to be archived after the work, in English.

Cita completa recomendada / Recomended full citation	
CITA: Various Authors. *Intensive Program ERASMUS: TOPCART. Geometric Documentation of the Heritage (administrative and academic documentation)*. Laboratorio de Documentación Geométrica del Patrimonio (UPV/EHU). 2013	:CITATION

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
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Integración europea de tecnologías

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Classification and storage: preparing your dataset

This document can be downloaded from the section "Storage, classification and archive" of the web page of this project (http://moodletic.ehu.es/moodle/mod/wiki/view.php?id=38975).

July 18, 2010

PROGRAMA INTENSIVO ERASMUS
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Patrimonio
Integración europea de tecnologías

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies
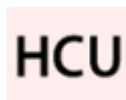
STORAGE AND CLASSIFICATION: Preparing your dataset

1.- Introduction

As we have seen during these days, Heritage is not static; on the contrary, it is subject to continuous modifications and transformations which, at worst, go as far as to their complete disappearance; for this reason, information referring to heritage must be considered in itself like heritage, which implies that it must be maintained able to be used for the future generations.

Fieldwork is the first step, then data need processing in order to obtain the final products: maps, 3D models, orthoimages, etc. Nevertheless we must take into account that probably these ones will not be the most powerful and complete of our results; actually, the 3D models and maps are just a selection of the collected information according to a definite purpose… but, in the future, we might want to re-use the information for a new purpose, consequently it is a good idea to store the original dataset with all the necessary (additional) information that anyone will need to understand it and work with it.

However… what means "re-usable dataset"? To answer this question let us change our point of view and start thinking that maybe we are not the ones who will make the definitive plan of the site, that Heritage goes far beyond the documents we can create about it. Summing up, the Heritage is not there because we want to plot plans or test a new instrument for surveyors (so we are the main actor in this affair); on the contrary, our work should be considered just as a contribution to the knowledge of the monument and should be understood together with the rest of the available information (so the center is the monument itself).

2.- Example

A more complete case will be analysed now: the "Portada de los Hierros" of the Cathedral of Valencia (Spain).

In order to focus briefly the project, we can say that it is a 35 meters high façade which has been documented by means of about 150 laser scans (30 millions of points per scan), the final product is a model of the surface with a point every 5 mm.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

The workflow describes the structure of the work; it shows the fieldwork in red, the office processing in blue and the outputs in green (fig. 1).
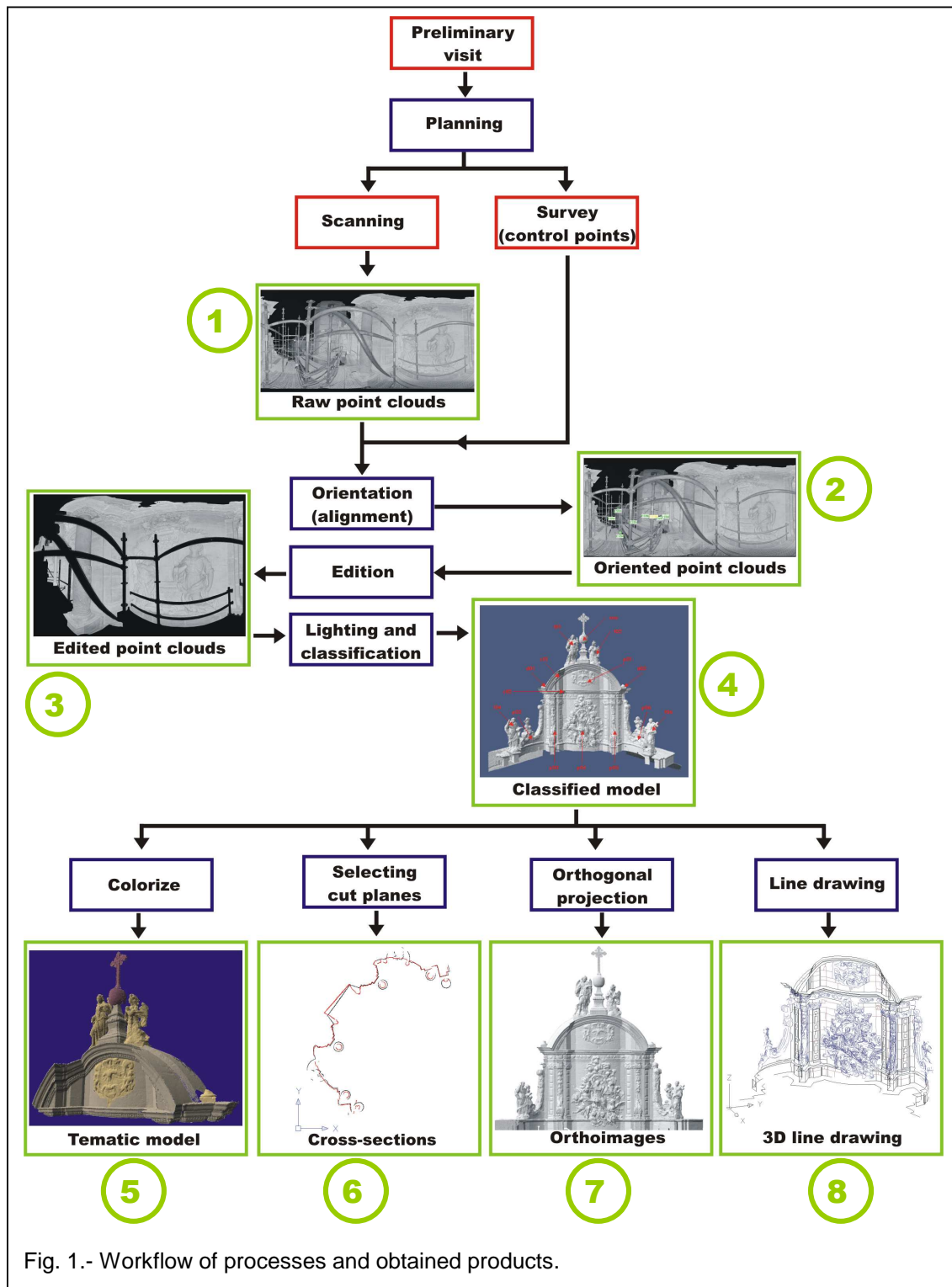

Fig. 1.- Workflow of processes and obtained products.

In this case, the original data are the raw point clouds (1), the coordinates of the control points and the sketches permitting their identification in the scans. The accuracy of the measures will be part of the metatada.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

Scans are oriented (alignment) putting all them in the same coordinate system
(2) by identifying the control points in each point cloud (fig. 2).

Fig. 2.- Scan orientation by identifying the visible benchmarks.

Point clouds go through an edition process in which all the information not
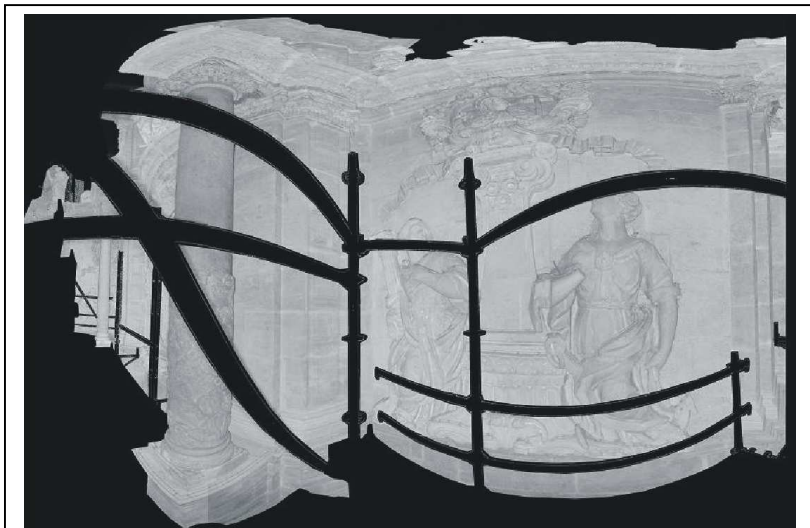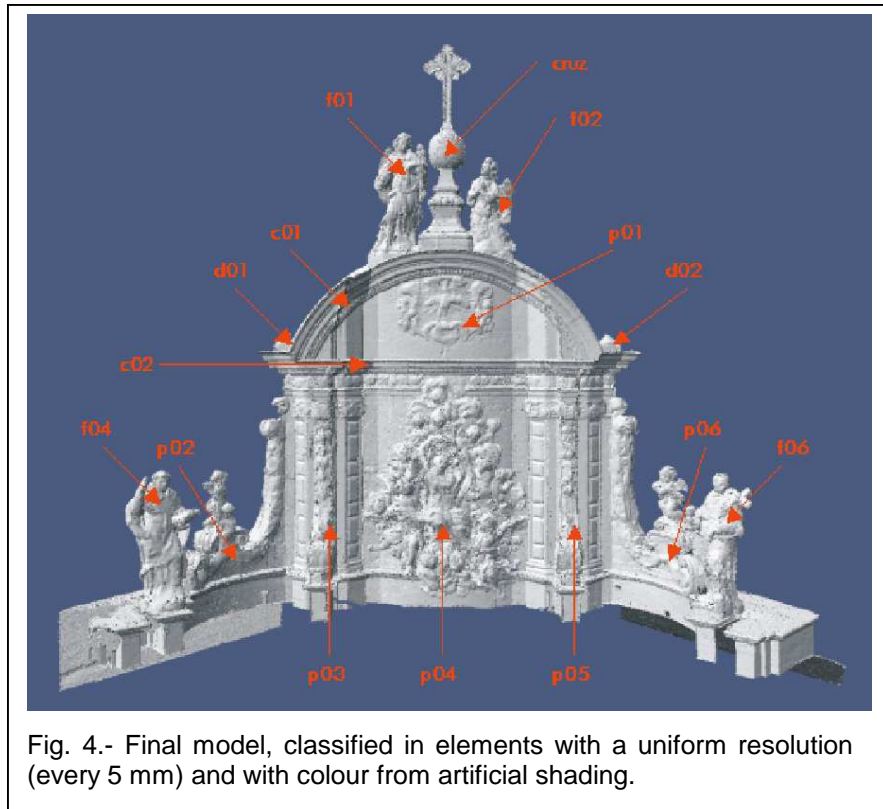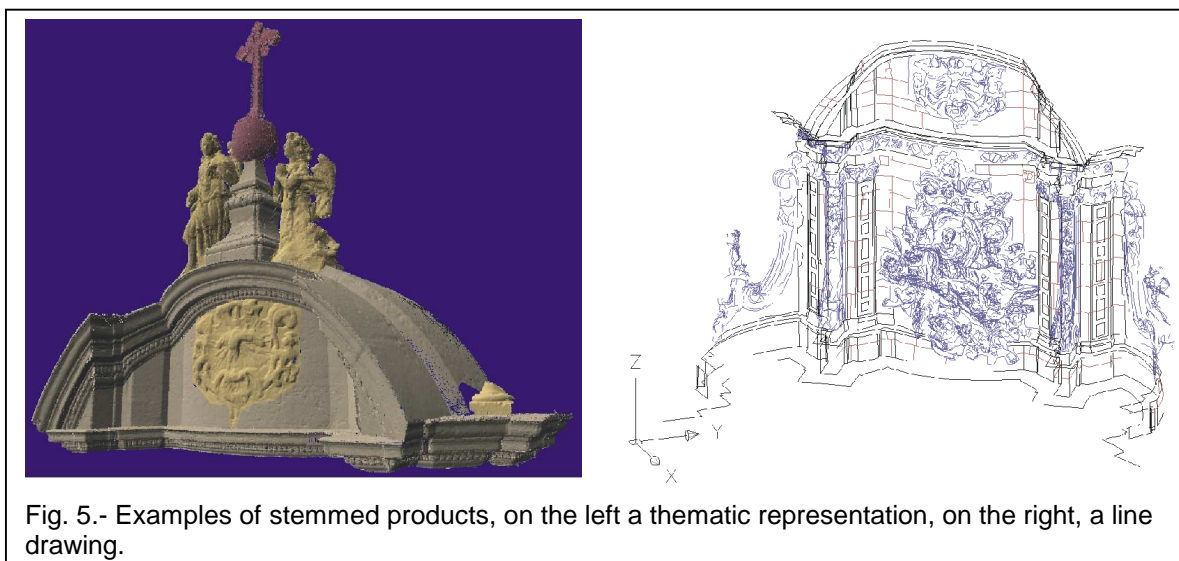related with the object to document is removed: in this case, the façade (3) (fig.
3).

Fig. 3.- During the edition process, all the information not related
with the main object is removed.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

In the next step, we gather all the information about each element on the façade: columns, statues, reliefs, etc (4). For each one, all the available information is added and it is processed in order to generate a single model with uniform resolution (a point every 5 mm). Then, we replace the intensity by a new homogeneous colour by means of an algorithm of artificial shading (fig. 4).

Fig. 4.- Final model, classified in elements with a uniform resolution (every 5 mm) and with colour from artificial shading.

Finally, from this model, the products such as coloured thematic models (5), cross-sections (6), orthoimages (7) or three-dimensional line drawing (8) are obtained (fig. 5).

Fig. 5.- Examples of stemmed products, on the left a thematic representation, on the right, a line drawing.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

As it can be seen, each processing step removes or modifies part of the input data (those not interesting for the aim of the current project) and it obtains a refined product, closer to the aimed objective.

The problem in "re-use" is that we do not know what will be valuable in the future, hence, it is advisable to store the intermediate steps, allowing in that way the possibility of recovering data just before the moment in which they were erased, that is, when they were more refined.

The following table shows a series of hypothetical re-uses no foreseen in the initial project but useful for new researches. The table also shows in which level the project should be resumed.

Table 1.- Examples of re-use and the level of the workflow from which we should resume.

Aim	Level from which the project should be resumed
Obtaining three-dimensional lines of different elements.	Classified model
Producing a new thematic cartography by following different criteria.	Classified model
Generating a new model with different spatial resolution or colour.	Edited point clouds
Re-classifying the façade into different elements.	Edited point clouds
Study of scaffolding systems at the beginning of the 21st century	Oriented point clouds
Ethnographic studies, such as traditional pottery.	Oriented point clouds
Study of the accuracy of algorithms for orientating point clouds.	Raw point clouds

Some of these mentioned uses are illustrated by the following image, as it can be seen that, apart from the façade, it contains information about a craftwork market. All this information will be removed during the edition process since it is not interesting for the actual aim, however, in the future, it can be most interesting for ethnographic purposes or scaffolding systems (fig. 6).
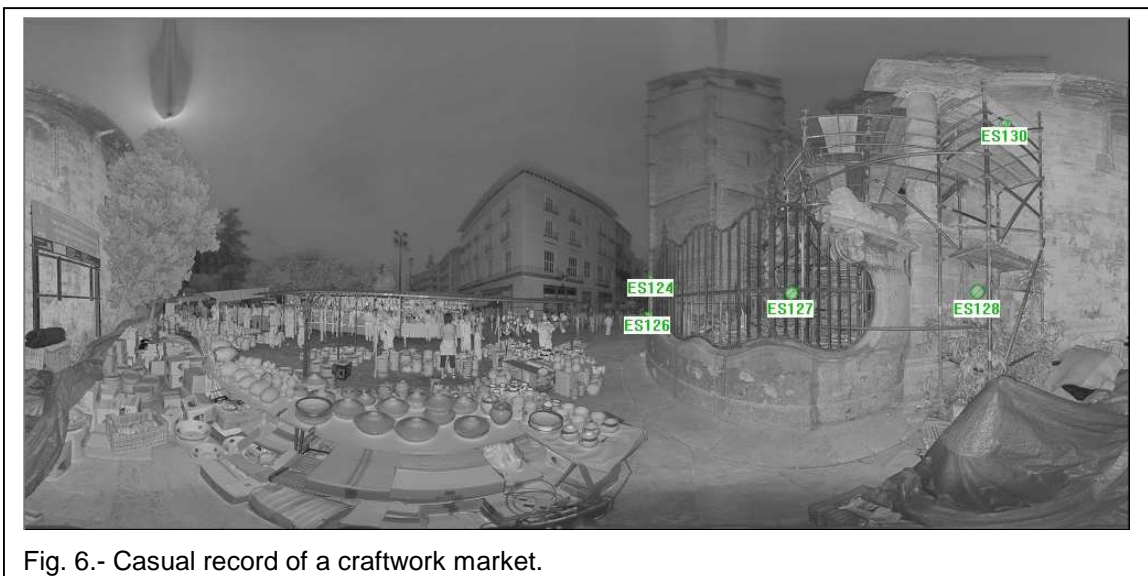

Fig. 6.- Casual record of a craftwork market.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

If we supply many intermediate products, the user will need the workflow which permit them to know the relationships between the elements, since the workflow is the key which arranges the levels of data processing and allows the organised transition through the processes.

On the other hand, each process (transforming the point cloud to the following level) has to be conveniently documented. Here are the parameters which have to be considerer at any rate:

- Process identification: a descriptive name.
- Process aim: what the process intends to do.
- Input data: registers with their technical features, outputs from previous process and complementary information (sensor calibration parameters, sketch with the location of the benchmarks, …).
- Actions performed by the process (description and mathematical background).
- Outputs and their technical features.

3.- Preparing the dataset

On the following pages we will present a template with the information that must be stored for each type of documentation done:

- Z+F laserscan.
- Ilris laserscan.
- Photogrammetry.
- Z-scan.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

DATASET: **Z+F laser scan**	**Checklist**

Instrument:

Do include in the report the model of the instrument and main characteristics. ☐

Include a copy of the last certificate of calibration or verification of the good state of the equipment. ☐

Dataset:

Original (raw) files from the point clouds from the laser scanner. The file naming convention will be: SPR10_gr?_ZFscan_[name or number of scan].[file extension] ☐

(Only if the naming convention is not used). Write down in your report which are the naming criteria and the meaning of each file of the dataset. ☐

Copy of the point clouds in an open format for archival purposes (e.g. an AscII file). The report has to contain a description of any data lost in the conversion. ☐

Description of the file format used for archival purposes. If an AscII file, description of the meaning of each column, if a standard format, copy of the document where the standard is defined. ☐

Tick this box if there is information about intensity of the laser and note down the span of the range of values from _____ to _____ ☐

Tick one these boxes if there is information about photographic texture…
… taken directly over the points. ☐
… as separate images that have to be wrapped (calibration of the camera included). ☐
… as separate images that have to be wrapped (non-calibrated camera). ☐

Control points

Plain text file with (only) the coordinates of the control points. The file name has to be: SPR10_gr?_ZFscan_controlpoints.txt ☐

The names of the control points follow the patterns(*):
…for targets (size aprox. A4) with number: gr?_cpZF_??? ☐
…for targets LDGP (size 4x4 cm) with number: D4_SP??? ☐
… for natural points: gr?_cpN_??? ☐

The coordinates are UTM-ETRS89, heights above sea level. ☐

Sketches

Document with all the necessary sketches to locate the control points in the point clouds and the location of the laser scans, the name of the file has to be: SPR10_gr?_ZFscan_sketches.pdf ☐

Notes:

(*) The name of the control points is the same for all the instruments: scans, photogrammetry, Z-scan, etc. Watch out and do not repeat the name of control points of different days.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

DATASET: **ILRIS scan**	**Checklist**

Instrument:

Do include in the report the model of the instrument and main characteristics. ☐

Include a copy of the last certificate of calibration or verification of the good state of the equipment. ☐

Dataset:

Original (raw) files from the point clouds from the laser scanner. The file naming convention will be: SPR10_gr?_ILscan_[name or number of scan].[file extension] ☐

(Only if the naming convention is not used). Write down in your report which are the naming criteria and the meaning of each file of the dataset. ☐

Copy of the point clouds in an open format for archival purposes (e.g. an AscII file). The report has to contain a description of any data lost in the conversion. ☐

Description of the file format used for archival purposes. If an AscII file, description of the meaning of each column, if a standard format, copy of the document where the standard is defined. ☐

Tick this box if there is information about intensity of the laser and note down the span of the range of values from _____ to _____ ☐

Tick one these boxes if there is information about photographic texture…
… taken directly over the points. ☐
… as separate images that have to be wrapped (calibration of the camera included). ☐
… as separate images that have to be wrapped (non-calibrated camera). ☐

Control points

Plain text file with (only) the coordinates of the control points. The file name has to be: SPR10_gr?_ILscan_controlpoints.txt ☐

The names of the control points follow the patterns(*):
…for targets (size aprox. A4) with number: gr?_cpZF_??? ☐
…for targets LDGP (size 4x4 cm) with number: D4_SP??? ☐
… for natural points: gr?_cpN_??? ☐

The coordinates are UTM-ETRS89, heights above sea level. ☐

Sketches

Document with all the necessary sketches to locate the control points in the point clouds and the location of the laser scans, the name of the file has to be: SPR10_gr?_ILscan_sketches.pdf ☐

Notes:

(*) The name of the control points is the same for all the instruments: scans, photogrammetry, Z-scan, etc. Watch out and do not repeat the name of control points of different days.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

DATASET: **Photogrammetry**	**Checklist**

Instrument:

Do include in the report the model of the camera and main characteristics. ☐

Include a copy of the last certificate of calibration or verification of the good state of the camera. There will be one certificate for each combination of box and lens with the following names (mPH = metric photograph):

mPh01 _____ ☐
mPh02 _____ ☐
mPh03 _____ ☐
mPh04 _____ ☐
mPh05 _____ ☐
mPh06 _____ ☐

Dataset:

Original (raw) files from the images. The file naming convention will be:
SPR10_gr?_mPh??_[name or number of photo].[file extension] ☐

(Only if the naming convention is not used). Write down in your report which are the naming criteria and the meaning of each file of the dataset. ☐

Copy of the images in formats for archival purposes.
DNG ☐
PNG ☐
JPEG ☐

Description of the file format used for archival purposes, if a standard format, copy of the document where the standard is defined. ☐

Control points

Plain text file with (only) the coordinates of the control points. The file name has to be:
SPR10_gr?_photo_controlpoints.txt ☐

The names of the control points follow the patterns(*):
…for targets (size aprox. A4) with number: gr?_cpZF_??? ☐
…for targets LDGP (size 4x4 cm) with number: D4_SP??? ☐
… for natural points: gr?_cpN_??? ☐

The coordinates are UTM-ETRS89, heights above sea level. ☐

Sketches

Document with all the necessary sketches to locate the control points in the images and the location of the shots, the name of the file has to be: SPR10_gr?_photo_sketches.pdf ☐

Notes:

(*) The name of the control points is the same for all the instruments: scans, photogrammetry, Z-scan, etc. Watch out and do not repeat the name of control points of different days.

PROGRAMA INTENSIVO ERASMUS
Documentación Geométrica del
Patrimonio
Integración europea de tecnologías

INTENSIVE ERASMUS PROGRAM
Geometric Documentation of Heritage:
European integration of technologies

Monasterio de San Prudencio del Monte
Laturce (La Rioja), 2009/10

DATASET: **Z-scan Menci**	**Checklist**

Instrument:

Do include in the report the model of the camera and main characteristics. ☐

Include a copy of the last certificate of calibration or verification of the good state of the camera. There will be one certificate for each combination of box and lens with the following names (mPH = metric photograph):

mPh01 _____ ☐
mPh02 _____ ☐
mPh03 _____ ☐
mPh04 _____ ☐
mPh05 _____ ☐
mPh06 _____ ☐

Dataset:

Original (raw) files from the images. The file naming convention will be:
SPR10_gr?_mPh??_[name or number of photo].[file extension] ☐

(Only if the naming convention is not used). Write down in your report which are the naming criteria and the meaning of each file of the dataset. ☐

Copy of the images in formats for archival purposes.
DNG ☐
PNG ☐
JPEG ☐

Description of the file format used for archival purposes, if a standard format, copy of the document where the standard is defined. ☐

Control points

Plain text file with (only) the coordinates of the control points. The file name has to be:
SPR10_gr?_Zscan_controlpoints.txt ☐

The names of the control points follow the patterns(*):
…for targets (size aprox. A4) with number: gr?_cpZF_??? ☐
…for targets LDGP (size 4x4 cm) with number: D4_SP??? ☐
… for natural points: gr?_cpN_??? ☐

The coordinates are UTM-ETRS89, heights above sea level. ☐

Sketches

Document with all the necessary sketches to locate the control points in the images and the location of the shots, the name of the file has to be: SPR10_gr?_Zscan_sketches.pdf ☐

Notes:

(*) The name of the control points is the same for all the instruments: scans, photogrammetry, Z-scan, etc. Watch out and do not repeat the name of control points of different days.