THE BROKERAGE ROLE OF SUPPORTING ORGANIZATIONS INSIDE CLUSTERS: HOW DOES IT WORK?

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ABSTRACT

The objective of this research is to deepen in the brokerage roles that supporting institutions play in conducting local business and technical knowledge inside clusters. We identify three main roles: a coordination role, characterized by the efforts that organizations play in internally coordinating themselves and establishing shared institutional framework; an interconnector role, where organizations foster communication along the value chain of the industry; and a gatekeeper role that allow organizations to connect cluster members with outside alters. Results obtained in the Toy valley cluster provide evidence that each kind of supporting organization tends to specialize in specific roles, since universities are best for a coordination role of technical knowledge while private organizations are key for vertical communication and coordination. Similar results were obtained when analysing the extra-cluster contacts that these organizations develop as gatekeepers, as they tend to establish specific communication conduits with their similar external alters.

Key words

Clusters, SME's, supporting organizations, networks, brokerage roles, gatekeepers

1. INTRODUCTION

The benefits of belonging to a cluster have been tightly connected with the boost of local networks between firms and supporting organizations (Giuliani, 2007; Hervás-Oliver *et al.*, 2015; Liao and Phan, 2015). Proximity fosters the exchange of valuable information about market trends, providers, use of machinery or regulations; while also provides a bases for the development of knowledge conduits between co-located agents (Morrison and Rabellotti, 2009). Sharing of information and experiences across organizational boundaries creates opportunities for transferring tacit knowledge and, subsequently, stimulates knowledge production and innovation (Inkpen and Tsang, 2005; Phelps, Heidl and Wadhwa, 2012).

Supporting institutions have traditionally been considered a key player in the development of these local networks. Beyond providing the cluster with specific support services, they act as repositories of/for? knowledge and opportunities for firms (McEvily and Zaheer, 1999). These institutions serve as brokers among firms that have complementary interests and could share information and knowledge. Rather than firms all being linked to each other, each can maintain a single connection with the supporting institution that specializes in providing access to information and knowledge held by the others (Almeida and Kogut, 1999; McEvily and Zaheer, 1999). They interact with a large number of firms, all undertaking similar activities and facing similar problems, so they have compiled and developed extensive experience and knowledge that can help firms to innovate their products and processes. It provides an opportunity for mutual learning that stimulates the creation of new knowledge and, at the same time, contributes to firms' ability to innovate (Molina-Morales and Martínez-Fernández, 2004).

Abundant literature has confirmed the benefits of supporting institutions in fostering local innovation. Research has shown how government agencies and supporting organizations act as mediators fostering cluster development (Mesquita, 2007; Gagné *et al.*, 2010). As facilitators, supporting institutions establish a flow of information, ideas, and knowledge within clusters (Gagné *et al.*, 2010) and provide new knowledge to innovate (F Xavier Molina-Morales, 2005). Evidence from the Boston biotech cluster points out that supporting organizations frequently coordinate knowledge between local firms (Owen-Smith and Powell, 2004). In their analysis of the regional innovation systems, Kauffeld-Monz & Fritsch (2013) prove that public research organizations are profoundly involved in knowledge exchange process and possess central brokerage positions within the regional innovation network. More recently, Molina-Morales & Martínez-Cháfer (2014) show that supporting organizations are relevant intermediaries of knowledge in the tile cluster of Castellon and provide evidence of the benefits they generate.

Nevertheless, it is not clear how supporting institutions articulate the connections between different members of the cluster (Molina-Morales and Martínez-Cháfer, 2014). There are questions such as if some supporting institutions have a brokerage role with other institutions that reinforce their intermediation inside cluster, or if they support knowledge and information transfer between agents, that need of further research. In this study we try answer these questions by deepening in the different brokerage roles that supporting institutions play in conducting local business and technical knowledge.

In doing so this paper firstly tries to contribute by incorporating a taxonomy of different brokerage positions (Gould and Fernandez, 1989) into existing studies about supporting institutions. Along with the general benefits associated with brokerage positions, there are also specific advantages that stem from different brokerage roles, identified by considering the characteristics of those that the institution is connecting to. Each type of brokerage role is the result of different connections in the local network, having diverse effects on the local exchange of information and knowledge. Through their own history, firms and supporting institutions establish different relationships that build a unique structure of local relationships (Balland, Belso-Martínez and Morrison, 2016). Due to the specificities of each portfolio of linkages, brokerage roles change with the agents involved, so do their functions of knowledge creation, transformation and transmission (Howells 2006).

In this vein, we try to refine our comprehension of the brokerage phenomenon in clusters by exploring the relevance of supporting organizations as bridges between the local network and the global sphere. By quantitatively comparing cluster supporting organizations and firms, we elucidate the mechanisms underlying the different processes facilitating knowledge flows from local and non-local repositories of knowledge. Furthermore, we also try to extend current literature by suggesting implications induced by the characteristics of different knowledge flows under different positions of the supporting institutions (Alberti and Pizzurno, 2015).

Finally, we try to understand the brokerage role of supporting institutions for both information and knowledge flows between agents of the cluster. In this sense, contacts established between peers (e.g. entrepreneurs, workers, researchers) do not necessarily entail transfer of tacit knowledge; it is more likely that they serve to share information. It is generally agreed that transferring and collectively creating tacit knowledge is most valuable for fostering local innovations (Maskell and Malmberg, 1999; Maskell, 2001). In spite of that, knowledge flows are also restricted only to few agents in the cluster, reducing the opportunities to establish

brokerage roles, that can be compensated with information flows between a broader group of agents (Morrison and Rabellotti, 2009).

Data collected in the Toy Valley in the Valencia region (Spain) using Roster-recall methodology and Social network analysis, corroborate the prevalence of local supporting organizations in knowledge mediation activities. Findings also reveal that not all these organizations broker knowledge to the same extent due to the specificities of each organization and the characteristics of knowledge shared. After this introduction, we present the theoretical framework. Then, the context of the investigation, the methodology and the results of the analysis carried out are described. Finally, the conclusions are discussed and the main limitations and potential future lines of investigation are presented.

2. THEORETICAL FRAMEWORK: THE BENEFITS OF DIFFERENT BROKERAGE POSITIONS

The understanding of how co-located firms and institutions inside clusters transfer and create knowledge has compelled to a growing recognition of network literature in regional studies (Morrison and Rabellotti, 2009). Rather than focusing on how proximity fosters mutual understanding, network perspective research concentrates on the structure of relationships that are developed between different members of the local network as communication enablers (Giuliani, 2007; Balland, De Vaan and Boschma, 2013). As a consequence, the position of each firm or institution in the web of relations becomes the main determinant of the cluster success (Crespo, Suire and Vicente, 2014). Strategic positions within networks where knowledge is exchanged, allow organizations to better access external knowledge sources (Buckley *et al.*, 2009), facilitate common learning processes (Schoenmakers and Duysters, 2006; Nooteboom, 2008) and improve performance (Zaheer and Bell, 2005; Shipilov and Li, 2008).

Brokerage roles connecting two different actors that otherwise would not have a relationship, is one of those strategic positions in a network (Burt, 1997; Hargadon and Sutton, 1997; Ahuja, 2000; Zaheer and Bell, 2005). This intermediary or brokerage situation enables privileged access to information transferred between unconnected partners and opportunities for arbitrage and better capitalizes on existing capabilities (Burt, 1997; Hargadon and Sutton, 1997; Zaheer and Bell, 2005; Shipilov, 2006). Accordingly, brokers emerge as facilitators of knowledge transfers (Nooteboom, 2003) and innovators that recombine external knowledge to create novel solutions (Hargadon, 1998; Verona, 2006). Moreover, other strategic positions in the cluster network, overall centrality, depend on the brokerage roles (Vicente, Balland and Brossard,

2011). Even in mature clusters, brokerage positions in local networks significantly increases firms innovative capacity (Casanueva, Castro and Galán, 2013).

While any actor of the network could play a brokerage role, the benefits associated to a supporting organization in an intermediary position are remarkable. As brokers, supporting organizations compile and disseminate knowledge and information between firms. Because these institutions interact with a large number of firms, they are exposed to a wide variety of solutions to organizational challenges. Based on broad experience from observing others who have dealt with similar problems, supporting organizations compile and disseminate summaries about capabilities and routines (McEvily and Zaheer, 1999; Molina-Morales and Martínez-Fernández, 2004). By connecting two unrelated agents, supporting organizations span the structural hole between them (Burt, 1992). When bridging unilateral ideas from two independent organizations, the supporting organization absorbs knowledge and boosts its dissemination within the network (Hargadon and Sutton, 1997; Hargadon, 2002). Competitors, providers and other actors of the network connected through a supporting organization can access to a greater diversity and amount of information, such as reports, documents and data, as well as to technological support by means of joint projects, machinery and specific facilities or specific instructions (Morrison and Rabellotti, 2009). By internally recombining the acquired knowledge and spreading more polished knowledge, supporting organizations in a brokerage position reinforce the cluster innovation potential practices (Clarke and Ramirez, 2014).

Cluster actors can play one or more brokerage roles, and using different contexts and alternative grouping criteria, previous research has identified different brokerage types and the implications derived (e.g. Lissoni 2010; Kirkels & Duysters 2010; Belso-Martínez et al. 2015). Following the methodology suggested by Gould & Fernandez (1989), cluster literature has frequently categorized brokerage roles based on actors' position within the local value chain (Belso Martínez, Molina-Morales and Martínez-Cháfer, 2015; Boari, Molina-Morales and Martínez-Cháfer, 2016), differentiating between firms and diverse supporting organizations (Alberti and Pizzurno, 2015) or splitting the population into two strata with location inside or outside the cluster (Vicente, Balland and Brossard, 2011). In particular, depending on the kind of actors interconnected, supporting organizations can play different brokerage roles each one with specific benefits and consequences for the cluster (Gould and Fernandez, 1989). As brokers, supporting organizations can connect actors that are also supporting organizations, behaving as broker-coordination type, or they can attach actors from other groups inside the

network, such as suppliers or competing firms (Molina-Morales, Belso-Martinez and Mas-Verdú, 2016).

If a supporting organization is attaching actors that are also supporting organizations, such as government agencies, universities or technical centers, it is developing a brokerage role of "coordination" (Gould and Fernandez, 1989). In this case, the supporting organization is favouring the exchange of information and knowledge between other institutions so communication between them would be greater, diffusing even more the experiences, knowledge, and valuable information that each local organisation would have obtained from their direct connections. In this sense, the coordination institution would strength existing links within the cluster by increasing the connectivity between them all (Molina-Morales, Belso-Martinez and Mas-Verdú, 2016). Also, the coordination institution helps the cluster to harness the collective action of groups or communities of actors (Clarke and Ramirez, 2014). Under a coordination organisation, the pressures to conform similar habits, norms, and routines between other local supporting organisations would be higher inside the cluster (Baum and Oliver, 1992). These pressures to conform common understandings would make communication easier between local organisations but also with firms and other actors of the cluster. As long as actors of the cluster follow these shared rules, values and conventions, they would more easily understand others' experiences and learn others' knowledge (Díez-Vial and Fernandez-Olmos, 2014). This is specially the case for transferring knowledge between firms, as they have to embark on a long, costly process of persuading, coordinating and learning from others that is attenuated under a shared institutional framework (Storper, 1995).

On the other hand, if a supporting organization is attaching actors from other groups, such as direct competitors in the industry or their providers, the institution is playing an "interconnector" role (Gould and Fernandez, 1989). In this case the supporting organisation intermediates between actors that are in different stages of the value chain, each one with distinct knowledge and information base. By knitting them together, the interconnector organisation provides an opportunity for novel recombinations of knowledge and experience in the cluster based on a certain diversity of the participant, so beneficial for further development of the cluster (Van den Bergh 2008). When actors are too similar in terms of their knowledge bases, as it usually happens between direct competitors in the cluster, they can add few to each other's knowledge (Porter, 1990). Suppliers provides a certain diversity, difference enough to engender new sources of ideas and knowledge, but not too much difference that makes mutual understanding and learning overwhelming (Lorenzoni and Lipparini, 1999). While this

connection role between different stages of the value chain could be developed by any actor of the cluster, thanks to their systematic network monitoring through the guidance and management of inter-firm cooperation (Owen-Smith and Powell, 2004; Almodovar and Teixeira, 2014), supporting organizations tend to have more complete information about the others' activities, finding it easier the role of successful matching along the value chain.

Along with these brokerage roles that supporting organizations can play, a third category emerges when considering connections with actors outside the cluster, called "gatekeeper" (Giuliani, 2011). Further than mediating locally, supporting organizations may also act as gatekeepers connecting the local buzz and the global pipelines (Bathelt, Malmberg and Maskell, 2004; Montoro Sánchez and Díez Vial, 2016).While intra-cluster mediation allows network actors to learn easily and continuously through recombination of knowledge (Molina-Morales et al. 2015), extra-cluster connections are crucial for the acquisition of new knowledge the survival of the cluster (Bathelt, Malmberg and Maskell, 2004; Wolfe and Gertler, 2004). Actors with strong connections outside the cluster, introduce external novelties into the system cluster (Morrison, 2008; Munari, Sobrero and Malipiero, 2012), enable new knowledge production, minimize risk of lock-in (Molina-Morales and Expósito-Langa, 2013) and induce cluster renewal (Molina-Morales and Expósito-Langa, 2013; Hervas-Oliver and Albors-Garrigos, 2014). Therefore, institutions that behave as gatekeepers serve two functions in the cluster: they obtain international knowledge and they disseminate it within the local network (Giuliani, 2011; Graf and Krüger, 2011).

Although leader firms frequently play this role of gatekeepers of knowledge (Giuliani and Bell, 2005; Morrison, 2008; Giuliani, 2011; Graf and Krüger, 2011; Munari, Sobrero and Malipiero, 2012; Randelli and Lombardi, 2014), supporting organizations can also exert external effects on the innovation system. In fact, they serve the functions of a gatekeeper to a greater extent than private actors (Graf, 2011; Kauffeld-Monz and Fritsch, 2013), and are crucial in lagging regions that suffer a lack of large firms. From the point of view of the gatekeeper, it means that it has to interact frequently and have a sufficient number of both local and international interactions, which requires a specific network structure that needs to be better understood (Boari and Riboldazzi, 2014). When an institution undertakes this role, they are not only increasing the openness of the cluster but also reducing the costs of maintaining so many contact to firms in the cluster (Hansen, 1999; Sharma and Blomstermo, 2003). As it was explained before, the institution facilitates the access to valuable knowledge from other institutions and firms, broadening the exposure of the firm to a greater diversity of perspectives, ideas, and

experiences (Francesc Xavier Molina-Morales, 2005; Stam and Elfring, 2008). In this sense, having connections outside the cluster expands even more the access to knowledge beyond what is available through each firm direct contact (Bunker *et al.*, 2009).

3. METHODOLOGY

3.1. The Toy valley cluster

The heart the toy sector in Spain is in the Valencian Community where 41.3% of jobs and 38.4% of total sales are concentrated. Approximately, 88% of the Valencian companies agglomerate in the Toy Valley, specifically in the cities of Ibi, Onil, Castalla, Tibi and Biar. Manufacturers are usually family-owned and small in size. The geographical concentration of related productive activities and the tight linkages between socio-economic actors allowed previous research to identify this area as an industrial cluster of Marshallian type (e.g Boix & Galletto 2006).

The origin of the Toy valley cluster dates back to late 19th century, when influenced by external stimuli, some families brought their experience and knowledge acquired through handicraft occupations to start producing dolls, miniatures or small cars. Progressively, a solid industrial atmosphere surrounded the area, and outdated manufacturing practices were replaced. During the 60's and 70's, the cluster underwent intense development which favored an accelerated accumulation of resources and strong spin-off dynamics.

The following decades witnessed a decline in the average number of workers per firm and the acceleration of outsourcing practices. In line with other Valencian clusters, economic perspectives deteriorated due to fierce global competition and the erosion of traditional competitive advantages (mainly based on labour costs). This decline slowed in the 90's after an intense reorganization of the system in which many flagship companies disappeared because of scarce flexibility. Technological innovations and the fragmentation manufacturing processes materialized in a compact population of firms, tightly linked in cooperative networks.

Four key factors determine the cluster´s current situation. Firstly, even the programs implemented, toys sales remain highly seasonal. Secondly, the spiralling competition from low cost producers, has widely reduced the market share of traditional Spanish toys. Thirdly, new market trends show preference for electronic gadgets in general. Fourthly, opportunism and irregular practices have become a major problem. Cheap imitations or unsafe products from Asia are having a detrimental effect on the track-record of many local manufacturers.

---Insert Figure 1 here ---

The systemic structure and supporting organizations of the toy valley is complex. As Figure 1 shows, a wide variety of network actors operate from different perspectives and stages of the value chain. For decades, in line with the "Marshallian" tradition, co-location fostered cooperative relationships and a climate of trust among the different actors (Hernández Sancho, 2004; Ybarra Pérez and Santa María Beneyto, 2006). However, both local and particularly international sourcing has turned out to be a major strategy (Belso Martínez and Escolano Asensi, 2009). The openness of local manufacturers assuming the inherent transaction cost, has also favoured the acquisition of extra-cluster knowledge and diminished the potential risks of cognitive lock-in (Hervás Oliver *et al.*, 2015).

---Insert Table 1 here ---

Table 1 provides a detailed list of the supporting organizations that support the development of the toy cluster. Most of their objectives are related to the "Marshallian" tradition such as R&D, consolidation of local networks, professional training or specialized services. However, growing efforts for scrutinizing and interacting in the global arena have enhanced their role as catalyzers and hybridizers of novel knowledge that is subsequently diffused within cluster boundaries. Just like in other clusters (F Xavier Molina-Morales, 2005; Molina-Morales and Martínez-Cháfer, 2014), once the potential advantages-opportunities that exist beyond the cluster borders had been evaluated, they have become transmitters of this technical and managerial knowledge at ~~th~~e local level.

The technical Institute for toy-making (AIJU) and the Spanish association of toy manufacturers (AEFJ) exemplify the above-mentioned activities. By providing specific services at reasonable cost, AIJU plays a pivotal role actor in the construction of firms' and capabilities. Additionally, it serves as a valuable repository of novel knowledge and fosters innovation by assisting in spheres such as product development, manufacturing or training. AEFJ has also contributed decisively to local competitiveness and innovation by providing a variety of services such as legal assistance, institutional representation and training. Moreover, the business association behaves as a forum where valuable managerial experiences are diffused within local actors of the network. Besides, several projects have transformed AEFJ into the leading star for the development of new products or the identification of market trends. For instance, AEFJ launched Spora, a specialized site that brings together all the creative potential generated by

designers and supporting organizations with the purpose of being disseminated amongst toy firms.

3.2. Data and Measures

We developed a questionnaire on the basis of previous literature and 8 in-depth interviews with relevant local manufacturers, researchers and institutions. The population of the firms surveyed was drawn from the business register of the local technical and business associations (AIJU and AEFJ respectively) which also aided us to correctly identify the population. Further research and refinement through the Iberian Balance Sheet System database (SABI) and key informants was also conducted. As our analysis takes into consideration not only firms but also a set of local supporting organizations, indications from the local associations and key informants were used to detect them.

The preliminary questionnaire was only slightly modified as a few problems were encountered during the pre-test pilot. To collect network data, "roster-recall" methodology was applied. Each interviewee was asked to select from an open list of local firms and supporting organizations from which technical or business information was received. Since we aim to evaluate the role of supporting organizations in both business information and technical knowledge networks, we asked the following questions in the roster: a) To which of the following firms on the list did you regularly ask for technical advice? b) To which of the following firms on the list did you regularly ask for business information? (Giuliani, 2007; Morrison and Rabellotti, 2009; Balland, Belso-Martínez and Morrison, 2016). Additionally to the members of the cluster, participants were invited to include other firms not listed from whom technical advice or business information had been obtained.

To guarantee accuracy of responses, a local technician largely involved in the toy industry and innovation programs administered the questionnaire to top-level managers and business owners through a 45-50 minute face-to-face interview. At the beginning of each meeting, the benefits of the project were explained and confidentiality was guaranteed to encourage accuracy in the replies given (Eisenhardt, 1989). Strong interest of informants in the results of the study assure the accuracy of records, so access to final results was offered an encouraged (Miller, Cardinal and Glick, 1997).

At the end, a total number of 85 firms and supporting organizations located in the Toy valley, accepted to collaborate during 2014. This yields a response rate of 95% on the total population identified initially. Toy manufacturers accounted for 39%, while suppliers and local

organizations represented 49% and 12% respectively. Peer debriefing by AIJU experts confirmed that all relevant players were considered and missing actors were very scarce.

Since relational data collected refer to two different networks, business information and technical knowledge networks, we organized data into two matrices composed of 85 rows and 85 columns, corresponding to the number of firms and local organizations in the cluster. The cells in the matrix show 1 for the existence of a tie between actor *i* in the row to actor *j* in the column and 0 otherwise. The matrices are asymmetric, given that the transfer of knowledge from actor *i* to actor *j* may not be bi-directional.

To test the brokerage role of the supporting organizations, we have measured the brokerage role of all different actors in the toy cluster network grouped into: i) supporting organizations ii) toy manufacturers, iii) suppliers, and iv) others. Supporting organizations, the main interest in this research, comprise government agencies, business associations, universities and technical centers. Suppliers are mainly providers of specialized inputs for the toy industry (e.g. eyes and hair for dolls). The final category, others, amalgamates firms producing non-specialized inputs (e.g. boxes).

In order to evaluate the mediating behaviour of the surveyed firms and local organisations, we assume a cluster's actor 'i' as being involved in brokerage if 'i' is directly connected to actors 'j' and 'g', but 'j' and 'g' are not directly tied (Gould and Fernandez, 1989). Based on the above categorisation derived from the activities conducted by the actors in the cluster network, we distinguish three different brokerage scores between the groups:

a) Brokerage score: counts the number of times an actor *i* mediates between *j* and *g*, regardless of what group the actors belong to. This is the general measurement of brokerage, without entering in the detail of specific roles.

b) Coordinator score: counts the number of times an actor *i* brokers between two unconnected actors, *j* and *g*. All three actors belong to the same category. In the specific case of supporting organizations, this means that there is a institution *g* that connect the institutions *i* and *j*.

c) Interconnector score: counts the number of times an actor *i* links together two unconnected actors *j* and *g*. All three actors belong to different groups. For this interconnector role developed by a supporting organization g, it means that the brokerage takes places between two actors of different groups: supplier, manufacturer or other.

In order to evaluate the role of supporting organizations as gatekeepers, we need to include a measure of extra-cluster connectedness for each actor of the network. We use information on the existence of extra-cluster linkages with providers, customers, competitors, consultancy services, universities, public research centres and private research centres. Following previous studies (Giuliani and Bell, 2005; Belso Martínez, 2006), we created a dummy variable that takes value 1 if any of these extra-cluster connections exist, 0 otherwise.

3.3. Results

Descriptive results about both knowledge and information networks are summarized in table 2 with several indicators such as density, reciprocity and transitivity. The density of our technical networks, measured by the number of ties between actors divided by the total possible connections, reveals tightly-knit structures and suggests a quicker flow of resources. The reciprocity value, reflecting mutuality in the information exchange, shows the rising steady trend of members to reciprocate business knowledge. Transitivity indicates balanced triads, which is therefore evidence for the existence of stronger ties in the business network.

---Insert Table 2 here ---

Social analysis techniques were also used to calculate the three brokerage scores for both networks. Once obtained, we applied permutation models for statistical analysis of dependent data and ranked the supporting organizations to statistically observe significant differences between brokerage structures. Permutation tests are a versatile class of statistic procedures in which the distribution of the test statistic is obtained by repeatedly permuting data (5,000 times in our case). These procedures are widely used within the field of social network analysis because of their robustness to dependence within the input data (Butts, 2007). In addition, analysis of variance was conducted to verify theoretical insights regarding gatekeeper behavior.

Cluster actors were successively divided into two factions, based on their profile, to examine the difference in each brokerage score between the subgroup of interest and the rest. Table 3 displays permutation model results based on the actor subgroup affiliation. Supporting organization present the highest global brokerage activity in both the technical network (p-value<.01) and the business network (p-value<.05). Within the technical network, note that both toy firms and local organizations significantly perform the coordinator role (p-value<.1 and p-value<.05 respectively) and the interconnector roles (p-value<.05 and p-value<0.01). In the business network, supporting organizations only, coordinate (p-value<.05) and toy firms

interconnect (p-value<.0.01) with significantly high frequency. These findings again demonstrate that supporting organizations are the most prominent sub- group among the brokers, and thus have the most opportunities for facilitating coordination or transferring valuable resources in the cluster.

---Insert Table 3 here ---

Table 4 lists the ten supporting organizations in the Toy Valley ranked by their global brokerage score. Only a few of the organizations have scores that are significantly high across the different types of brokerage in either the technical or the business network. Furthermore, individual organizations show differential tendencies for specific brokerage roles (significance levels are determined using network permutation models). Note that both AIJU and AEFJ occupy all roles in the two networks with a significantly high frequency (p-value<.01). OTRI-UA and OTRI-EPSA occupy coordinator positions with a significantly high frequency, but do not evidence a relevant interconnector or very scarce global brokerage. "Fundación crecer jugando" is tightly linked to AEFJ, brokers technical knowledge through the three structures (p-value<.01). Finally, ADL-Castalla achieves statistical significance for horizontal brokerage in the technical network (p-value<.01). This unexpected result can be explained as it is the only actor providing technical training in this city.

---Insert Table 4 here ---

Table 5 displays the results of the analysis of the gatekeeper behaviour".[1] Local supporting organizations attain the greatest number of extra-cluster connections. However, most of their linkages are limited to knowledge-intensive service providers such as consultancy services, public research centres and universities (p-value<.01) or private research centres (p-value<.05). Toy producers and suppliers infuse knowledge from similar ones located outside the cluster (p-value<.05 and p-value<.1 respectively).

---Insert Table 5 here ---

3.4. Discussion

The results obtained in this research show that network characteristics of the toy cluster do not significantly differ when considering the technical or the business network. In both cases local

[1] Values reflect mean differences between the group of interest and the rest of the sample. Only statistically significant positive mean differences are highlighted to ease the interpretation of results.

actors develop web of connections with similar density, reciprocity and transitivity (Table 2). Nevertheless, when a deeper analysis is taken into account, analyzing with whom these connections are created at actor level relevant differences appear. Consistent with recent research (Kirkels and Duysters, 2010; Alberti and Pizzurno, 2015), we demonstrate that brokerage activities are performed by certain cluster actors, particularly local supporting organizations. Moreover, our findings also reveal that different flows of knowledge and information imply different kinds of participation in brokerage role (Giuliani and Bell, 2005; Morrison and Rabellotti, 2009).

Dealing with different actors, results show that above any other actor in the cluster -supplier, toy firm or others- supporting organizations play significant brokerage role in the local network (Table 3). Globally considered, they play a significant role in both the technical network and the business network, while none of the other actors do. Disentangling the different brokerage roles, we have observed that the interconnector role is significant only in the technical network, but not in the business network. It would imply that supporting organizations favor the transfer of technical knowledge along the value chain but that local firms do not need of these organizations to transfer more explicit business information. While previous studies have pointed out the relevance of leading firms in creating this interconnector role (Lorenzoni and Lipparini, 1999), is this research we observe that supporting organizations also play this role. In this sense, (Hoffmann *et al.*, 2017) in their study of the behavior of the industrial district of Castellón before and after an economic crisis, confirmed the presence of vertical cooperation involving local supporting organizations to surmount the crisis.

The coordination role of supporting organizations can be observed in both the technical network and the business network, indicating the benefits of shared norms and values disseminated by the higher connectivity between organizations. In his study of the Chilean Salmon cluster, Maggi Campos (Pietrobelli and Rabellotti, 2006) attributed part of its success to the development of local institutions, universities and other R&D and technology transfer centers, that helped to establish common standards along the cluster.

Analyzing each supporting organization and its brokerage roles (Table 4), we can differentiate between universities and private organizations. Universities, except for the University Miguel Hernandez, have a role of coordination on other supporting organizations, but not an interconnector role. A plausible explanation for these results is that universities tend to be focused on generating scientific research not easily transferred to firms and suppliers because it is generally considered too general, or too theoretical and fundamental, and thus too long-

term to be immediately used (Díez-Vial and Montoro-Sánchez, 2016). They indirectly transfer knowledge via the publication of research results, technology transfer or graduates offices (Kirkels and Duysters, 2010).

Private organizations, mainly AEFJ and AIJU have an important role as both coordination and interconnector in the technical and business network. In line with previous research (Alberti and Pizzurno, 2015), the prevailing positions of AEFJ, AUJI respond to their capability to mix market and technical knowledge thanks to a wide number of relationships, helping to circumvent potential technological bias (Alberti and Pizzurno, 2015). Interestingly, we support the prominence of business associations in brokering any kind of knowledge that would increase cluster competitiveness through the activation of networks and the channeling of resources. This is possible due to the increasing involvement of AEFJ in the innovation field, either directly or indirectly -e.g. through The "Fundación Crecer Jugando"-.

Finally, the gatekeeper role of supporting organizations is relevant for some extra-cluster contacts (Table 5). Previous research has found that local institutions have a positive effect on a cluster openness (Aydalot and Keeble, 1988; Nassimbeni, 2001) as long as firms have established relationships with supporting organizations. Analyzing with whom outside the cluster supporting organizations interact, we have observed that these contacts are mainly other supporting organizations -universities, public research centers and private research centers- and consultancy services. As happens inside the cluster, supporting organizations prefer to establish relationships with other organizations, leaving extra-clusters contacts along the value chain based on transferring not highly tacit information to toy firms and their suppliers.

4. CONCLUSIONS AND IMPLICATIONS

Using data collected in the Toy valley, this study adds to cluster literature a thorough analysis of their supporting organizations brokerage roles. Our findings highlight the importance of incorporating network level research on cluster studies. While at cluster level we could not identify significant differences between the web of relationships established to exchange business and technical knowledge, as we disentangle these relationships, focusing on specific actors, relations and positions in the network, interesting conclusions can be presented.

Firstly, we have observed that supporting organizations have a relevant role of brokerage between different actors of the value chain, mainly manufacturers and their suppliers. This activity is leaded by private organizations that foster mutual understanding between other actors in other to successfully transfer technical knowledge and business information. As a consequence, each actor of the value chain can benefit of the experience and knowledge of the others, while keeping specialized in their own capabilities. On contrary, universities are more oriented toward the coordination of supporting organizations, providing a shared institutional environment that helps mutual understanding inside the cluster.

Secondly, we have examined in detail the role of supporting organizations as gatekeepers, opening the cluster to external contacts. We have noticed that supporting organizations tend to establish extra-cluster contact with other supporting organizations, while suppliers and manufacturers do the same with their extra-cluster alters. This finding endorses our arguments about brokerage specialization, so rather than substitutes, supporting organizations and firms have a complementary role so the gatekeeping role of one reinforces the gatekeeping role of the others.

These results have valuable managerial and policy implications. First, clusters actors engaged in innovation practices need access to diverse repositories of knowledge as they have complementary roles. Managers should design their position in the network taking into account the specific benefits that supporting organizations can provide. While linkages with supporting organizations maximize the opportunities to obtain both technical and business knowledge, caution should be taking when selecting potential partners among them, as not all local supporting organizations are source of knowledge an information in the same extent. Moreover, contacts with supporting organizations do not eliminate the necessity of firms to establish their

own contacts. As long as they combine their own brokerage actions with those provided by the supporting institutions they could benefit most from the cluster.

Policy makers should conceive programs in view of the asymmetric capacity of cluster actors to disseminate knowledge locally. Partnerships including relevant brokers like supporting organizations or certain firms would be advisable in order to benefit from more recombinable knowledge. In addition, local supporting organizations should consider potential strategies to build extra-cluster relationships with toy manufacturers and suppliers that would engender complementary knowledge flows and synergies.

This study is not without limitations. The analysis concerns one cluster during its maturity stage. Comparisons with systems in other industries and evolutionary stages may generate complementary results and discard potential biases. Longitudinal research based on network data would also throw interesting insights. Our analysis of gatekeeper activities seems limited compared to intra-cluster brokerage. Supplementary research should try to refine and extend these results. Including extra-cluster relationships in the network data would be advisable. Finally, another research path is related to innovative returns provided by each brokerage structure and broker profile. The analysis of potential differences derived from the knowledge shared would also add to present state of the art.

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Figure 1: The structure and actors in the Toy Valley Cluster

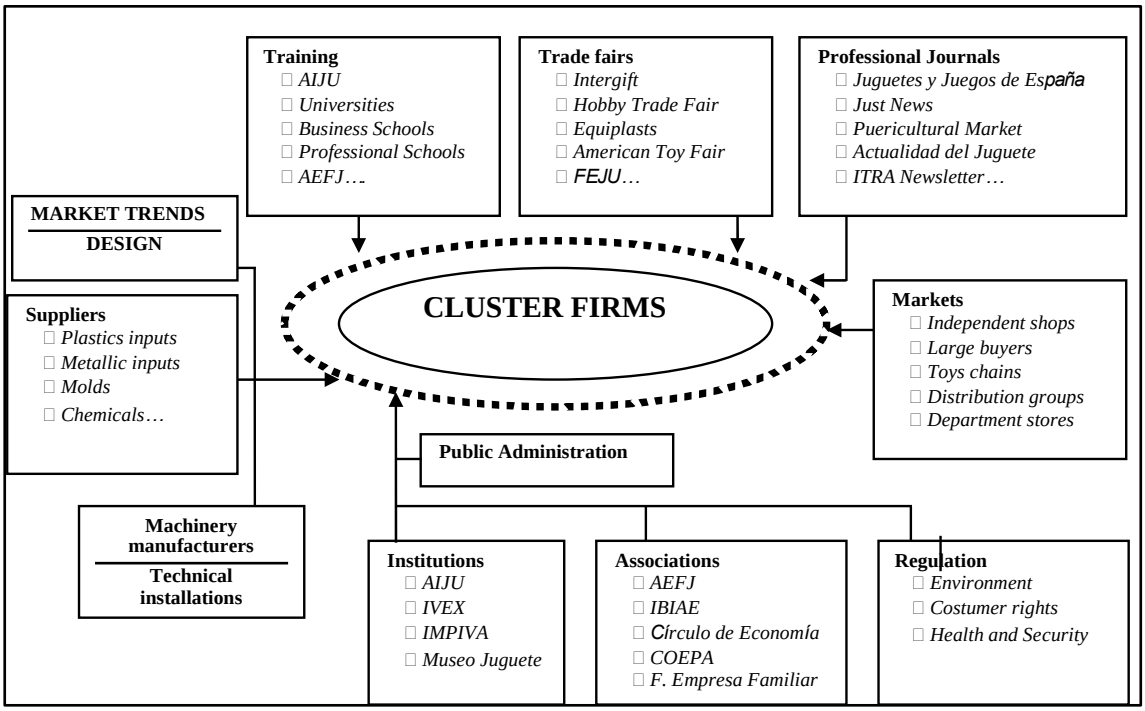

Table 1: Supporting organizations in the Toy Valley Cluster

Institution	**Nature**	**Field**	**Activities**
Universities: Miguel Hernandez Politecnica de Valencia Alicante	Public universities focused on higher education and research in different industries.	Technology and management	Training, scientific research projects (regional and international)
Vocational training center *(Instituto Formacion Profesional)*	Public center. Training on technical and design for the toy sector	Technology and design	Secondary and professional schools. Specialized in the local labor market
Technical Institute for Toy-making (AIJU, *Instituto Tecnológico del Juguete*)	Public entity. Research and technological innovation for the toy industry	Technology and design	Training, technological research, toy and material tests. Products and market analysis.
Spanish Association of Toy Manufacturers (AEFJ, *Asociación Española de Fabricantes de Juguetes*)	Private. Defending and promoting interests of the toy industry	Promotion and management	Support on specific issues like training, cooperation and environment
Business Association of Ibi (IBIAE, *Asociación de Empresarios de Ibi*)	Private. Promoting interests of local companies of different sectors	Promotion	Provide support on training, business information cooperation and environmental issues
Chamber of Commerce, Industry and Navigation (*Cámara de Comercio, Industria y Navegación*)	Public. Promoting local companies of different industries-	Promotion	Promotion (especially international), defending industrial interests, research projects, training and information
Local Development Agency (ADL, *Agencia de Desarrollo Local*)	Public. Promoting the local economic and business atmosphere	Promotion	Local development agency. Training, labor mediation, self-employment, career guidance
Crecer Jugando Foundation	Private foundation. Promoting the industry through children´s rights.	Promotion	Defense of the fundamental right to play as one valuable activity for children.

Table 2. Descriptive data of the networks in the Toy Cluster

	Technical Network	**Business Network**
Number of actors	85	85
Number of linkages	1379	1362
Density	.193	.190
Reciprocity	.352	.407
Transitivity	.434	.467

Table 3. Local brokerage roles: mean difference, standard deviation and permutation model results

	Technical Network			**Business Network**		
	Global Brokerage	**Coordinator**	**Interconnector**	**Global Brokerage**	**Coordinator**	**Interconnector**
Toy manufacturing firms	-1.376(1.74)	*-.300(1.98)	***-.690(1.33)	-1.421(1.79)	-1.045(1.73)	***.252(2.16)
Suppliers	-2,223(.88)	-.754(1.25)	-1.944(.35)	-1.617(.1.47)	-.480(1.55)	-1.858(.439
Supporting organizations	***3.150(7.38)	**1.991(2.54)	**.565(4.41)	**1.782(8.57)	**1.370(2.81)	-.287(5.03
Others	-2.028(1.07)	-.585(.00)	-2.369(.35)	-2.268(.75)	.519(.00)	-2.251(.72)
Total	.778(3.484)	.187(2.647)	-.842(2.104)	0.843(3.551)	.285(2.180)	-.598(2.533)

Significance level: ***<.01; **<.05; *<.1

Table 4. Brokerage roles and supporting organization

	Technical Network			Business Network		
	Global Brokerage	**Coordinator**	**Interconnector**	**Global Brokerage**	**Coordinator**	**Interconnector**
Spanish Association of Toy Manufacturers (AEFJ)	***16.915	***4.115	***5.368	***18.529	***6.509	***12.560
Technical Institute for Toy-making (AIJU)	***13.073	***2.449	***9.928	***17.102	***2.809	***3.951
Local Development Agency of IBI	***7.031	-.883	.777	*1.607	.342	.258
"CRECER JUGANDO" FOUNDATION	***6.459	***5.364	***3.284	-2.256	-.891	-2.602
University of Alicante	*1.788	**2.032	.384	-2.300	***5.687	-2.840
Polythecnic University of Valencia	-2.189	***5.780	-2.818	-2.687	***1.987	-2.840
Local Development Agency of Onil (ADL)	-2.686	***2.449	-2.818	-2.850	-.069	-2.840
University Miguel Hernandez	-2.822	-.883	-2.818	-3.088	-.891	-2.840
Chamber of Commerce, Industry and Navigation	-2.973	.366	-2.818	-3.118	-.891	-2.840
Business Association of Ibi (IBIAE)	-3.093	-.883	-2.818	-3.118	-.891	-2.840

Significance level: ***<.01; **<.05; *<.1

Table 5. Gatekeeper role: descriptive, mean difference, permutation model results

	Extra-cluster contacts						
	Suppliers	**Customers**	**Competitors**	**Consultancy Services**	**Universities**	**Public Research Centres**	**Private Research Centres**
Toy manufacturing firms	-0.016	0.057	**0.247	-0.038	-0.127	-0.087	-0.061
Suppliers	*0.104	0.085	-0.147	-0.129	-0.055	-0.027	0.003
Supporting organizations	-.007	-.360	-.380	***0.453	***0.460	***0.287	**0.160
Others	0.098	0.085	0.378	-0.207	-0.098	-0.049	-0.061
Mean	.901	.918	.635	.200	.094	.047	.368
Sd	.294	.276	.484	.402	.294	.213	.152

Significance level: ***<.01; **<.05; *<.1