

The role of brokers in destination's knowledge networks

Abstract

This paper applies a two-mode Social Network Analysis approach to identify the brokers in knowledge networks resulting from interactions taking place at specialized seminars and courses organized in a tourism destination. Empirical findings show that Technology and Innovation Centers can be the leading hub of 'administered knowledge networks' - understood as efficient knowledge governance arrangements – in which a wide variety of actors, including universities, private sector associations, public organizations and firms, play complementary roles depending on the nature of interactions (formal transfer vs informal exchange flows). These structures are found fundamental for the functioning of localized systems of learning.

Keywords: knowledge networks, knowledge brokers, social network analysis, two-mode networks, relational economic geography, tourism

Introduction

Successful specialized regions in a globalized knowledge-based economy have come to be seen as those where actors embedded in collaborative networks are truly engaged in knowledge exchange processes (Bathelt and Glückler, 2011; Brenner, Cantner and Graf, 2013; Bathelt and Gibson, 2015). These synergies create knowledge flows that facilitate the sharing and acquisition of expertise in the domain which constitutes the core of the region's economic activity, either through the building of formal relations or through informal contacts (Balland, Belso-Martínez and Morrison, 2016).

When studying processes of localized learning and innovation, mainstream economic geography has mainly focused on manufacturing or high-tech industries, while neglecting service industries and, in particular tourism related activities, despite its huge impact and spatial extent (Ioannides and Debbage, 2014; Niewiadomski, 2014). This circumstance seems to be changing, as has been discussed by Jones (2016) but more research efforts are needed to advance the incorporation of relational economic geography approaches to the study of the organization of places in which tourism is the main engine for regional development (Ioannides and Debbage, 1998, 2014; Debbage and Ioannides, 2011)

Following this vein, the attempt of this paper is to explore the promising avenues that studying knowledge networks and dissemination processes in tourism destinations can give to economic geography in general, to relational economic geography in particular, and to the understanding of tourism districts (Sanz-Ibáñez and Anton Clavé, 2014).

From a methodological perspective, a two-mode network approach is proposed as a powerful tool to explore the structural characteristics of knowledge networks resulting from interactions taking place at specialized seminars and courses organized in a coastal destination located in Catalonia (Spain), while providing new insights to the question of who are the brokers in these networks. The analysis distinguishes between informal exchange flows – produced through casual or spontaneous conversation– and formal transfer flows – resulting from the transmission of knowledge from speakers or lecturers to attendees. Results provide evidences about the role of Technology and Innovation Centers (TICs) as bridging organizations promoting collaboration and the circulation of knowledge within the different spheres in the triple helix (Goddard, Robertson and Vallance, 2012).

The paper is structured as follows. Section two provides a review of the literature dealing with the issues under study in the context of relational economic geography approaches, as well as the specificities of tourism specialized regions and the advancements achieved so far in tourism studies. Section three explains the research design and methodologies applied. Section four presents the empirical evidences obtained. Section five discusses the results in relation to the literature. Section six summarizes some concluding remarks and provides suggestions for future research directions.

Networks and localized systems of learning in specialized productive places: the role of brokers

Specialized regions are networked regional economies in which geographical proximity – as well as other forms of cognitive, organizational, social and institutional proximity (Boschma, 2005; Balland, 2012) – and frequent contacts facilitate the transfer of the specific and embedded knowledge and expertise that is ‘in the air’ (Boschma and Lambooy, 2002; Bathelt and Glückler, 2011; Glückler, Lazega and Hammer, 2017). Even though acknowledging the increasing role of ICT and online partners/intermediaries in these productive spaces, it is worth to study the path to learning and innovation supported by interactions and knowledge flows between co-located firms and non-economic actors who work in close collaboration and are involved in ‘a learning system producing localized knowledge, strongly based on the local culture and the capabilities of local actors’ (Belussi and Sedita 2009, 508).

Research on networking and knowledge dissemination take as a point of departure the assumption that interconnections between individuals or organizations taking place in – formal and informal – social and economic networks act as channels through which knowledge resources can potentially flow (Østergaard, 2009; Baggio and Cooper, 2010; Balland, de Vaan and Boschma, 2012; Glückler, Lazega and Hammer, 2017). From such a perspective, the existence of a well-structured network with a high degree of cohesion ‘has proved to be an important determinant when explaining the mechanisms by which ideas, information and knowledge

“travel” from one element of the system to another’ (Baggio, Scott, and Cooper 2010, 3). Structural and social embeddedness, as the work of Balland, Belso-Martínez, and Morrison (2016) shows, have much to do with the formation of cohesive networks.

The innovativeness and adaptability of networks can be also achieved in less cohesive networks, when specific agents bridge ‘structural holes’ and provide new information to unconnected nodes (Burt, 2004). Indeed, in knowledge networks - the systems including interconnections made via the intended effort by organizations and/or individuals to share and obtain knowledge resources to the benefit of network participants (Vicente, Balland and Brossard, 2011; McLeod and Vaughan, 2015) - generally only a small number of actors are the most central and have a strategic positioning, whereas the rest of actors tend to play more marginal roles in disseminating knowledge (Giuliani, 2007). These hub organizations, sometimes referred in the literature as brokers of knowledge or gatekeepers, support the dissemination of knowledge among local stakeholders and at the same time connect the local network with external knowledge resources that may benefit the local innovation system (Kauffeld-Monz and Fritsch, 2011; Drew, Ritchie and King, 2014). This last function is particularly crucial for highly specialized places due to the need of external knowledge inputs to avoid negative path dependence effects (Martin, 2010; Glückler, Lazega and Hammer, 2017).

Knowledge brokers can be firms. Entrepreneurs ‘recognize opportunity, mobilize resources, and create value, and are key to the

creation of institutions and the building of capacity that will sustain regional economic development' (Feldman 2014, 1). Factors such as size, organization, or business strategy make knowledge needs differ from firm to firm, and at the same time have a direct effect on the ways in which firms acquire and exchange knowledge for fostering innovation (Hjalager, 2010). The biggest firms in the system are generally the ones with a stronger knowledge base, higher absorptive capacity (Giuliani, 2007) and more economic and technical resources for knowledge promotion among their employees. Small firms, in turn, tend to play a less significant and passive role in knowledge dissemination and base their strategy in tacit experiential knowledge and in following the leaders in the industry.

Public authorities and private (trade) associations have been also identified as a relevant stakeholders whose policies can enhance the generation of knowledge (Hjalager, 2010; Van der Zee and Vanneste, 2015). There is a growing consensus, moreover, that universities also can hold an outstanding central position in knowledge networks and, hence, perform a pivotal role as drivers of knowledge dissemination in regional economic development (Srinivas and Viljamaa, 2008; Kauffeld-Monz and Fritsch, 2011; Goddard, Robertson and Vallance, 2012). This is due to the third mission universities have acquired in the knowledge-based economy: the transfer of knowledge to industry and society (Etzkowitz and Leydesdorff, 2000; Srinivas and Viljamaa, 2008). This mission is particularly important in the case of regions or economic sectors constituted with a lack of large and globally connected firms (Kauffeld-Monz and Fritsch, 2011).

Finally, Technology and Innovation Centers (TICs) are seen as bridging organizations that serve to and proactively enhance collaboration and knowledge exchange between actors from the different spheres of the triple helix that might not arise spontaneously (Goddard, Robertson and Vallance, 2012). The point is, however, that despite there is a growing policy trend creating TICs for promoting regional development, there is still missing further theoretical discussions and empirical research about the specific functions TICs should perform to activate innovation in different territorial settings and economic sectors (Goddard, Robertson and Vallance, 2012). In addition to this, a need of tailoring TICs characteristics and functions to its innovation environment is claimed (Miller, 2014).

Knowledge networks in the tourism sector

Knowledge dissemination in regions specialized in industrial sectors or high-tech industries can take place through different vehicles and can vary from place to place. Some works have identified spin-off processes and labour mobility (Ter Wal and Boschma, 2009); client-supplier linkages and socio-institutional relationships (Giuliani, 2007); or university-industry contacts, by means of formal cooperation, mobility of graduates or informal social networks (Østergaard, 2009) as critical elements for knowledge exchange. These processes can also take place in service-oriented regions but, certainly, further research is needed to tackle the specificities of the mechanisms through which knowledge is shared and transferred in regions specialized in economic sectors such as tourism (McLeod and Vaughan,

2015).

These issues have been only partially addressed in the tourism literature. A number of works have explored the role of agglomeration economies and the positive effects of collaboration among actors in the tourism production system, including upgrading synergies facilitated by global-local strategic coupling relations (Sanz-Ibáñez and Anton Clavé, 2016; Niewiadomski, 2017) and knowledge dissemination (Baggio and Cooper, 2010; McLeod and Vaughan, 2015) but the fact is that the understanding of the workings of knowledge in tourism is still a challenge.

To begin with, according to Cooper (2015, 64), knowledge in tourism is mostly tacit, which makes it ‘sticky and difficult to turn into explicit, communicable information’. Hence, it is ‘highly personal and hard to formalize, making it difficult to communicate or share with others’ (Xiao 2006, 147). Second, Cooper also sustains that knowledge has to be continuously adapted to the constantly changing conditions of the global market, so it evolves and changes. Third, knowledge ‘is generally context specific, created in communities of practice, which are formed by actors belonging to the same (or similar) sector of activity – e.g. accommodation, research or public organizations, among others.’ (Cooper 2015, 64).

These considerations, together with the ‘lack of gearing between the research community and the tourism industry itself’ (Cooper 2015, 72), cause that knowledge generation, dissemination and acquisition in tourism occur in a more complex, informal and sometimes not well-planned manner than in other industries (Hjalager, 2010). The positive effects of network

structure in the transfer of knowledge is generally acknowledged (see, for instance, Baggio and Cooper 2010) but the networks created by knowledge transfer processes are also important. In fact, a strong, positive environment which is conducive to interactive learning and knowledge transfer favours knowledgeable agents with improved capability to innovate and create new knowledge (McLeod and Vaughan, 2015). According to Shaw and Williams (2009, 329), ‘the central ideas behind this reasoning are that tacit knowledge is the key competitive advantage, and that proximity is essential to developing strong levels of trust and common values which are critical for effective knowledge sharing.’

For the purposes of this article, although acknowledging that there are many more ways in which knowledge can be disseminated, the research is focused on knowledge networks and flows which emerge from the interaction and participation of actors in seminars and courses - referred as indirect conduits by Shaw and Williams (2009). These sort of activities still represent one of the most efficient channels for promoting interactive learning in sectors such as tourism, highly fragmented and in which economic actors hardly interact (Van der Zee and Vanneste, 2015). Besides, as Bathelt and Glückler (2011) maintained in the case of international trade fairs, seminars and courses in tourism provide unique opportunities for multiple encounters and external social relationships, which not only facilitate the access to new information but also the transfer of these information from one type of relationship to another (business partnerships, community membership, neighbouring, etc.).

In this sense, seminars and courses are seen as knowledge-enhancing arenas or meeting places that help construct ‘administered networks’ (Haugland *et al.*, 2011), which can be defined as systems purposely developed to enhance bottom-up localized learning (Malmberg and Maskell, 2006). These are formal governance structures that link economic and non-economic actors and focus on ‘identifying relevant knowledge and capturing it, transferring and sharing it, and ensuring that organizations are engineered to optimize flows and to manage them effectively’ (Cooper 2006, 48).

Knowledge Formal Transfer (FT) in seminars and courses is defined here as the process referring to the transmission of knowledge that occurs as a result of the formal interaction between speakers or lecturers and attendees. Hence, it refers to the traditional conception of the way in which actors attending seminars and courses can benefit from acquiring external knowledge from experts either for their academic background or for their professional expertise – e.g. consultants, policy makers, scientists, teachers, entrepreneurs. This being said, actors participating in seminars and courses can not only learn by listening to experts. Instead, new information, know-how and know-who can be obtained by knowledge Informal Exchange (IE) processes. Indeed, educational events are a perfect platform for creating meeting places for actors – e.g. firms, trade associations, consultancies, public agencies and governments at different levels, to refer to the most relevant – to interact and learn from each other (Ness, 2014). These synergies may emerge through informally-based exchanges of ideas,

knowledge, and even sometimes work-related gossip (Shaw and Williams, 2009).

The co-presence and face-to-face contacts produced during these activities – sometimes even at coffee breaks or lunches – facilitate the socialization of actors and lead to the formation, development and consolidation of informal social networks through which the knowledge – mostly tacit – that each individual and organization possesses is shared easily by building on informal norms of trust and reciprocity. As Bathelt and Glückler (2011, 132) put it ‘this buzz consists of specific and continuously updated information (...) the application of shared interpretative schemes, common understandings of new knowledge and technologies, as well as shared cultural traditions’.

All in all, fruitful discussions have emerged but empirical advances made so far in economic geography – and even more so when it comes to tourism studies (McLeod and Vaughan, 2015) – have not yet clarified how knowledge networks resulting from courses and seminars are structured, as well as which role the different actors involved in this specific sector play in favouring knowledge dissemination. These are the main issues this paper aims to address.

Research design and methodology

Data collection and relational database

This paper tackles knowledge share and transfer in central Costa Daurada

during 2013 and 2014. This area is a major Mediterranean coastal destination that comprises three municipalities: Salou, Cambrils and Vila-seca, 100 kilometres south of Barcelona. The area is home to PortAventura, one of the top European theme parks (Sanz-Ibáñez, Wilson and Anton Clavé, 2017). In particular, the objective of the research is twofold: first, it aims to explore the structural characteristics of the central Costa Daurada tourism knowledge network; and second, it aims to disentangle the brokerage roles played by the different actors involved in this network. The empirical analysis applies social network analysis methods, which have been extensively acknowledged as valuable to contribute further to the analysis of the organization of productive spaces and the impact of these structures for disseminating knowledge and enhance innovation (Ter Wal and Boschma, 2009; Aarstad, Ness and Haugland, 2015).

The participation of actors in specialized courses and seminars constitute one of the forms of education that promote the circulation of knowledge among actors, and increase the technical abilities and functionalities of employees and firms operating in specialized regions (Boschma and Lambooy, 2002; Hallin and Marnburg, 2008). The data was provided from archival resources of the most active and prominent actors organising educational activities in the destination, namely three business associations (which bring together the majority of firms belonging to the accommodation sector) and a regional tourism oriented TIC (the Science and Technology Park of Tourism and Leisure, closely linked to the university, public organizations and productive sectors in the area).

More concretely, three data bodies were created based on the interactions occurring during the period 2013-2014 (two years). The first one listed knowledge-related activities organized in this period whose purpose were: 1) training of employees and industry representatives on new skills and/or 2) updating their knowledge on management of tourism organizations to meet the continuous changes in the sector and promote innovation in the region. These activities included topics like marketing and sales strategies, application of ICTs in tourism or language skills for improving customer service, among other topics. On the contrary, promotional events, institutional meetings or sessions oriented to update the sector on new regulations, for instance, were excluded. After this selection, a total of 51 activities were kept.

Second, the records of attendees (including employees, middle managers and executives of both private companies and public organizations) to each activity were collected in a complementary database. Thirdly, a list of actors who participated in the activities as speakers was compiled. In both steps actors are not taken as individuals, but rather as organizations in which participants worked or represented. Additionally, other secondary data sources were collected and cursorily analysed through strategic overviews, so as to have a holistic view of the characteristics and participants of each selected activity. The sources comprized documents such as annual reports of the organizations consulted and informative/promotional material for the activities.

Network construction and analysis

Summarizing, databases created contained information about two types of elements: seminars and courses, on the one hand, and organizations (actors) involved in them on the other – generally, small events where the more frequent attendance volume was around 15 attendees –, as well as relations between them (who participated in each activity). From a network analysis viewpoint, such a sort of information structure is labelled 'bipartite', 'two-mode' or 'affiliation' network (see the seminal contribution by Davis, Gardner, and Gardner 1941; or more recent applications in economic geography such as Balland, 2012; Balland and Rigby 2015; Crespo, Suire, and Vicente 2016; Vicente et al. 2011). In order to make the analysis more manageable, bipartite networks are transformed into two 'one-mode' networks (i.e. where nodes are elements of one type or the other – i.e. 'activity networks' or 'participant networks'). As the main interest of this paper is to analyse how the networks of actors are organized, 'participant networks' were built where organizations would be linked through the participation in (at least) one activity.

The above-described bipartite analysis, following the regular procedures in this field, was applied to two sort of knowledge flows: a) formal transfer (FT), resulting from the transmission of knowledge from speakers or lecturers to attendees; and b) informal exchange (IE) among attendees to the same activities, which is produced through casual or spontaneous conversation among actors. Accordingly, two networks were constructed. First a Knowledge Network with Formal Transfer (KN-FT),

where nodes are organizations and arcs connecting them represent directed knowledge flows from speakers to attendees. Second a Knowledge Network with Informal Exchange (KN-IE), where nodes are organizations and a link between two of them indicate attendance to (at least) one common activity.

Once both networks were created, a preliminary analysis using `igraph` and `sna` packages of R statistical toolkit (Csárdi and Nepusz, 2006; Butts, 2013) was conducted in order to examine the general structural properties of both networks. Specifically, besides the number of nodes, the number of edges or arcs and their density, the following basic structural features were obtained: clustering coefficient, average path length, diameter, degree assortativity, assortativity by activity field, and degree distribution.

Next, the analysis focused on quantifying the relevance of concrete nodes and to determine the brokerage roles played by these nodes in the KN-FT and KN-IE networks. For this purpose, it was first calculated the three centrality measures formalized by Freeman (1979) – namely Degree, Closeness and Betweenness centralities. Second, a brokerage analysis adopting the methodology proposed by Gould and Fernandez (1989) helped to identify up to 5 brokerage roles, namely: coordinator, consultant, representative, gatekeeper and liaison role. Complementarily, taking the normalized values of the five brokerage roles for the two networks as initial data, the authors applied a clustering technique (using Euclidean distances and paired-group clustering) so as to seek for relational patterns among actors.

Results

Visualization and basic descriptive statistics

The two networks under study are displayed in Fig. 1. In both cases, it can be observed that a small number of 'bridging organizations' prevent the network from falling apart into separated components. When comparing across the two networks, KN-IE looks denser than KN-FT. This is an expected consequence of the way both networks were constructed, as each activity generates more links in the first than in the second case.

FIGURE 1. ABOUT HERE

TABLE 1. ABOUT HERE

The relatively high clustering coefficients and positive values of assortativity by activity field shown in Table 1, confirm quantitatively that in both networks similar nodes tend to connect in dense groups. Despite having approximately the same number of nodes, KN-IE presents more than twice the number of connections in KN-FT, a much higher density and double clustering coefficient. As pointed out, these results should be related to the nature of the relationships represented by links. Moreover, the low diameter values (as a reference, notice that the diameter of a random regular graph with 250 nodes is $\text{LOG}(250) = 5.52$, approximately) and negative degree assortativities would indicate the presence of hubs (i.e. nodes concentrating a number of connections far above the average). Hubs have

been reported to have a highly significant influence on knowledge dissemination and, therefore, the analysis was further deepened concerning this point.

FIGURE 2. ABOUT HERE

A degree distribution analysis of both networks, with details on in- and out-degree for KN-FT, confirms that there were, indeed, a few organizations with an extraordinarily high connectivity. Sharp decays and long queues showed by all four plots (Fig. 2) indicate a severely unequal scenario, where few nodes have very high degrees and most of them have relatively few connections - this is especially clear for KN-FT (see top-right plot). The two plots at the bottom of Fig. 2 allow for a separated look at attendees (in degree, left panel) and speakers (out degree, right panel).

In sum, networks under study are integrated by a relatively large number of actors who tend to connect with other players working in the same economic activity. Therefore, results suggest that a small group of organizations that facilitate connectivity within the networks.

Individual roles: centralities and brokerage

Tables 2 and 3 present the top-10 values of Freeman's centrality measures (i.e. Degree, Betweenness, and Closeness) for the two networks KN-FT and KN-IE. These lists include firms and business associations, R&D organizations, and also actors representing the public sector.

Results for Degree centrality show that organizations displaying the most influential position in both networks are the TIC and the University. Noteworthy, these nodes are those that provide new or external knowledge to the actors of the destination. In addition, the regional government can be found in the third position in both networks. Regarding the other actors presenting high values of degree centrality, slight differences can be identified when comparing results obtained in the KN-IE and the KN-FT. In KN-IE the larger firms – i.e. local hotel chains and camping resorts – also play a central role. On the contrary, in KN-FT, this relevance is shared with consultancy firms and business associations, as well as the Destination Management Organization of the destination and one of the local authorities. Going a step further, Degree (in) and Degree (out) results help us identify that when it comes to knowledge formal transfer (KN-FT), consultants and business associations are positioned as knowledge providers and larger firms are the main consumers of new knowledge.

TABLE 2. ABOUT HERE

TABLE 3. ABOUT HERE

Turning to the betweenness centrality, results present only slight differences in the rank order. The TIC, the University, and the regional government keep their influential position as knowledge intermediaries in the KN-FT. Conversely, actors presenting a stronger power of intermediation in KN-IE are some active local camping resorts - this is due to the fact that these subsector is a fairly closed group, in which the majority

of firms are poorly connected to the rest of actors in the network. Finally, low and homogeneous closeness centrality values show that relations in both networks are non-hierarchical - actors in general are able to reach other actors and exchange knowledge on shorter path lengths.

Centrality measures provide information on the relevance of concrete nodes taking into account information about the KN-IE and the KN-FT as a whole (macroscopic scale). With the purpose to determine the frequency of nodes playing mesoscopic brokerage roles, as well as their statistical significance taking into account the general characteristics of the network, Gould and Fernández proposed a sort of census methodology in 1983. Their method identifies up to 5 other brokerage roles, namely (Butts, 2013): coordinator, representative, consultant, gatekeeper, and liaison. With the purpose to analyse the brokerage strategies of actors participating in the networks under study, a complete Gould and Fernandez (1989) brokerage analysis has been developed. Tables 4 and 5 display the most significant results obtained.

Focusing on KN-FT (Table 4), it can be observed that brokerage roles are well defined and performed by few actors. The TIC exhibits high scores in all types of brokerage, but it seems to have a more significant role as 'liaison'. This indicates that the presence of this actor encourages members from different groups to establish relationships and exchange knowledge. Likewise, the TIC also obtains a lead role as 'representative' of the R&D organizations group, which means that this actor also facilitates members of other groups to contact and absorb the knowledge of R&D

organizations. The University presents a similar brokerage profile to that of the TIC, but with lower scores.

Complementarily, the DMO in the area also presents higher values as ‘liaison’. However, the results focusing on each specific role (columns) show that the distinguishing roles are: 1) ‘gatekeeper’, encouraging public authorities to transmit knowledge to members of other groups; and 2) ‘coordinator’, favouring contacts and knowledge sharing between different public sector organizations. If one compares these results to the profile exhibited by the regional government, it can be seen that results obtained by this actor are higher in the case of the ‘representative’ role and ‘consultant’ role. This means that the regional government facilitates members of other groups to have contacts and access knowledge provided by public organizations and, at the same time broke relations between members of other groups to which it does not belong.

TABLE 4. ABOUT HERE

Results obtained in the case of KN-IE also show that in this network actors playing brokerage roles are more numerous (58) than in KN-FT (10). The rest of actors in each network obtained negative results and so, are not identified as brokers. Focusing on the top ten actors playing the most significant brokerage roles in KN-IE, R&D institutions (the TIC and the university), similarly to KN-FT, continue playing a leading role as ‘liaison’ and ‘consultant’, which means that these nodes speed up knowledge

exchange among all members of the network. Public organizations, in turn, do not display a role as relevant as in formal transfer but still are positioned as supportive actors assuming functions of 'liaison'. When it comes to informal exchange flows, firms – especially the larger ones – come into play as key actors facilitating knowledge dissemination. In this group, two types of brokerage roles can be identified. On the one hand, the 'liaison' function is played by larger local hotel chains, who facilitate the exchange of knowledge beyond the borders of their own group. On the other hand, a locally-owned resort firm stand as 'gatekeeper', acting as intermediary in the exchange of knowledge among members of its own group and actors representing other sectors in the network. This role is supported by several firms in the same sector, which are of help to coordinate the exchange of knowledge within the group, and in no case with members of other groups. Note that in Table 5, the representative column is missing because relations in this type of networks are non-directed.

TABLE 5. ABOUT HERE

With the aim to obtain a classification of actors depending on their role played in KN-FT and KN-IE, a cluster analysis technique was executed, using Euclidean distances and paired-group clustering and taking the normalized values of the five brokerage roles calculated for the two networks. Results obtained – see dendograms shown in Figure 3 – allowed to determine groups of actors with homogeneous performance but with a certain degree of heterogeneity with respect to actors included in other

clusters. In formal transfer processes (KN-FT) the cut level has been established giving a partition of actors into three different clusters, while in informal exchange (KN-IE), into four clusters. Tables 6 displays the main characteristics of each cluster as well as a definition of the role each cluster performs according to the brokerage results.

FIGURE 3. ABOUT HERE

TABLE 6. ABOUT HERE

Discussion and conclusions

Research to date evidences that networking and knowledge dissemination dynamics shape the nuanced characteristics of specialized regions.

However, there is need of further theoretical discussion and empirical research to understand knowledge network structures, the ways in which knowledge can be disseminated, as well as the actors whose role is key for these processes to be efficient in tourism specialized regions (McLeod and Vaughan, 2015). These are key issues that can benefit practitioners, academics, and professionals willing to create competitive advantage for firms and territories of tourism destinations in particular, and of specialized productive regions in general, (Hallin and Marnburg, 2008; Cooper, 2015).

This paper holds that a two-mode social network analysis method applied to tackle knowledge networks emerged from the participation of actors in seminars and courses can provide a better understanding of how

interactive learning in these productive places is supported by formal and informal relations (Østergaard, 2009; Bathelt and Glückler, 2011; Bathelt and Li, 2014), and shed light on who are the brokers enabling the proper performance of these networks (Drew, Ritchie and King, 2014). The results obtained raise some discussion points which help advance established concepts and theories in economic geography.

From an overall perspective, the results show that knowledge networks' structure are different depending on the nature of interactions. The degree distribution and centrality analysis confirmed the presence of few hubs in formal transfer and informal exchange (as found in Giuliani's 2007 work) and that these actors bring a glue that connects actors who tend to be isolated and engage them in interactive learning (Hallin and Marnburg, 2008). The comparative analysis of brokerage roles also helps revealing the significant role of other actors, besides the most prominent brokers, in knowledge dissemination.

These outcomes trigger the idea that tourism destinations can implement knowledge management strategies oriented to create an environment where actors consider knowledge diffusion and interactive learning as an essential process (Goddard, Robertson and Vallance, 2012; McLeod and Vaughan, 2015). This aim is particularly crucial when defining tourism policies aimed at promoting sustainable economic development which takes the generation, codification and adoption of internal and external knowledge as key for enhancing the resilience of tourism specialized productive regions to changing market conditions. Along these

lines, results show that the analysed knowledge networks are favoured by the presence of an organized structure in which several actors have an active participation and play complementary brokerage roles, which positively contribute to the proper performance of these networks and the localized system of learning. These organizational system is generally referred as ‘administered knowledge network’, which should be understood as efficient knowledge governance arrangements that speed up learning, innovation, and spread efficient business practices (McLeod and Vaughan, 2015).

More precisely, these resulting networks are understood as platforms willing to: 1) connect the diverse communities of practice present in a region, including academia, the public sector, and firms representing the different subsectors involved (Cooper, 2006); 2) enhance informal relationships and trust among stakeholders with the aim to ease the transmission of tacit knowledge (McLeod and Vaughan, 2015); 3) enrich the local knowledge base through the organization of seminars and courses on topics highly relevant to the operation of firms and organizations; and, finally, 4) orientate decision-making processes in innovative ways so improving the competitiveness of the destination and setting the grounds to new development pathways (Anton Clavé and Wilson, 2017; Sanz-Ibáñez, Wilson and Anton Clavé, 2017).

As illustrated in this paper, TICs are more than an interface between local stakeholders to facilitate the commercialization of scientific research (Goddard, Robertson and Vallance, 2012), but arguably act as a leading administrator stimulating university–industry–government relations. This

finding supposes a slight contrast to the prevailing idea that universities are the actors performing the most crucial role as drivers of knowledge creation and dissemination in regional economic development (Etzkowitz and Leydesdorff, 2000; Srinivas and Viljamaa, 2008). Furthermore, brokers are generally associated in the literature with gatekeeper functions, that is, as intermediaries that make connections between local and external knowledge (Breschi and Lenzi, 2015). This function is necessary for all specialized regions to enrich local knowledge bases and avoid lock-in – and can be identified in the networks studied – but, as the high values on liaison role evidence, brokers can also play a vital role when it comes to bridge ‘structural holes’ and facilitate local connections in the case of fragmented and traditionally not well-connected economic sectors.

The leadership of TICs expands the scope of the analysis usually focused on inter-firm relations (Balland and Rigby, 2015; Balland, Belso-Martínez and Morrison, 2016). What remains clear, however, is that knowledge governance can be favoured putting in place a distinctive division of complementary roles and functions among the different actors that intervene – as shown in the clustering analysis results – and a strong commitment and involvement of the main brokers – universities, public administrations at different levels, business associations, and leading firms operating in different subsectors – with a common objective: create an innovative environment for ensuring a knowledge-based development (Etzkowitz and Leydesdorff, 2000). Likewise, findings show that large firms became examples to follow when it comes to informal knowledge

exchange dynamics and act as driving forces for the rest of actors to be innovative and transform local communities (Feldman, 2014).

Administered knowledge networks should remain in transition, monitoring the sector dynamics at the destination and the global market, while in close contact with leading-edge knowledge, technology and expertise which help offering knowledge-related activities responding to skills and knowledge gaps identified. For these synergies to take place, there is need to ensure the sustainability and activity of TICs and their ‘administered knowledge networks’ by fund raising contracts by EU framework programs, governments at different levels, and sometimes also by private sector associations of firms (Goddard, Robertson and Vallance, 2012).

All in all, the research presented in this paper shows the potential of analysing tourism specialized regions to enrich economic geography and relational economic geography literature. Future research directions may be oriented to extend the analysis including external linkages, comparing knowledge networks with business networks, or even using other analytical tools that allow to examine in-depth the underlying mechanisms of formal and informal knowledge network dynamics, including social mechanisms and proximity issues. A comparative analysis of knowledge Informal Exchange and Formal Transfer mechanisms can also be applicable to other sectors characterized by low budget for research and personnel training, predominance of small and medium-sized firms, or with high levels of tacit and contextual knowledge.

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Figure 1. Visual representation of KN-FT (left) and KN-IE (right) networks. Colours correspond to different activity fields.

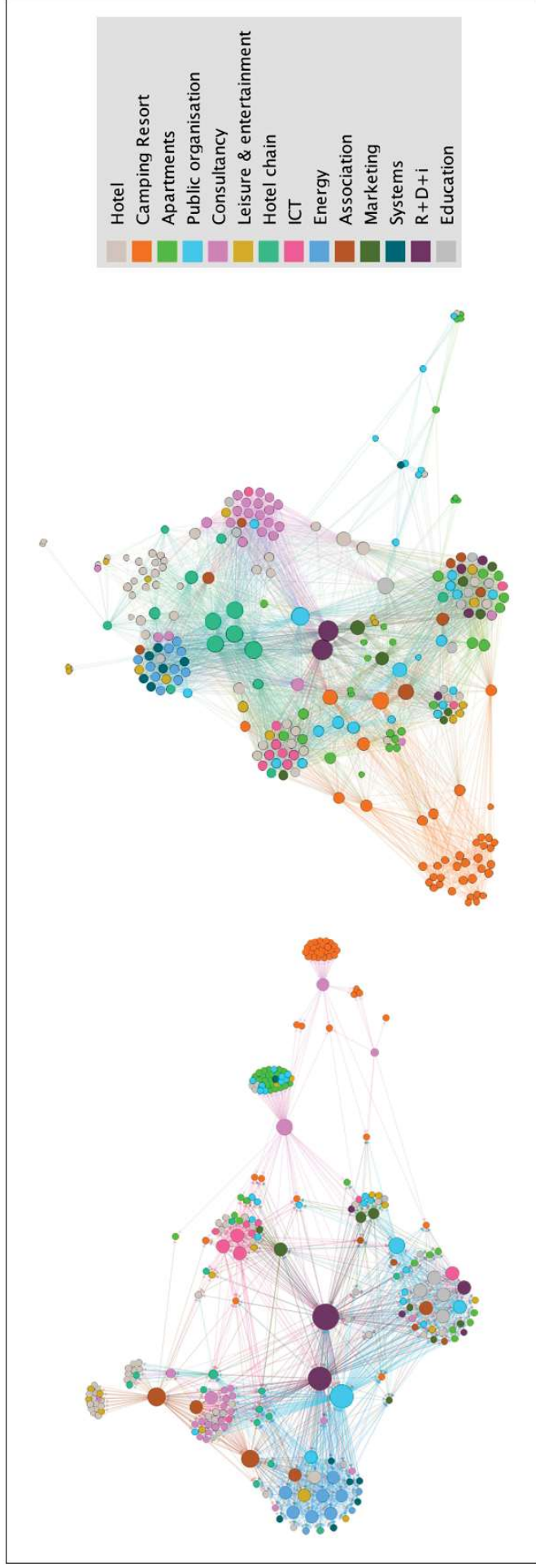


Figure 2. Cumulative degree distributions. *TOP: Total degree of KN-IE (left) and KN-FT (right). BOTTOM: In and Out degree of KN-FT (left and right, respectively). Sharp decays and long queues indicate a severely unequal scenario.*

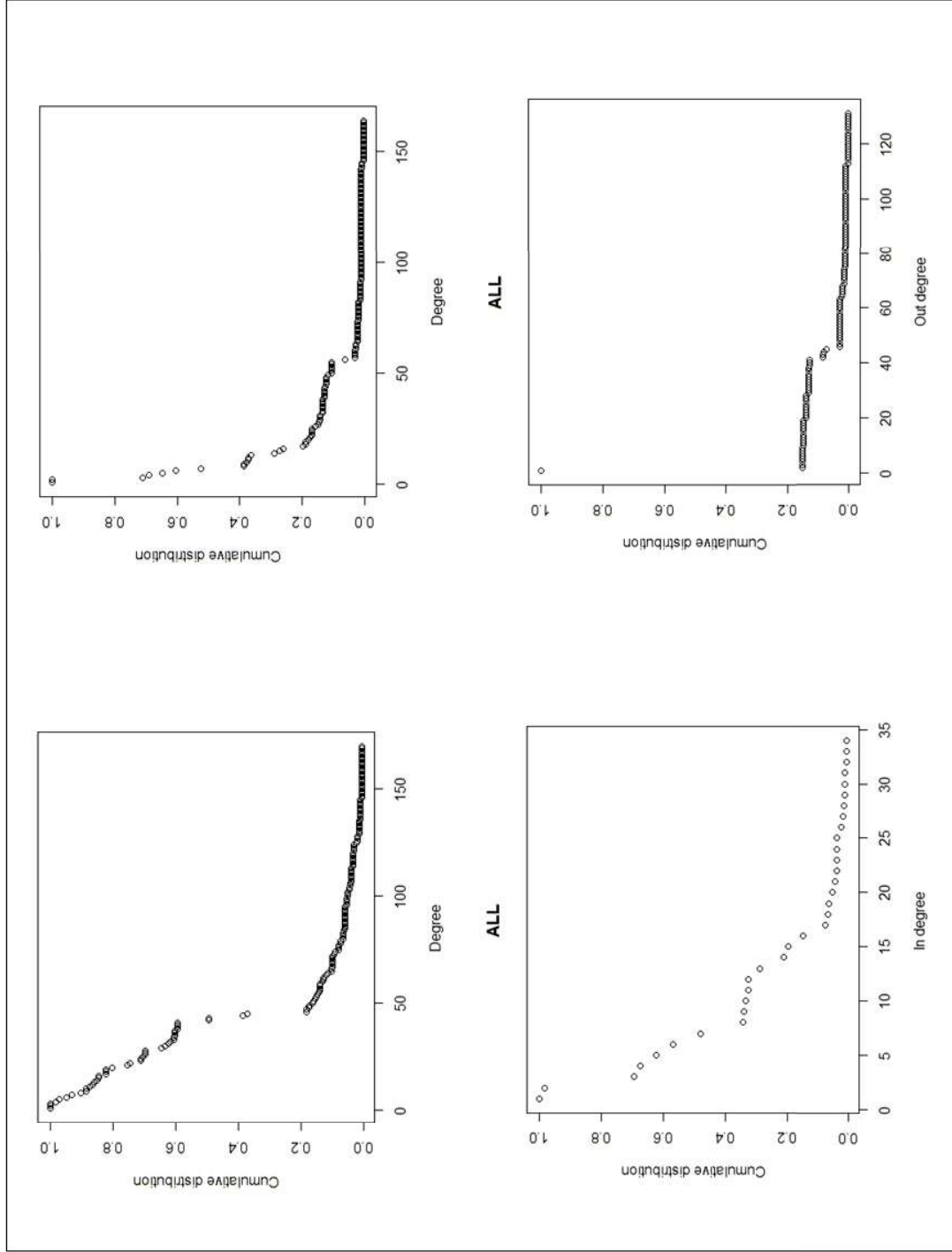


Figure 3. Dendograms representing the hierarchical clustering in KN-FT (left) and KN-IE (right).

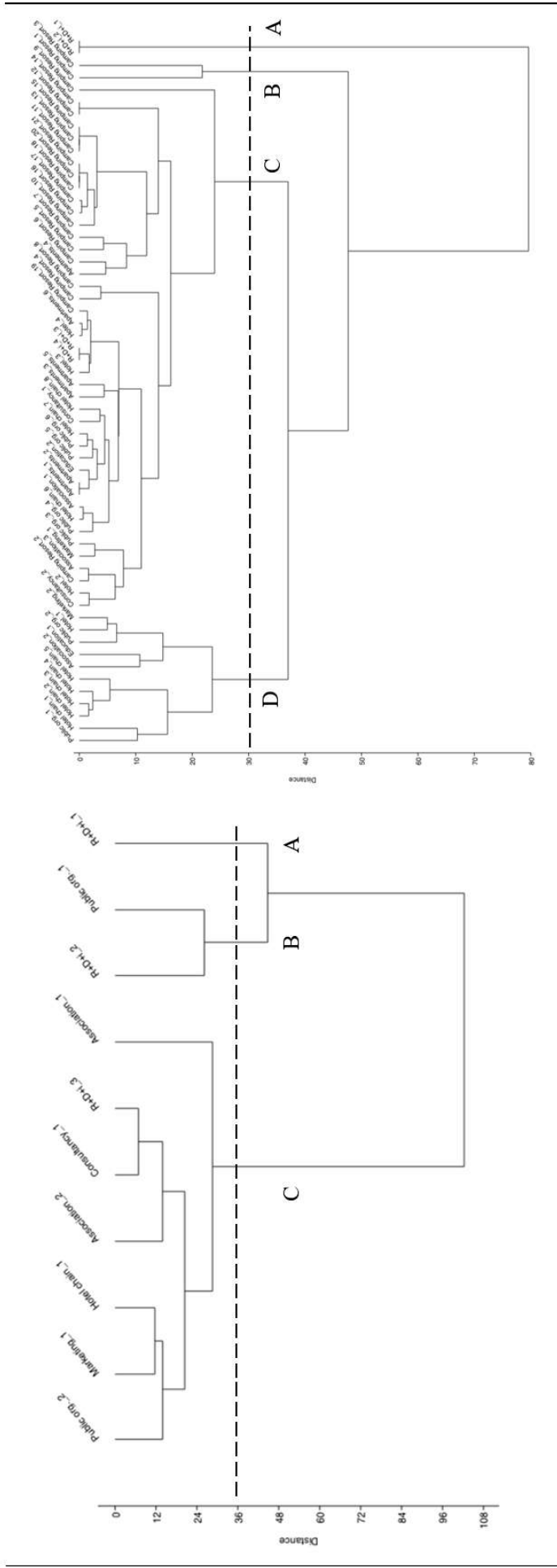


Table 1. Basic descriptive structural measures for both networks under study.

Structural measures	Informal exchange (KN-IE)	Formal transfer (KN-FT)
Order (Num. of nodes)	249	253
Size (Num. of edges/arcs)	4894	1804
Density	0.16	0.03
Clustering Coefficient	0.64	0.33
Ave. Path Length	2.04	1.78
Diameter	4	3
Degree assortativity	-0.05	-0.11
Assortativity by activity field	0.14	0.04

Table 2. Centrality measures for KN-IE (informal knowledge exchange represented as an undirected network).

Knowledge Network – Informal Exchange

<i>Degree centrality</i>		<i>Betweenness centrality</i>		<i>Closeness centrality</i>	
PCT – TIC	169	TPR – Local camping resort	2489.722	PCT – TIC	0.003
URV – University	169	RSS – Local camping resort	1872.379	URV – University	0.002
GEN – Regional Government	144	PCT – TIC	1813.717	GEN – Regional Government	0.002
EPS – Local hotel chain	134	URV – University	1813.717	BMJ – Consultancy	0.002
TPR – Local camping resort	127	OHT – Local hotel chain	1812.683	PTD – Destination Manag. Org.	0.002
OHT – Local hotel chain	124	4RH – Local hotel chain	1727.556	ITG – Consultancy ICT	0.002
4RH – Local hotel chain	123	RBH – Foreign hotel chain	1620.559	FOR – Tourist apartments	0.002
GRE – Local hotel chain	123	EPS – Local hotel chain	1431.092	LPA – Local camping resort	0.002
BEH – Local hotel chain	119	GRE – Local hotel chain	1149.978	STM – Consultancy ICT	0.002
ASC – Business Association	112	GEN – Regional Government	1075.880	IPR – Consultancy – MK	0.002

Table 3. Centrality measures for KN-FT (formal knowledge exchange represented as a directed network).

Knowledge Network – Formal Transfer

<i>Degree centrality</i>		<i>Degree (in) centrality</i>		<i>Degree (out) centrality</i>	
PCT – TIC	163	PCT – TIC	33	PCT – TIC	130
URV – University	144	URV – University	33	URV – University	111
GEN – Regional government	141	GEN – Regional government	30	GEN – Regional government	111
FEH – Business association	90	TPR – Local camping resort	27	FEH – Business association	73
PTD – Destination Manag. Org.	81	ATM – Consultancy MK	26	SCP – Business association	67
SCP – Business association	72	4RH – Local hotel chain	25	PTD – Destination Manag. Org.	63
GOT – Consultancy	62	EPS – Local hotel chain	24	GOT – Consultancy	62
IPR – Consultancy MK	59	BEH – Local hotel chain	24	IPR – Consultancy MK	44
AJS – Local government	55	GRE – Local hotel chain	24	ITG – Consultancy ICT	44
GHB – Business association	55	OHT – Local hotel chain	24	STM – Consultancy ICT	44
<i>Betweenness centrality</i>		<i>Closeness centrality</i>			
PCT – TIC	1593.927	PCT – TIC	0.003		
URV – University	1079.777	URV – University	0.002		
GEN – Regional government	863.027	GEN – Regional government	0.002		
SCP – Business association	411.169	GOT – Consultancy	0.002		
EPS – Local hotel chain	258.936	PTD – Destination Manag. Org.	0.002		
IPR – Consultancy MK	200.983	FEH – Business association	0.002		
PTD – Destination Manag. Org.	198.974	AJS – Local government	0.002		
FEH – Business association	191.886	SCP – Business association	0.002		
ESV – Consultancy	45.602	EPS – Local hotel chain	0.002		
AJS – Local government	11.083	IPR – Consultancy MK	0.002		

Table 4. Standardised Brokerage Scores (β) for the most relevant actors in KN-FT (formal knowledge exchange represented as a directed network). These values are calculated as z-scores and, assuming normal distribution, values $|\beta| > 1.96$ are considered to significantly exceed chance at any role (see Gould and Fernandez (1989) for details).

Nodes	Coordinator	Consultant	Representative	Gatekeeper	Liaison
PCT – TIC	23.635	32.173	72.693	38.342	105.156
URV – University	5.805	24.787	54.507	29.249	84.912
GEN – Regional government	10.328	14.805	32.218	23.287	79.212
PTD – Destination Management Org.	7.387	6.467	4.051	13.669	17.108
FEH – Business association	12.329	2.068	25.912	3.069	14.193
SCP – Business association	-0.182	-1.062	13.612	-0.445	1.251
EPS – Local hotel chain	-0.277	1.819	-0.561	11.973	7.879
IVT – Consultancy R&D	5.805	-1.351	-0.387	-0.387	-1.818
IPR – Consultancy MK	-0.161	4.621	-0.417	3.019	14.823
EST – Consultancy	-0.444	-1.281	1.354	11.973	0.439

Table 5. Scores for main brokers in KN-IE (undirected network).

Nodes	Coordinator	Consultant	Gatekeeper	Liaison
PCT – TIC	8.584	34.334	20.365	72.061
URV – University	8.584	34.334	20.365	72.061
GEN – Regional government	8.986	17.177	17.711	46.737
EPS – Local hotel chain	10.290	22.727	16.067	38.490
TPR – Local camping resort	15.166	5.421	38.547	20.596
OHT – Local hotel chain	10.290	19.939	13.228	30.221
GRE – Local hotel chain	10.290	21.301	12.786	28.984
4RH – Local hotel chain	10.290	18.514	12.995	29.405
BEH – Local hotel chain	10.290	16.376	11.878	25.902
RSS – Local camping resort	16.573	2.289	27.221	6.222

Table 6. Clusters of main brokers in KN-FT and KN-IE.

Cluster	N. Actors	Type of actor/s	Behaviour in the network	
KN-FT	A	1	TIC	Administrator (benchmark) Legitimated by others as the most knowledgeable actor – creates knowledge and/or make external knowledge available to others.
	B	2	University Regional Government	Partner Support the distribution of knowledge among actors in the network.
	C	7	Others (firms and business associations)	Supporter Benefit from other actors' knowledge or the new knowledge resources introduced in the network.
KN-IE	A	2	TIC	Administrator (coordinator) Proactively coordinates and favours the exchange of new knowledge through the organisation of activities where interactive learning can take place. Partner Support the distribution of knowledge among actors in the network.
			University	
	B	2	Large firms (isolated subsector)	Bridge Filter and transmit knowledge to members of their group when it is not well-connected within the network.
	C	43	SMEs DMO (regional/local) Business associations Consultancy	Supporter Benefit from other actors' knowledge or the new knowledge resources introduced in the network.
D	11	Regional Government Large firms Business associations	Seeker More actively involved in the network and in the search and exchange of knowledge. Example to follow and driving force.	