Measuring social capital with Twitter within the electronics

and ICT cluster of the Basque Country

1. <u>INTRODUCTION</u>

The influence of social capital in regional prosperity is acknowledged both in academic reflections and public policies on account of its presence in interactive learning (Lundvall et al., 2002; Westlund, 2006). Innovation is a process that highly depends on communication, since actors operate in a context in which the resources they need to mobilize are shared with others and actually change (Lundvall and Christensen, 2004), and this interaction demands reliance on social capital, via formal or informal networks (Schuller, 2006).

In the background of clusters, modern literature contends that social capital is key to cluster development and if lock-in situations are avoided, firms within clusters may benefit from many factors related with social capital: efficiency of action and information diffusion (Burt, 1992), lower costs of monitoring processes and transactions (Malmberg, Sölvell and Zander, 1996), plus a better co-ordination because of direct contacts and often trust-based relations among economic agents (Porter, 1998). In this respect, Rosenfeld (2003) states that social capital in clusters leads you to the "know-who" that allows you to build the "know-how".

According to Nahapiet and Ghosal (1998), social capital has three interrelated dimensions: structural, relational and cognitive. Following other works (Boschma and Ter Wal, 2007; Giuliani, 2007; Ter Wal and Boschma, 2009) this paper constitutes an attempt to measure social capital through Social Network Analysis (SNA) in order to map the linkages both at the structural and relational dimension, and understand the nature of these ties at bonding, bridging and linking level.

This study targets the electronics and ICT cluster of the Basque Country[1], one of the most dynamic clusters among the twenty-two that currently integrate the Basque cluster policy.

This policy, started in the early 1990s, has long been maintained until now and one of its pillars was the creation of several cluster associations (CA, henceforth), institutions for collaboration whose objective was to improve each cluster's competitiveness by facilitating cooperation among their affiliated members and key agents of the industrial and innovation policies of the region (Aranguren and Navarro, 2003; Aranguren et al., 2010). Even though the first efforts to assess the influence of CAs do not provide conclusive evidences (Aranguren et al., 2014), there is a broad agreement about the positive effects of these CAs on innovation, human capital formation and internationalization of their affiliates, and on soft outcomes such as the creation and promotion of social capital and trust-based relationships favourable for competitiveness and economic growth (Valdaliso et al., 2011; Aragón et al., 2014; Aranguren et al., 2014).

In the Internet era, Social Network Sites (SNSs) can be used as another means to spread information and build a network of contacts. These Computer-Mediated Communication (CMC) platforms allow individuals to introduce themselves, articulate their social networks, and establish or maintain connections with others. Although exceptions exist, the available research suggests that most SNSs primarily support pre-existing social relations. The online social network application analysed in this article, Twitter, is a real-time information network that connects users to the latest information using micro-blogs (messages which contain a maximum of a 140 characters[2]). The service presents itself as a new application for moving and finding information at an extremely rapid pace, and it is said to be a more and more important tool for electronic word-of-mouth communication (eWOM) (Jansen et al., 2009).

This paper focuses on three research questions. The first and second aim to verify if Twitter might be used in order to explain structural and relational social capital in clusters, respectively. Likewise, the third question attempts to infer the information shared among the affiliates and check if it matches with the main issues accomplished in the cluster. From the total population of organizations that belong to GAIA, I have identified 160 that have an active Twitter account and a map of relationships has been made depending on who is following who and who is followed by whom. Afterwards, Twitter's openness and flexibility allowed us to develop an application programming interface (API) to extract almost 263,000 tweets related to these 160 users and finally an analysis was performed elaborating quantitative data. Data collection was performed in two moments: February and August 2016. Sources of the CA were also contacted on 19 September 2016 within an interview conducive to obtain some more evidences that have upgraded the investigation.

The paper is structured as follows: the second section provides the theoretical background on social capital and explains how the Internet is converted as a new means to promote social capital. The third section introduces cluster initiatives as drivers of social capital and the particular performance of GAIA. The fourth section presents the methodology and data and later on the empirical study is carried out. The fifth section is dedicated to a contextual discussion where the most meaningful interpretations are emphasized. Finally, the main conclusions of my research are mentioned in the sixth section.

2. THEORETICAL DISCUSSION

Social capital

Many researchers affirm that network relationships among co-located firms play a key role in supporting innovation and competitiveness (Porter, 1998; Schmitz and Nadvi 1999;

Eisingerich, Bell and Tracey, 2010). For example, the impact of cluster initiatives on the performance of firms is based theoretically on collective dynamics and relationships that spur innovation or learning (Aragón et al., 2014). Accordingly, 'soft' attributes such as the atmosphere of the cluster are important assets that facilitate collaboration and trust among cluster members, promoting joint activities (Fromhold-Eisebith and Eisebith, 2008). In this sense, network policies attempt more and more to set a social infrastructure with a high presence or creation of social capital.

Although social capital seems to be a key factor in regional development (Malecki, 2012), there is little consensus around what should be understood with it (Inkeles, 2000). The most comprehensive definitions of social capital are multidimensional (Putnam, 1995; Nahapiet and Ghoshal, 1998), incorporating certain elements that have been given different emphasis depending on the perspective of each author (Adler and Kwon, 2002; Lorenzen, 2007). The literature offers three main interpretations:

a) From an individualistic viewpoint, social capital is an "individual resource" found in networks of relationships of a person and his/her associated expressive and instrumental means (Bourdieu, 1986).

b) A second perspective considers social capital as a "community resource", a set of attributes and properties present in the social structure (i.e. shared norms and values, personal trust) that facilitate operation and collective action (Coleman, 1988).

c) Finally, for the macro approach, social capital is a "macro-social and macro-institutional resource" that, built upon issues such as citizenship, general confidence and social cohesion, lubricates the economy and the society (Putnam, 1993).

The disparity of attributes encompassed by social capital, its presence in the micro and macro spheres and the wide range of effects that it generates, result in a complex and discussed concept often criticized for its ambiguity. Given the need to refine this notion, some authors dared to identify two characteristics that all perspectives have in common: some aspects of social structure (Aragón et al., 2014), and the capacity to facilitate certain interactions of agents within that structure (Coleman, 1988)[3]. In this line, Nahapiet and Ghoshal (1998) stated that social capital is the result of complex interrelations and interdependencies between the structural (overall pattern of connections), relational (personal relationships) and cognitive (common context) dimensions. Further, Woolcock (2004) mentioned three types of relational assets that people have access to: bonding social capital (immediate family, friends, and neighbours), bridging social capital (more distant colleagues and associates) and linking social capital (connections to people in positions of authority).

In this paper, I employ a wide concept of social capital that considers all the elements constituting a resource to achieve cooperative outcomes. More particularly, due to my interest in social capital as both an underlying foundation for clustering policies and an outcome of such policies, my goal is to analyse relations among associated actors within a network and the features that give cohesiveness and help to reach collective objectives.

Social Capital and Internet

Since the Internet Revolution, researchers have started to explore the possibilities of CMC to build social capital among users. For example, Nie (2001), contended that Internet use reduces face-to-face time with others, which may decrease an individual's social capital. Nonetheless, this viewpoint has been heavily criticised and some researchers have argued

that online communication might supplement or replace personal interactions, diminishing any loss due to the time spent online (Wellman et al., 2001). Moreover, communication over the Internet appears to be a complement to face-to-face social interactions rather than a substitute for it. Research in this vein has investigated how online interactions interface with offline ones, and studies of communities supported by virtual networks, such as the Blacksburg Electronic Village or the Netville community in Toronto, concluded that CMC had a positive repercussion on community involvement and social capital (Hampton and Wellman, 2003).

SNSs are social communities of the web, connected via electronic mail and networking applications that are hosted in websites. These tools allow individuals to present themselves, articulate their social networks, and establish or maintain connections with others (Ellison, Steinfield and Lampe, 2007). They can be oriented towards work-related contexts (e.g., LinkedIn.com), romantic relationship initiation (e.g., Meetic.com, Badoo.com), microblogging (e.g. Twitter), some particular fields such as music (e.g., MySpace.com, Bandcamp.com) or the college student population (the original goal of Facebook.com).

What makes SNSs unique is not that they enable users to meet new people, but rather that they allow individuals to maintain existing offline relationships. On many of the large SNSs, participants are not necessarily ''networking'' or looking to meet strangers; instead, they are primarily communicating with people who are already a part of their extended social network. To emphasize this articulated social network as a critical organizing feature of these sites, Boyd and Ellison (2007) label them ''social network sites''. This is one of the main aspects that differentiate SNSs from earlier forms of public CMC (Ellison, Steinfield and Lampe, 2007).

Researchers have emphasized the importance of Internet-based linkages for the formation of weak ties, which serve as the foundation of bridging social capital. Resnick (2001), for example, suggests that new forms of social capital and relationship building will arise in SNSs because online relationships may be supported by technologies like distribution lists, photo directories, and search capabilities. Donath and Boyd (2004) speculate that SNSs could largely increment the number of weak ties a user could create, because the technology is well-suited to maintaining these ties cheaply and easily. Thus, bridging social capital might be increased by such sites which support loose and latent social ties, enabling users to form and retain larger, diffuse networks of relationships (Wellman et al., 2001).

In an article written on the electronics and ICT cluster of the Basque Country, Valdaliso et al. (2011) suggest that social networks may promote the creation and diffusion of intra-cluster knowledge linkages, but at the same they acknowledge the difficulty to measure this indicator due to the intangible nature of these formal and informal networks. This paper constitutes an original effort to overcome this obstacle and dares to map social networks within GAIA at the structural and relational dimension.

The combination of a growing interest concerning this particular subject together with the existence of some limitations of previous research mentioned above allowed me to propose three research questions that will be addressed in the following sections of this paper:

RQ#1: Can Twitter be used to reflect the existence of structural social capital in clusters? In particular, in the case analysed (GAIA), what are the underlying patterns of connection among the overall population of cluster affiliates, and who are the most networked organizations?

RQ#2: Can Twitter be used to understand relational social capital in clusters? Specifically, what is the relational embeddedness that GAIA associates have developed with each other through a history of real interactions, and who are the most active organizations?

RQ#3: Can Twitter be a trustful tool to identify the information that is shared in the cluster? Notably, what is flowing among the most relevant actors of the GAIA network and to what extent differs from the main topics addressed in the cluster?

3. CLUSTER INITIATIVES AND SOCIAL CAPITAL

Cluster policies aimed at nurturing and supporting cooperative relationships among economic agents have been increasingly employed in Europe during the last two decades. They are a classic example of a 'soft policy'; instead of dealing with subsidies for specific production- or innovation-related activities, they try to promote a general atmosphere conducive to cooperative relationships between agents (Aranguren et al., 2014).

The majority of these cluster policies provide financial, infrastructural and/or technical support for the formalization of cooperative relationships between agents in some form of association or network. Indeed, many clusters are built around institutions whose main objective is to improve each cluster's competitiveness by facilitating and fostering cooperation/collaboration among their members, including firms, research centres, universities, government, and so on. Such institutions are, of course, not only associated with cluster policies; some have long been present in the form of trade associations, entrepreneurial networks, industry associations, etc. (Aranguren et al., 2014). Actually, cluster initiatives, or CAs, can be started by companies, universities, or government agencies, but research shows that this fact is not so relevant. Their success depends on the

active role of all agents in collaborating and searching common objectives (Sölvell, Lindqvist and Ketels, 2003; Ahedo, 2004; Fromhold-Eisebith and Eisebith, 2008; Aranguren et al., 2010). In this sense, different empirical studies have pointed to cluster and trade associations, and other institutions for collaboration as drivers and enablers of social capital formation in their respective regions (Carbonara, 2002; Giuliani and Bell, 2005; Aranguren et al., 2010; Valdaliso et al., 2011; Aragón et al., 2014; Aranguren et al., 2014).

Cluster Associations in the Basque Country

The Basque Country is an old industrial region located in the North coast of Spain that transformed its economy during the 1970s and 1980s, achieving in the 2000s per capita income and productivity levels much higher than those of Spain and above the EU average (OECD, 2011). From the 1980s on, its regional government owns important policy competences and the highest degree of financial autonomy in the EU (Morgan, 2013; Magro, 2014). Besides, Cooke, Boekholt and Tödtling (2000) argue that it is one of the few European regions that can be considered a truly Regional Innovation System (RIS).

In the early 1990s, the Basque Country pioneered in Europe a cluster policy that has long been maintained until today. One of the vital elements of that cluster policy was the creation and support of CAs, institutions that focus their efforts on promoting firm cooperation (particularly in research activities), improving the cluster business environment and strengthening the innovative capacity of member firms. They also assist the internationalization process through presence at international fairs, joint commercial missions to emerging markets, and creation of export consortia. In 2006, the firms formally affiliated to CAs accounted for 28% of Basque employment and 32% of the gross value added of industry (Orkestra, 2009).

GAIA, the CA that is studied in this paper, is the Association of industries for electronics and ICT of the Basque Country. It is a non-profit, private and professional entity, currently integrated by more than 260 companies, that pursues the assimilation and efficient usage of the sector's technologies with the aim of collaborating in the development of the Information and Knowledge Society. It was established in 1983 when the regional government sponsored the creation of AIEPV[4], an industry association which promoted networking and inter-firm cooperation in three fields: labour formation, research activities and internationalization. AIEPV transformed into a Cluster Association of electronics and ICT industries in 1996. This change was the outcome of the sheer technological convergence among electronics, software and telecommunication technologies, on the one hand, and of the efforts of regional government to promote an ICT cluster in the Basque Country, on the other. In the last 20 years, the electronics and ICT cluster of the Basque Country has experienced a remarkable growth in terms of number of firms, employment and turnover. In 2015, the GAIA firms' turnover accounted for near 5% of Basque GDP and 19% of regional industrial product, when 30 years before the respective figures were 0.7 and 1.9% (GAIA, EUSTAT)[5]. The performance of GAIA firms in terms of research intensity, employment qualifications and internationalization is better than that of non-associated ones (Valdaliso et al., 2011).

4. **METHODOLOGY AND DATA ANALYSIS**

Starting in the 1990s, networks have acquired a great attention in regional economics and economic geography (Grabher, 2006). Only lately, SNA techniques have been used in order to examine the structure of interaction in regions and geographical clusters. Thus, more and more scholars attempt to measure social capital through SNA, a promising qualitative and

quantitative tool for empirically investigating the structure and evolution of inter-organizational interaction and knowledge flows within and across regions (Ter Wal and Boschma, 2009).

In general terms, SNA is considered to be something more than a simple methodological approach. It is a different way of envisaging the society and the economy, and it is based on the assumption that relationships among interacting actors are important to explain their nature, behaviour and outputs (Giuliani and Pietrobelli, 2011). Nevertheless, SNA is not only a visualization, descriptive or exploratory tool. While rich in qualitative details, SNA has also a very important role to play in impact assessment analysis as it generates highly valuable quantitative network indicators both at the level of the firm (or other relevant unit of research) as well as at the cluster level, which can be used in econometric estimations (Giuliani and Pietrobelli, 2011).

Moreover, SNA has the potential to contribute further to the investigation of regional innovation systems (Cooke, 2001). With social network methodology, they can be studied more systematically by mapping the network relations of leading agents with other agents (like research institutes, educational facilities and capital suppliers) within and outside the region. Thereby, relevant information is gathered on how well these major organizations are connected, and at what spatial levels (Ter Wal and Boschma, 2009).

Twitter as a proxy of the GAIA network

Twitter is an online social networking service that has been described as "the SMS of the Internet" because it enables users to send and read short 140-character messages called "tweets". It was created in March 2006 by Jack Dorsey, Evan Williams, Biz Stone and Noah

Glass and the service rapidly gained worldwide popularity. According to Wikipedia, in 2013 Twitter was one of the ten most-visited websites and as of May 2015 it had more than 500 million users, out of which more than 302 million were active users.

In a research performed about word-of-mouth communication on Twitter, Jansen et al. (2009) found that around 19% of the posts mentioned the name of a brand, product or service and over 50% of them were positive tweets (only one third were negative). More than half of the people who log in to Twitter each day do not tweet themselves, but simply sign in to read about what is happening in their world, and this can influence consumer attitude and behaviour. Indeed, companies are so involved in social media because this new form of electronic word-of-mouth is approximately 20 times more effective than marketing events and 30 times more effective than media appearances (Trusov, Bucklin and Pauwels, 2009).

The popularity and success of Twitter has lead many researchers to analyse the rich dataset created by messages posted to this microblogging system. The early works were mainly quantitative studies and focused on the properties relating to the domains of user and message, and little by little a new set of papers included linguistic and semantic analysis of tweets (as I do in this paper). After a decade from its foundation, there are more than one thousand research publications that rest on Twitter, in areas such as politics and government, business, education, health community and journalism (Williams, Terras and Warwick, 2013).

The reason to choose Twitter for this paper is based on several assumptions. To start off, I think that measuring social capital in GAIA with Twitter would have sense due to the fact

that companies affiliated to this association are involved in electronics and ICT, and thus they might be familiar with the use of this application. In fact, almost 63% of GAIA associates are logged in Twitter and therefore the way they interact in this platform might be representative to map their network of connections.

But why Twitter and not another SNS tool? Firstly, because unlike Facebook or LinkedIn, the default setting for tweets is public, which permits people to follow others and read each other's tweets without giving mutual permission. Additionally, the Twitter application program interface (API) is easier to access since it allows the integration of Twitter with other web services and applications. And finally, I concluded that Twitter is more suitable to study businesses; while LinkedIn can be more oriented towards individual work-related contexts and Facebook might focus on friends and family, Twitter is a very popular service for businesses to enter the social media arena and one of the best social tools empowering the brand to connect with customers.

In this paper, Twitter is used as a proxy to measure social capital among GAIA associates in two different ways: when answering the first research question, the declared intention to follow somebody (and to be followed by others) is inferred as an indicator for the structural social capital within the electronics and ICT cluster. Nevertheless, the intention does not guarantee any interaction (somebody may have lots of following/followers without any communication flow at all), so only analysing the last tweets of all users we can have a picture of how they contacted each other via Twitter, which is considered as a magnitude of relational social capital in the second research question.

To collect the data, I looked for usernames related to GAIA affiliates in the Twitter searching tool and I e-mailed those ones that apparently were not Twitter users to kindly inform me if they had an active account. Finally, I got 160 usernames out of the 254 affiliates in GAIA in December 2015 (62.99%).

Data analysis

For the first research question, I opened a new account in Twitter (@vcpetiri) and I clicked the option "follow" for each one of the above mentioned 160 organizations. After, I visited the profile of all these users and I checked which other GAIA affiliates they were following (it was quite easy because Twitter directly shows you this account's followers from your following list) and with all this information I elaborated a non symmetric 1 mode matrix. The resulting network is the following one:

Figure 1: Network of following-followers
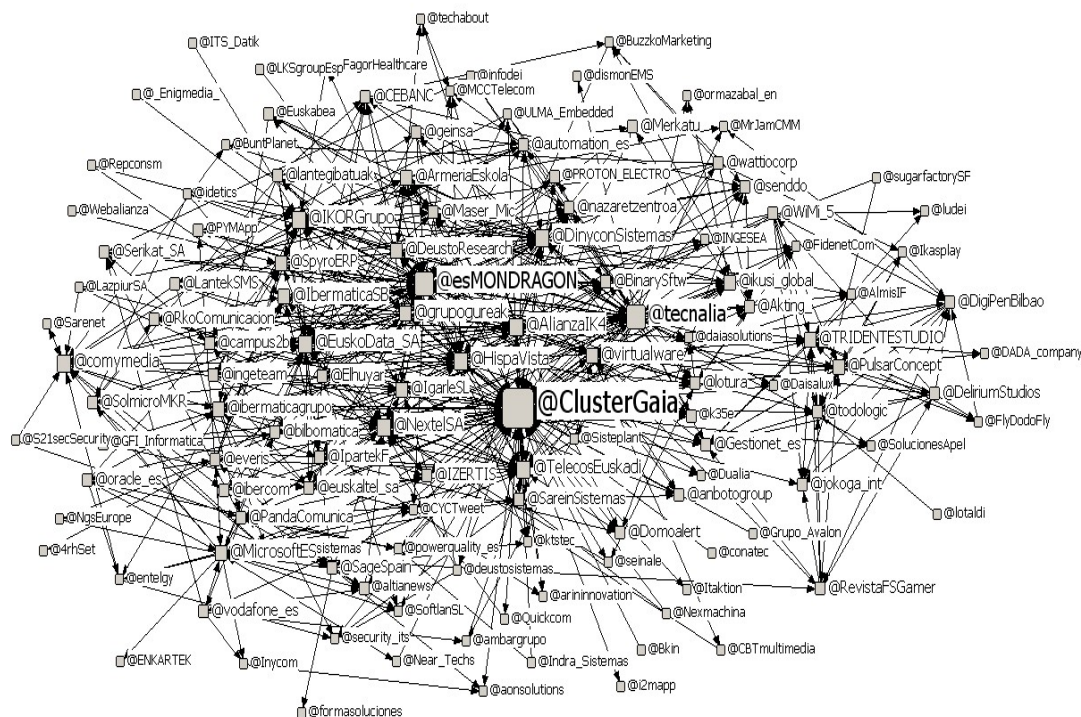
Source: author's elaboration, using UCINET 6 (Borgatti, Everett and Freeman, 2002) and NetDraw (Borgatti, 2002). Note: node and label size represent degree centrality (in + out). Figures 2 and 3 have been designed alike.

As it can be seen in appendix 1, the most connected agent considering GAIA-GAIA relationships is Cluster GAIA, the Twitter account of the CA. Despite it has less followings/followers as a whole compared to other usernames (e.g. Microsoft or Hispavista), it is pretty much concentrated on the GAIA network. In fact, it is in the first place in terms of betweenness centrality, which indicates that it is the main actor connecting other GAIA members that will be otherwise disconnected. As a result, it has the highest eigenvector centrality, which means that Cluster GAIA is the central node of that network. Tecnalia and IK4, the two principal research centres of the Basque Country, are also remarkable actors in the GAIA network, together with companies such as Mondragon Corporation, Ikor or Dinycon Sistemas.

For the second research question, I built a REST (Representational State Transfer) API that provides a programmatic access to read approximately the last 3,200 Twitter posts of each user. This way, 161,568 tweets[6] were extracted in February 2016 and downloaded in a database. Later on, some calculations were made in order to see who the most active users in different fields are.

In appendix 2, I show GAIA usernames by mentions and retweets[7] sorted by total degree (in and out). As it can be seen, there are several active actors sending and receiving references, some in fact reaching a wide range of usernames (e.g. Microsoft, Euskaltel or Vodafone). But as far as GAIA network is concerned, the most connected actor is again Cluster GAIA since it

is the main bridge node and the most influential one, followed by Tecnalia, Virtualware, Ibermatica and IK4. This is the subsequent graph:

Figure 2: Network of interaction through mentions (last 3,200 tweets of each user)
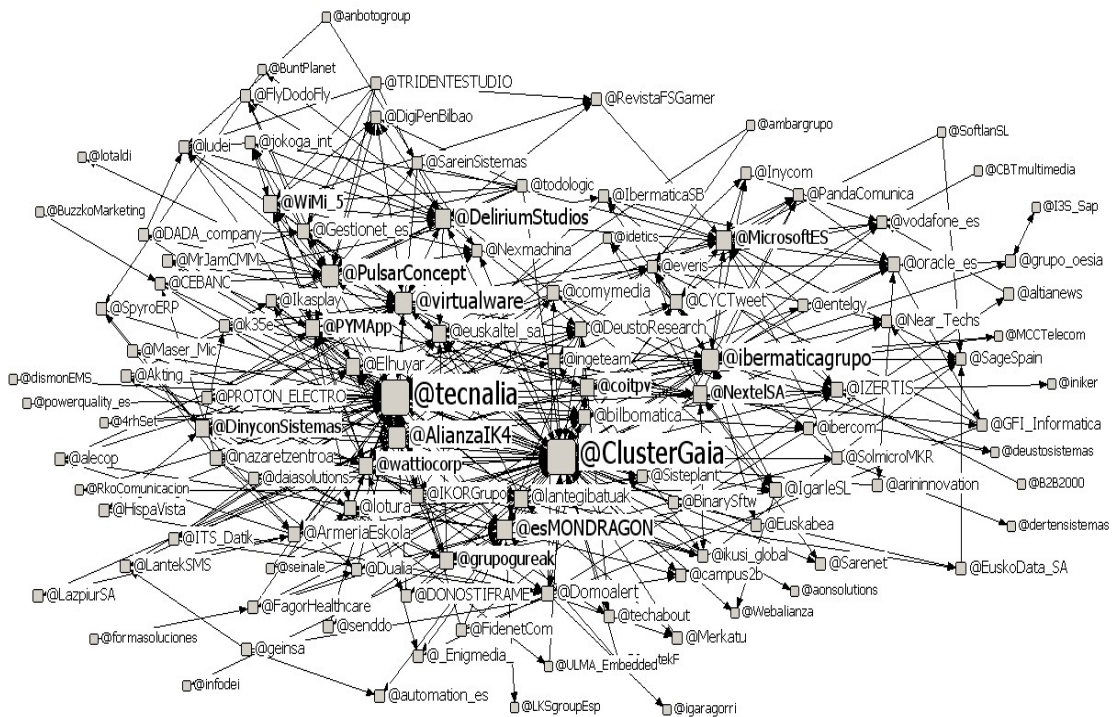
Unlike the following/followers standing, patterns of interaction in Twitter are more dynamic since they may change quite rapidly, and that requires looking at the network at different moments in time. Therefore, I ran a Streaming API[8] and compiled a second sample of 101,203 tweets between 18 April and 31 August 2016, resulting in the oncoming graph (data showed in appendix 3):

Figure 3: Network of interaction through mentions (April-August 2016)
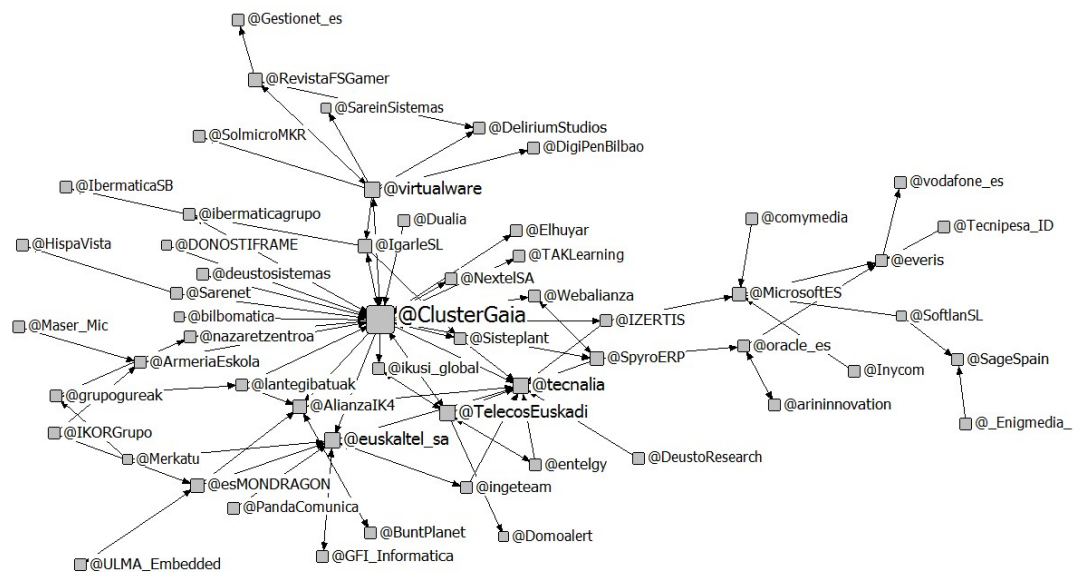
This is a clearer and smaller nebula, quite well articulated though. Cluster GAIA is once again the central node, creating up to 12 cliques in collaboration with some well connected actors (Tecnalia, Euskaltel, etc.). Similarly, there are others that, despite having a low degree, open up new channels to connect the core with several subgroups in the periphery (i.e. Virtualware, Izertis or Spyro).

Yet, even though it is not alluded in the research questions, it must be noted that GAIA members also contact other users that do not belong to the association but tweet about topics related to electronics and ICT and hence should be taken into account. In appendix 4 I present the principal non GAIA actors in receiving mentions (in quantity and diversity) based on sample 1. The University of Deusto and, to a lesser extent, the University of the Basque Country are top actors, together with some institutions like Innobasque (Basque Innovation Agency), Adegi (Association of Entrepreneurs of Gipuzkoa) or SPRI (Society for the Promotion of Industry of the Basque Government). Mass Media (@ap, @el_pais, @diariovasco, @expansion, @expansioncom, @elmundoes, @elcorreo_com,

@eleconomistaes, @eitb), online communities (@youtube, @tic, @xataka, @ticbeat, @mkdirecto, @wwwhatsnew, @puromarketing), individual users related to some companies (@txemafranco from Lantegi Batuak, @artmonedero from Delirium Studios or @juanliedo from Ibermatica) and some individual users (@alfredovela, @tuitsdegabriel, @asadapi, @antoniosanto) have been echoed, too.

Furthermore, it might be interesting to find out which non GAIA users are mentioning associates. As seen in appendix 5 (which has been built on sample 2), in general, the most active actors are individuals that mention or retweet exclusively the firm where they are working or even running. If attention is paid on the diversity of affiliates mentioned, the ranking changes completely and in this case, the majority of usernames represent organizations such as journals, public institutions, research centres or other cluster entities.

Finally, to answer the third research question, I present in appendix 6 the most repeated hashtags[9] and words within the studied tweets. As we can see summarized in Table 1, users mostly talk about technology, Internet and its applications, cloud computing, big data, innovation, entrepreneurship, companies, customer service and marketing.

Table 1: Most repeated hashtags and words (in italics, hashtags and words in Spanish)

Topic	Hashtags	Words
Technology	#BtMS, *tecnologia*, *#TI*, *#TIC*	*tecnología*
Internet applications	#app(s), #Facebook, #Google, #Oracle, #Android, #internet	app(s), Google, Microsoft, internet, Facebook, Apple, Twitter, *aplicaciones, Samsung, movil*

Cloud computing, big data	#cloud, #BigData, #IoT, #cloudcomputing, #PostPC	web, online, sistema, digital, datos, redes
Innovation, entrepreneurship	#innovacion, #reimaginaeltrabajo, #emprendedor/a	*nuevo/a*, new, *proyecto*
Company	*#empresa(s), #pyme(s)*, #startup	*empresa(s)*, business
Customer service, marketing	#ecommerce, #CustomerService, #custserv, #Marketing	*servicio*, service, customer, marketing
Place	*#Donostia, #Bilbao, #Eibar, #Madrid*	*internacional, España, nacional*
Broadcasting	*#infografia*, #infographic, *#musica*, #music, *#videojuego(s)*	video
Social media	#SocialMedia, #SocBiz	*social*
Education, training	*#educación, #formación, #FP*	*jornada, curso, formación, evento*
Security	*#seguridad*	*seguridad*

5. DISCUSSION

Centrality in previous figures provides some nodes with certain benefits. Let's explain them based on a simple example introduced in Figure 4:

Figure 4: Contextualizing centrality in Twitter
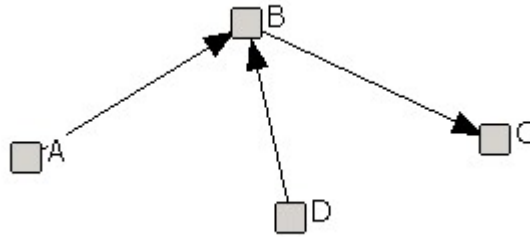
At the structural dimension, if A follows B, A can see that B is following C and equally D is following B. This information can be useful to expand the network of contact for A (A may be interested in C and D and can start following them). And at the relational dimension, without changing its network of contacts, A will be informed about every single action B is performing in Twitter, and it is especially important from the bridging point of view that A will automatically get all retweets of B (in this example, originally written by C) without following C (and sometimes even not knowing it).

Another finding is that, although Figure 1 and 2 describe different dimensions with distinct characteristics, central actors are similar in both networks. Indeed, as illustrated in Table 2, having lots of followers/followings (especially the former) is tightly associated with the number of mentions (in and out), even if exceptions exist. Thus, there is a sort of relation between the 'pipelines' of the GAIA network and the flow of information and knowledge that share the nodes. Likewise, available data show a positive correlation between being active in Twitter and receiving some kind of response, both in terms of structural social capital (the more followers you have, the more followings you have) and relational social capital (the more mentions you make, the more mentions you receive).

Table 2: Pearson correlation coefficient[10]

	FOLLOWERS	FOLLOWING	MENTIONS IN	MENTIONS OUT	TWEETS	Followers	Following	Mention in	Mentions out
FOLLOWERS	1								
FOLLOWING	0,9256	1							
MENTIONS IN	0,0829	0,0648	1						
MENTIONS OUT	0,2633	0,2338	0,7912	1					
TWEETS	0,3109	0,3099	0,5643	0,7921	1				
Followers	0,1367	0,2599	0,4856	0,3861	0,3999	1			
Following	0,0544	0,1518	0,2270	0,2223	0,2733	0,7882	1		
Mention in	0,1495	0,2691	0,5791	0,4872	0,4600	0,8879	0,5836	1	
Mentions out	0,0046	0,0882	0,5979	0,5817	0,4911	0,7525	0,6948	0,7581	1

The dynamic study of interactions reveals the predominance of some central actors that form the heart and principal arteries of the system. Nevertheless, it is also noticeable the presence of a changing bunch of organizations with different features (some of them tweet a lot while others write less tweets but more diversified) that give cohesion to the network, linking usernames that otherwise would not be connected and sometimes even creating hubs in the shape of triads.

Obviously, GAIA network is not isolated and is in contact with the whole Twitter universe. When it comes to the inputs, data in sample 2 show that there are some individual users that exclusively retweet the company they belong to, broadening info related to the firm as it were a marketing campaign. Despite their high amount of tweets, they are not meaningful for the GAIA network. More attention ought to be placed upon few amateur users that cite a wider variety of associates.

Another big trend is identified in outgoing messages, since GAIA members vastly mention Mass Media when they publish news related to electronics and ICT. Again, this tendency should not be overestimated since, generally speaking, it is about trivial information of public interest which is not directly related to the cluster. From a critical perspective, it is more interesting to observe (i) how users tend to interact with other users in their bonding area (for example, other firms from the same entrepreneurial groups) or even the linking sphere (connections with local authorities); and (ii) the more personal content of these tweets.

Lastly, as for the semantic part of the analysis, I contrasted the most repeated hashtags and words listed in Table 3 with the main topics compiled from the news section in the webpage of GAIA[11], and what I found is that the majority of words and firms are pretty much the same, but not the themes: in Twitter they talk more on technological issues (BtMS, ecommerce, BigData, etc.) whereas news at the homepage are more informative. This finding could enhance the role of Twitter as a platform to share explicit knowledge.

6. CONCLUSIONS

Getting over some constraints broadly stated in the literature, this paper constitutes an original attempt to measure social capital within the electronic and ICT cluster in the Basque Country through Twitter, one of the most popular microblogging services nowadays. 62.99% of the associates owned an active account in February 2016 so I assume the way they interrelate in Twitter can be representative to map their network of connections.

The analysis performed at the structural and relational level reveals a strong correlation, intra and inter dimensionally. Particularly meaningful is the relation between intention and interaction in Twitter use at the GAIA network (GAIA members vs. GAIA members): the most following/followed GAIA users are the most active organizations, because there is a positive correspondence between followers and incoming mentions (very high correlation), and also between followings and sent mentions (high correlation). In other words, once a GAIA username is followed by another GAIA affiliate, a real contact should be expected through mentions. These tight relations could be explained thanks to the social and organizational proximity of the association, but other reasons may be involved as well (their geographical proximity or simply the interest to share information about electronics and ICT).

As for the nodes, Cluster GAIA is a highlighting actor and, adopting the metaphor of Anderson and Jack (2002), clearly acts as glue and a lubricant: the glue that binds to create a network plus the lubricant that eases and energizes network interaction. The two principal research centres of the Basque Country (Tecnalia and IK4) also are relevant actors of the structural and relational social capital, along with some private companies like Virtualware, Ibermatica, Pulsar Concept or Delirium Studios. Finally, if we have a broader perspective and consider non GAIA users too, other stakeholders such as universities, institutions, Mass Media, online communities and several individuals orbit the cluster.

I suggest that the most connected agents play a dual role. Primarily, they act as bridge nodes, helping to set relations among others who previously did not interact with one another and thus fostering not only the bridging but also the bonding and linking social capital of the whole cluster. Apart from that role, they also operate as gatekeepers of knowledge and information (e.g. technology, Internet and its applications, cloud computing,

big data, innovation, entrepreneurship, companies, customer service and marketing) that is flowing among the relevant actors (Morrison, 2008). Gatekeepers provide each of the agents with a connectivity function that enables them to avoid the cost of maintaining side-by-side relations (Rychen and Zimmermann, 2008). This requires a high level of absorptive capacity (Zahra and George, 2002) but on the other hand endows the gatekeepers with a high level of relational capital.

This paper contributes to the literature on social capital in two different ways. First, I present the Twitter network as a valid proxy to measure social capital, especially for clusters related to Computer Sciences and Telecommunications. In this sense, I believe that the fact that the main topics listed in Table 3 are directly related to the activity of the cluster adds some extra value to the representativeness of Twitter as a proxy of social capital and particularly reinforces the significance of the samples that have been used in this examination. And second, I give the preliminary results of this empirical exercise conducted on the Basque Country, mapping for the first time the structural and relational linkages of users that belong to GAIA, which may be a first step in order to improve the connectivity of the affiliates and the regional cluster policy itself.

Limitations to this study include that some associates may not be taken into account because they are not in Twitter. It is well known that some firms do not publicly own an account in this network, but workers and entrepreneurs (often using an anonymous profile) follow colleagues and competitors. In practice, it implies a real flow of information but it is almost impossible to track these interactions due to their hidden status. Apart from Twitter (by far the most used platform according to GAIA sources), there are other channels of communication in GAIA too, such as an extranet called WikiGAIA, a list of e-mails or

technical committees for face to face contact, but I could not access to this data since it exceeded the confidentiality of the associates. All in all, I suppose that those firms that are not in Twitter will contact other members in a way or another and therefore will not be as isolated as this paper may suggest.

Another restriction is the fact that REST API only allows the analysis of the last 3200 tweets and this view could be too short-sighted especially in the case of usernames that tweet a lot (for instance, all tweets captured for Vodafone date from February 2016 and thus do not offer the historical perspective that this study seeks). Finally, a further future research line might tackle the challenge to estimate the cognitive dimension of social capital that this paper does not approach.

By measuring social capital by SNA, I have taken a dynamic[12] perspective as social capital formation and development is a cumulative process, path- and place-dependent, that co-evolves with cluster and regional development (Staber, 2007). In any case, a great deal of further research is needed on how networks evolve over time and space (Ter Wal and Boschma, 2009). After all, 'social capital is not a 'thing', but a process' (Anderson and Jack, 2002).

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FOOTNOTES:

[1] This CA is more known as GAIA. For further information: http://www.gaia.es

[2] This limit was expanded to 280 characters in November 2017.

[3] Lozares et al. (2011) make a similar distinction and talk about the formal and substantive components of social capital.

[4] AIEPV stands for "Asociación de Industrias de la Electrónica del País Vasco" and was the first association prior to GAIA.

[5] See http://www.gaia.es/turnover.html and http://en.eustat.eus. Last seen: 10-10-2016.

[6] The first and last tweets of the dataset were written on 11 April 2007 and 19 February 2016, respectively.

[7] Users can mention other users writing the "@" sign followed by a username. To repost a message from another Twitter user and share it with one's own followers, a user can click the retweet button within the tweet. In this paper, mentions and retweets have been considered similarly as a means to refer to other usernames.

[8] In comparison to REST API, Streaming API enables to collect unlimited input and output data, but is technically a bit more complex to monitor and process.

[9] A hashtag is a word or a phrase prefixed with a "#" sign that is used to group posts together by topic.

[10] Variables in capital letters correspond to the relation of GAIA members with the whole Twitter network; lower-case variables refer to connections of GAIA members exclusively with other GAIA associates. The darkness of the cell indicates the strength of the correlation.

[11] http://www.gaia.es/Noticias-GAIA.html and http://www.gaia.es/Noticias-de-asociados.html. Last seen: 10-10-2016.

[12] Dynamic in terms of procedure but quite static in time, since both samples have been collected in 2016.

Appendix 1: Top 50 connected GAIA usernames (sorted by Degree GAIA)

P.	Username	Total Followers	GAIA Followers	Following Total	Following GAIA	GAIA		
						Degree GAIA	Betweenness Centrality	Eigenvector Centrality
1	@ClusterGaia	2,352	69	1,575	75	144	26.2696	53.2189
2	@esMONDRAGON	19,700	38	15,100	33	71	6.5649	40.2120
3	@tecnalia	1,920	53	12,100	13	66	9.8019	44.4424
4	@DinyconSistemas	474	14	1,572	20	34	1.1641	25.7703
5	@TelecosEuskadi	595	8	2,003	25	33	1.8841	24.8416
6	@IKORGrupo	697	12	948	21	33	3.3976	26.3448
7	@NextelSA	814	10	579	22	32	1.9013	22.8317
8	@EuskoData_SA	424	6	1,053	25	31	1.8450	22.4046
9	@HispaVista	7,918	11	5,966	20	31	2.3918	21.1600
10	@AlianzaIK4	3,136	24	170	6	30	1.3479	28.4267
11	@comymedia	1,533	10	1,890	19	29	2.3076	15.6918
12	@virtualware	1,974	13	828	14	27	1.4537	14.5262
13	@MicrosoftES	28,300	18	3,087	8	26	3.0246	9.2251
14	@grupogureak	1,037	14	447	9	23	0.5698	21.8734
15	@ibermaticagrupo	2,160	14	2,370	9	23	0.8784	16.8481
16	@SpyroERP	437	8	911	14	22	1.3792	19.0365
17	@DeustoResearch	2,259	14	1,179	8	22	0.5473	19.4361
18	@PulsarConcept	790	11	308	10	21	1.5942	11.3317
19	@ArmeriaEskola	999	8	952	12	20	0.1096	18.5058
20	@IbermaticaSB	1,812	8	630	11	19	0.5583	16.6342
21	@IgarleSL	114	9	132	9	18	0.2824	16.3225
22	@ikusi_global	588	10	469	8	18	0.2712	15.2582
23	@TRIDENTESTUDIO	379	6	780	12	18	1.9790	10.4258
24	@PandaComunica	21,900	10	3,106	7	17	0.9238	9.0440
25	@IpartekF	437	7	483	9	16	0.1097	12.2151
26	@lotura	479	6	323	10	16	0.3859	13.7173
27	@BinarySftw	363	4	628	11	15	0.8898	13.0212
28	@Elhuyar	4,221	12	206	3	15	0.2625	20.0791
29	@euskaltel_sa	5,722	6	608	9	15	0.1207	15.4906
30	@everis	13,300	11	995	4	15	1.3132	11.4683
31	@Maser_Mic	67	5	166	10	15	0.2970	13.9034
32	@SageSpain	28,100	11	1,157	4	15	1.3217	8.5785
33	@senddo	489	8	340	7	15	0.1710	8.3399
34	@CEBANC	614	6	487	8	14	0.2102	11.8174
35	@DigiPenBilbao	735	8	464	6	14	0.1961	4.9026
36	@RevistaFSGamer	7,265	9	2,291	5	14	0.4186	4.5263
37	@todologic	357	4	921	10	14	1.6803	7.3198
38	@IZERTIS	2,770	6	802	8	14	0.1525	12.0022
39	@nazaretzentroa	929	7	584	7	14	0.0555	14.3127
40	@DeliriumStudios	2,513	10	40	3	13	0.0598	4.5983
41	@automation_es	462	8	113	5	13	0.1586	12.3915
42	@ingeteam	1,379	9	247	4	13	0.1275	17.7342
43	@lantegibatuak	1,884	8	739	4	12	0.0775	10.3802
44	@oracle_es	2,587	8	538	4	12	0.1674	4.9571
45	@Gestionet_es	522	0	294	11	11	0.6298	10.3395

P.	Username	Received mentions		Written tweets	Mentions made				
46	@SareinSistemas	99	4	66	7	11	0.3546	11.5439
47	@SolmicroMKR	425	4	632	7	11	0.2654	10.3525
48	@WiMi_5	1,597	9	1,268	2	11	0.7543	8.7355
49	@Akting_	199	5	81	5	10	0.1961	8.9002
50	@anbotogroup	1,515	5	1,939	5	10	0.0464	6.0425

Appendix 2: Top 50 ranked GAIA usernames in mentions, sorted by Degree GAIA (sample 1)

P.	Username	Received mentions	GAIA usernames mentioning	Written tweets	Mentions made	Mentioned GAIA usernames	GAIA		
							DEGREE GAIA	Betweenness Centrality	Eigenvector Centrality
1	@clustergaia	484	43	903	978	32	75	14.8764	51.5791
2	@tecnalia	736	54	3,222	2,719	18	72	15.6720	54.8024
3	@virtualware	708	17	3,214	5,446	20	37	1.9812	30.0590
4	@ibermaticagrupo	447	13	3,007	3,068	23	36	5.5804	27.8893
5	@alianzaik4	418	19	3,252	2,925	17	36	2.2264	31.4299
6	@pulsarconcept	221	15	979	1,790	18	33	2.6222	21.0705
7	@esmondragon	149	18	2,764	1,794	10	28	2.9448	23.1641
8	@deliriumstudios	848	14	2,493	5,051	13	27	1.5286	17.5092
9	@microsoftes	556	17	3,262	4,611	8	25	2.7857	13.1628
10	@wattiocorp	338	12	2,104	2,274	11	23	0.6289	17.8484
11	@wimi_5	401	10	1,271	1,735	12	22	0.9426	16.3166
12	@grupogureak	755	10	1,355	2,499	10	20	1.4886	16.7393
13	@dinyconsistemas	235	9	1,016	1,355	11	20	0.3852	18.4341
14	@nextelsa	214	6	2,121	2,056	14	20	1.1693	17.9772
15	@pymapp	196	11	3,230	1,359	9	20	0.3991	16.5623
16	@coitpv	36	4	854	955	16	20	1.8083	23.9871
17	@elhuyar	1,066	8	2,692	4,104	10	18	0.6859	18.6071
18	@lantegibatuak	742	7	2,037	4,557	11	18	0.6514	16.9709
19	@euskaltel_sa	55	15	3,226	2,796	3	18	1.0884	22.5365
20	@everis	1,377	10	3,257	4,819	7	17	1.0226	14.1599
21	@lotura	116	5	1,690	1,516	12	17	0.3568	17.9667
22	@armeriaeskola	298	7	2,241	2,642	9	16	0.4487	14.7763
23	@izertis	233	9	2,322	1,720	7	16	1.9255	10.5647
24	@oracle_es	358	9	2,340	2,108	6	15	0.3602	6.3105
25	@deustoresearch	145	7	3,259	4,767	8	15	0.5758	21.2207
26	@gestionet_es	124	8	3,222	588	7	15	0.5316	13.9418
27	@domoalert	47	5	891	350	10	15	1.1966	11.0384
28	@comymedia	39	4	1,379	1,057	10	14	0.9616	13.0721
29	@cyctweet	396	6	3,244	5,582	7	13	0.2534	14.8263
30	@nazaretzentroa	278	3	2,666	3,160	10	13	0.2554	14.4046
31	@bilbomatica	80	10	179	194	3	13	0.1785	18.4621
32	@igarlesl	29	6	150	111	7	13	0.2931	9.7381
33	@ingeteam	620	6	744	1,175	6	12	0.0302	15.9457
34	@ikorgrupo	53	4	2,433	2,026	8	12	0.0816	14.7711
35	@digipenbilbao	131	7	1,019	708	4	11	0.0053	7.7557
36	@jokoga_int	34	5	47	121	6	11	0.0526	6.4076

P.	Username	Received mentions (total)	Received mentions GAIA	GAIA usernames mentioning	Written tweets	Mentions made	Mentioned GAIA usernames	DEGREE GAIA	Cliques
37	@ludei	356	8	1,618	2,014	2	10	0.2362	6.5308
38	@ibermaticasb	230	4	3,255	2,596	6	10	0.3125	8.7266
39	@ibercom	218	4	2,154	1,856	6	10	0.8686	9.7244
40	@dualia	164	4	1,811	2,233	6	10	0.0336	12.3363
41	@mrjamcmm	97	4	3,250	484	6	10	0.0219	9.7512
42	@ikusi_global	19	5	280	302	5	10	0.0291	11.4624
43	@ikasplay	18	6	104	146	4	10	0.1156	11.6113
44	@cebanc	247	4	1,499	1,260	5	9	0.9491	9.3701
45	@campus2b	125	5	3,215	4,062	4	9	0.6157	7.8939
46	@akting_	82	4	309	455	5	9	0.0082	8.6363
47	@sisteplant	63	6	163	166	3	9	0.0933	12.2748
48	@fagorhealthcare	53	5	1,771	1,568	4	9	0.9104	10.1925
49	@vodafone_es	21	8	3,238	3,197	1	9	1.1790	6.1220
50	@pandacomunica	164	5	3,243	1,498	3	8	0.0382	6.7416

Appendix 3: Top 50 ranked GAIA usernames in mentions, sorted by Degree GAIA (sample 2)

							GAIA		
P.	Username	Received mentions (total)	Received mentions GAIA	GAIA usernames mentioning	Written tweets	Mentions made	Mentioned GAIA usernames	DEGREE GAIA	Cliques
1	@ClusterGaia	275	85	16	319	416	20	36	12
2	@tecnalia	1,027	88	11	610	457	2	13	8
3	@virtualware	345	87	3	265	495	8	11	2
4	@euskaltel_sa	2,163	67	7	2,663	2,440	4	11	2
5	@TelecosEuskadi	156	38	4	183	233	6	10	3
6	@AlianzaIK4	141	24	6	184	150	3	9	2
7	@SpyroERP	18	6	3	60	58	5	8	2
8	@IgarleSL	8	5	3	14	23	4	7	3
9	@RevistaFSGamer	551	84	3	538	381	4	7	1
10	@esMONDRAGON	303	27	3	214	203	4	7	0
11	@MicrosoftES	2,661	85	5	595	676	2	7	0
12	@Sisteplant	27	9	3	17	21	3	6	2
13	@ibermaticagrupo	157	43	3	277	142	3	6	1
14	@ArmeriaEskola	89	20	4	49	107	2	6	0
15	@grupogureak	220	48	3	96	218	3	6	0
16	@lantegibatuak	555	99	2	235	482	4	6	1
17	@IZERTIS	194	20	2	78	117	4	6	1
18	@everis	1,099	105	4	342	338	2	6	0
19	@oracle_es	637	34	3	251	229	3	6	0
20	@Webalianza	5	3	3	1	2	2	5	1
21	@ingeteam	317	62	2	90	166	3	5	1
22	@DeliriumStudios	211	40	3	156	298	2	5	1
23	@ikusi_global	97	16	3	80	100	2	5	1
24	@entelgy	522	29	2	510	451	3	5	1
25	@ULMA_Embedded	20	10	2	13	23	2	4	0
26	@NextelSA	25	11	2	29	48	2	4	0
27	@arininnovation	28	9	2	284	318	2	4	0

28	@Elhuyar	406	107	2	240	450	2	4	0
29	@deustosistemas	24	6	2	24	22	2	4	0
30	@GFI_Informatica	624	53	2	456	332	2	4	0
31	@nazaretzentroa	139	9	3	71	75	1	4	0
32	@BuntPlanet	66	4	2	49	53	2	4	0
33	@Sarenet	259	13	1	791	775	3	4	0
34	@IKORGrupo	84	2	1	424	266	3	4	0
35	@SageSpain	3,280	19	3	843	878	1	4	0
36	@Maser_Mic	8	4	1	30	16	2	3	0
37	@DigiPenBilbao	67	30	2	105	56	1	3	0
38	@SolmicroMKR	30	7	2	20	19	1	3	0
39	@_Enigmedia_	154	33	1	147	157	2	3	0
40	@DeustoResearch	134	22	1	299	528	2	3	0
41	@HispaVista	46	6	2	15	20	1	3	0
42	@TAKLearning	16	2	2	44	61	1	3	0
43	@Tecnipesa_ID	46	5	1	313	373	2	3	0
44	@Gestionet_es	29	3	2	261	25	1	3	0
45	@IbermaticaSB	29	3	2	156	19	1	3	0
46	@Dualia	27	2	1	27	36	2	3	0
47	@Inycom	1,106	79	1	607	660	2	3	0
48	@comymedia	15	1	1	114	66	2	3	0
49	@PandaComunica	1,414	69	1	547	253	2	3	0
50	@vodafone_es	32,253	43	2	32,135	31,938	1	3	0

Appendix 4: Top 50 non GAIA usernames in received mentions by GAIA members (sorted by received and diversity of mentions, respectively)

P.	Username	Received mentions from GAIA	GAIA usernames mentioning	P.	Username	Received mentions from GAIA	GAIA usernames mentioning
1	@deusto	1,479	46	1	@ap	806	75
2	@microsoft	1,067	32	2	@youtube	525	71
3	@oracle	994	15	3	@el_pais	481	60
4	@ap	806	75	4	@innobasque	565	57
5	@puromarketing	599	29	5	@expansion	316	56
6	@alfredovela	599	14	6	@expansioncom	285	54
7	@xataka	578	37	7	@elmundoes	199	54
8	@innobasque	565	57	8	@diariovasco	449	51
9	@youtube	525	71	9	@tic	406	51
10	@el_pais	481	60	10	@grupospri	307	47
11	@diariovasco	449	51	11	@deusto	1,479	46
12	@ik4_tekniker	441	16	12	@eitb	200	46
13	@mkdirecto	436	31	13	@eleconomistaes	237	45
14	@upvehu	418	34	14	@euskadinnova	146	45
15	@tic	406	51	15	@fundaci	293	43
16	@microsoftayuda	402	3	16	@abc_es	148	41
17	@funandserious	381	15	17	@adegi	288	39
18	@lanbideejgv	367	12	18	@elcorreo_com	224	39
19	@tuitsdegabriel	364	1	19	@xataka	578	37

P.	Username	Written mentions	GAIA usernames mentioned		P.	Username	Written mentions	GAIA usernames mentioned
20	@ideko_ik4	355	9		20	@ticbeat	259	37
21	@orkestra	343	21		21	@cincodiascom	170	36
22	@txemafranco	328	4		22	@google	124	36
23	@negociosyempren	318	3		23	@pau	89	35
24	@expansion	316	56		24	@upvehu	418	34
25	@vetustamorla	309	8		25	@beaz_bizkaia	243	34
26	@grupospri	307	47		26	@iker	171	33
27	@artmonedero	297	8		27	@rtve	83	33
28	@gorabide	297	5		28	@microsoft	1,067	32
29	@asadapi	295	14		29	@deia_bizkaia	125	32
30	@fundaci	293	43		30	@mkdirecto	436	31
31	@adegi	288	39		31	@eitbcom	82	31
32	@expansioncom	285	54		32	@wwwhatsnew	203	30
33	@antoniosanto	274	6		33	@upvehu	197	30
34	@ticbeat	259	37		34	@puromarketing	599	29
35	@vadejuegos	256	9		35	@inc	118	29
36	@xatakamovil	249	11		36	@redpuntoes	68	29
37	@beaz_bizkaia	243	34		37	@konekta20	125	28
38	@eleconomistaes	237	45		38	@intel	66	28
39	@computingbps	229	19		39	@radioeuskadi	65	27
40	@fomentoss	227	21		40	@sharethis	80	26
41	@elcorreo_com	224	39		41	@elconfidencial	70	26
42	@xbox	220	5		42	@eroski	178	25
43	@juanliedo	216	3		43	@arantxa_tapia	105	25
44	@atzegi	209	3		44	@notgip	101	24
45	@xbox_spain	208	4		45	@tecnologiavasca	99	24
46	@deustodbs	207	14		46	@portaltic	142	22
47	@ceit_ik4	206	17		47	@cisco	116	22
48	@wwwhatsnew	203	30		48	@orkestra	343	21
49	@eitb	200	46		49	@fomentoss	227	21
50	@lumia	200	1		50	@muycomputer	136	21

Appendix 5: TOP 50 non GAIA usernames in written mentions to GAIA members (sorted by written and diversity of mentions, respectively)

P.	Username	Written mentions to GAIA	GAIA usernames mentioned	Working at	P.	Username	Written mentions to GAIA	GAIA usernames mentioned
1	@vllanteng	438	1		1	@DJacomeNorato	105	11
2	@jlromolastra	313	1	Sage Spain	2	@BigDataTweetBot	26	9
3	@cirogalante	214	1	Vodafone	3	@_Cloud_I_	9	9
4	@JBenito01	200	1	Sage Spain	4	@Innobasque	28	8
5	@knario47	199	1		5	@inigoladronm	11	8
6	@SoniaUrr	163	1		6	@Byte_TI	10	8
7	@InnoTecSystem	146	3	Entelgy Group	7	@carlosfdezgomez	10	8
8	@asturkonuka	140	1		8	@JulenZaballa	31	7
9	@porelmovil	133	1		9	@economiadehoyes	13	7
10	@pyme_emprende	113	1		10	@BEC_BIEMH	28	6
11	@luispardo1	113	1	Sage Spain	11	@JRMelara	26	6

12	@DJacomeNorato	105	11		12	@miquelag72	18	6
13	@SantiMayoralas	103	1	Panda Security	13	@frankInnovacion	17	6
14	@guiller_palacio	101	2		14	@ThinkupLKS	16	6
15	@Leireaguero	98	1	Tecnalia	15	@ADEGI	9	6
16	@Morillas_JA	96	1	Vodafone	16	@albertobokos	7	6
17	@Robertofr63	95	1		17	@descargar_mspy	6	6
18	@RecursosyTecnlg	93	1		18	@FuturEnviro	16	5
19	@gabrielbv74	89	1	Inycom	19	@andres_mleal	9	5
20	@jmaguiar70	88	1		20	@omegamx1a	7	5
21	@UCZ443	87	1		21	@PrecoBaixoAgora	6	5
22	@NAtutxa	85	2	Euskaltel	22	@GEZKI_	39	4
23	@carmenurbano	85	1	Inycom	23	@AzuMingarro	30	4
24	@German_robles_r	79	1		24	@FuturEnergy_	24	4
25	@virtualgarry	75	2	Virtualware	25	@ITUser_es	22	4
26	@txemafranco	75	3	Lantegi Batuak	26	@psasigain	20	4
27	@Miguel_SBD	74	1	Sage Spain	27	@ClusterTICAstur	18	4
28	@handresmartin	69	1		28	@Gtzl	18	4
29	@NaiaraRRHH	67	1	CYC	29	@djjacomenorato	17	4
30	@JeanHBeaufort	65	1		30	@AranchaAsenjo	14	4
31	@Alberbonar	62	1	Sage Spain	31	@H_Enea	14	4
32	@davidgaga5000	60	1		32	@mrguezpasarin	14	4
33	@SocialMediaMFF	59	1		33	@ITReseller_es	13	4
34	@mubielau	56	1	Sage Spain	34	@SisteplantPR	11	4
35	@MireiaBonafe	56	2	GFI Spain	35	@Beaz_Bizkaia	10	4
36	@VictorVidalGime	55	2	Inycom	36	@ituser_digital	10	4
37	@juanlu_rc	55	1	Sage Spain	37	@metalindustri	9	4
38	@DjGhost512	55	1		38	@WalkOnProject	9	4
39	@albertomtnezper	55	1		39	@Director_TIC	8	4
40	@EiderLecumberri	54	1	Ingeteam	40	@FomentoSS	8	4
41	@dmihala	54	1	Oracle	41	@grupospri	8	4
42	@gemavillaher	52	1		42	@orkestra	8	4
43	@psantia13	51	1	Vodafone	43	@elmundoempresa	7	4
44	@merceditasmar	51	2		44	@empresaexterior	7	4
45	@EvilTwinattack	50	1		45	@KursaalDonostia	7	4
46	@IraiZb	49	1	Lantegi Batuak	46	@mongemalo	7	4
47	@Herkken	49	1		47	@EuskalValley	6	4
48	@annasanzgimeno	49	1	Inycom	48	@FPeuskadi	6	4
49	@TinoJovani	48	1	Sage Spain	49	@sbarturen1	6	4
50	@sojagu	48	1	CYC	50	@mlcluster	5	4

Appendix 6: Top 50 ranked hashtags and words

P.	Hashtags	Count	%	P.	Words	Count	%
1	#app(s)	1,998	1.53%	1	empresa(s)	2,437	0.30%
2	#BtMS	1,825	1.40%	2	nuevo/a(s)	1,915	0.23%
3	#tecnologia	1,471	1.13%	3	app(s)	1,554	0.19%
4	#Donostia	1,368	1.05%	4	social	1,174	0.14%
5	#empleo	1,354	1.04%	5	Google	1,109	0.14%

6	#ecommerce	1,133	0.87%	6	new	1,061	0.13%
7	#cloud	1,102	0.85%	7	video	1,017	0.12%
8	#innovacion	1,087	0.83%	8	internacional	966	0.12%
9	#empresa(s)	1,021	0.78%	9	jornada	948	0.12%
10	#BigData	984	0.76%	10	servicio	823	0.10%
11	#pyme(s)	969	0.74%	11	proyecto	814	0.10%
12	#GFI	962	0.74%	12	España	721	0.09%
13	#seguridad	900	0.69%	13	customer	676	0.08%
14	#infografia	852	0.65%	14	web	644	0.08%
15	#TI	786	0.60%	15	entrevista	612	0.07%
16	#SocialMedia	775	0.60%	16	marketing	576	0.07%
17	#TIC	770	0.59%	17	Microsoft	572	0.07%
18	#CustomerService	750	0.58%	18	curso	569	0.07%
19	#videojuego(s)	748	0.57%	19	internet	555	0.07%
20	#reimaginaeltrabajo	625	0.48%	20	Facebook	554	0.07%
21	#FF	609	0.47%	21	tecnologia	546	0.07%
22	#HTML5	605	0.46%	22	Apple	536	0.07%
23	#Marketing	596	0.46%	23	online	534	0.07%
24	#Bilbao	595	0.46%	24	consejos	532	0.06%
25	#Facebook	548	0.42%	25	business	524	0.06%
26	#custserv	539	0.41%	26	mejor(es)	942	0.11%
27	#musica	534	0.41%	27	presentacion	507	0.06%
28	#infographic	530	0.41%	28	claves	500	0.06%
28	#NazaretZentroa	526	0.40%	29	sistema	466	0.06%
30	#educacion	496	0.38%	30	Twitter	458	0.06%
31	#Eibar	486	0.37%	31	gestión	454	0.06%
32	#IoT	474	0.36%	32	service	452	0.06%
32	#SocBiz	463	0.36%	33	deportes	443	0.05%
34	#Google	414	0.32%	34	digital	436	0.05%
35	#music	411	0.32%	35	Sage	425	0.05%
36	#Madrid	405	0.31%	36	premio	424	0.05%
37	#Oracle	401	0.31%	37	datos	423	0.05%
38	#Android	395	0.30%	38	tecnico/a	421	0.05%
39	#trabajo	395	0.30%	38	futuro	420	0.05%
39	#SPD	385	0.30%	40	nacional	415	0.05%
41	#cloudcomputing	369	0.28%	41	red(es)	414	0.05%
42	#formación	359	0.28%	42	noticia	402	0.05%
43	#SeriousGames	351	0.27%	43	aplicaciones	398	0.05%
44	#emprendedor/a	642	0.49%	44	compañeros	390	0.05%
45	#discapacidad	342	0.26%	45	Samsung	385	0.05%
46	#internet	338	0.26%	46	evento	379	0.05%
47	#startup	328	0.25%	47	movil	370	0.05%
48	#FP	325	0.25%	48	director	369	0.04%
49	#100armeriaeskola	315	0.24%	49	seguridad	359	0.04%
50	#PostPC	301	0.23%	50	formacion	347	0.04%