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Leading Firms in Technology Clusters: The Role of Alenia Aeronautica in the Campania Aircraft Cluster

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Abstract

Many scholars have emphasized how important it is to be part of a technology cluster, in order to have favorable conditions to trigger the innovation process both at the firm and cluster levels. Moreover a number of contributions explain how the presence of a leading firm in a cluster positively affects cluster development. The leading firm favors the diffusion of knowledge among cluster members and acts as an interface to absorb new knowledge from external sources. However, studies on this topic focus predominantly on cases of successful clusters and there is little understanding of the issues regarding clusters that failed or were unsuccessful. Our aim is to investigate if the presence of a leading firm in a technology cluster always favors processes of development or if, on the contrary, it can hinder cluster growth by encouraging a lock-in phenomenon. We respond to the research question by analyzing the behavior of a leading firm (Alenia Aeronautica) in the Campania aircraft cluster. On the basis of research results we conclude that the presence of a focal firm in a technology cluster is not always a positive factor if this firm does not act as knowledge hub with explicit objectives of transferring knowledge to other cluster members. On the contrary, in some cases the presence of a focal firm may actually hinder cluster development by limiting the activity of other companies in the system.

Keywords: technology cluster, focal firm, knowledge spillover, aircraft industry, Italy

Paper type: Research paper

1. Introduction

According to mainstream literature, learning and innovation are the result of interactive processes in which different actors come together to collaborate in solving specific problems. Many scholars have emphasized how important it is to be part of a technology cluster, in order to have favorable conditions to trigger the innovation process both at the firm and cluster levels.

Researchers have demonstrated that industrial clusters permit important localized knowledge spillovers, because firms benefit from the availability of a pool of skilled labor and, given their geographical and social proximity, new ideas circulate easily from one firm to another, promoting processes of incremental and collective innovation (see among many others: Becattini, 1989; Asheim, 1994; Saxenian, 1991; Audretsch & Feldman, 1996; Maskell & Malmberg, 1999; Baptista, 2000).

Other researchers have stressed the importance of extra-cluster networking, since over-reliance on localized knowledge can result in the "entropic death" of a cluster that remains locked in to an increasingly obsolete technological trajectory (Camagni, 1991; Grabher, 1993; Cantwell & Iammarino, 2003; Bathlet, 2004).

The lack of consensus on the nature and effects of spillovers generated within a cluster has long dominated the attention of scholars. In particular several studies have underlined the positive effects that the presence of leading organizations, especially large firms, can have on knowledge spillovers, facilitating knowledge circulation and avoiding lock-in phenomenon (Boari & Lipparini, 1999; Lazerson & Lorenzoni, 1999 Agrawal & Cockburn, 2003; Feldman, 2003). The leading firm favors the diffusion of knowledge among cluster members and acts as an interface to absorb new knowledge from external sources (Munari, Sobrero & Malipiero, 2011). However, studies on this topic focus predominantly on cases of successful clusters and there is little understanding of the issues regarding clusters that failed or were unsuccessful (Doloreux, 2002).

Lang (2009) identified six forces that could negatively impact the competitiveness of clusters: 1) a homogeneous macroculture, 2) a negative identity discrepant, 3) an intra-cluster power imbalance, 4) the introduction of new market rationalities, 5) the lack of untraded interdependencies, 6) the presence of negative externalities. If the leading firm is not able to oppose to these forces then the cluster could fail. Analysis of the experiences of underdeveloped clusters could show that the presence of a leading firm is not only insufficient to encourage cluster development, but also that in some cases it would hamper cluster growth.

Given these considerations, the aim of this paper is to investigate how the presence of a leading firm can affect cluster development. In particular, the work is aimed at answering the following research question:

- Does the presence of a leading firm always favor the process of cluster development or, on the contrary, does it in some cases encourage lock-in phenomenon?

We respond to this question by analyzing the behavior of a leading firm, Alenia Aeronautica Spa, in the Campania aircraft cluster.

The aircraft industry is particularly effective for our analysis because clusterization is very common in this sector. The aeronautics sector presents a series of particular characteristics, such as modularity in production and complexity of final product, which make it almost impossible for a single enterprise to carry out all the phases of production (Frigant & Talbot, 2005). In addition, it is necessary to have a coordinating body in order to respond to the needs for continual innovation, which are often satisfied by drawing on innovations developed in other sectors (Benzler & Wink, 2010) and for management of the extensive networks of relationships at both local and international level (Biggiero & Samarra, 2010; Kechidi & Talbot, 2010). Niosi and Zhegu (2005, 2010) have demonstrated that the presence of leading firms enhances the process of knowledge diffusion, and has favored the birth and development of aircraft clusters in many parts of the world (Niosi & Zhegu, 2005; 2010). Clifton, David, Ehret & Pickernell (2011) analyze the Wales aeronautic cluster and conclude that, for peripheral economies, the roles of government and institutions, such as universities, are of secondary importance to those of the firms themselves, but that these actors are necessary as facilitators and to provide important support structures.

The paper is articulated as follows: Section 1 synthesizes previous studies that analyze the role of leading firms in cluster development; Section 2 provides a brief description of the Campania aircraft cluster and illustrates the research methodology; Section 3 gives the detailed results of the empirical analysis; Sections 4 and 5 present the conclusions and highlight the theoretical and political implications.

2. Theoretical Background: the Role of Leading Firms in Cluster Growth

A number of contributions explain how the presence of a leading firm in a cluster positively affects cluster development. Some scholars have conducted detailed analysis of the evolution of industrial districts, illustrating the pivotal role played by key actors and institutions (Boari & Lipparini, 1999; Giuliani, 2005; Dhanaraj & Parkhe, 2006). Lorenzoni and Baden-Fuller (1995) focus on the role of what they call “focal firms” within industrial districts. These are defined as “strategic centers” that can assure the survival and development of the entire district, thanks to their superior coordinating skills and ability to steer other firms toward innovation cycles and new growth opportunity. These actors are key to generating new knowledge and technologies, spinning off innovative companies, attracting researchers, investments and research facilities, enhancing other firms’ R&D activities, stimulating demand for new knowledge, and capturing and creating externalities.

Studies of several Italian industrial districts show how larger firms played a fundamental role in collective learning processes, acting as drivers for innovation development and cluster growth (Boari & Lipparini, 1999; Lazerson & Lorenzoni, 1999). In particular, Lissoni (2001) explained how the mechanical district of Brescia (northern Italy) was quite dependent on a small number of firms (e.g. world-leading Lonati Spa) to foster incremental innovation and the welfare of the whole district. Another example of leading firms’ centrality in district development is that of Benetton, which developed many relationships with smaller producers and distributors in order to subcontract and outsource production, thus stimulating efficiency and innovation development among its collaborators (Camuffo, Romano, & Vinelli, 2001).

Empirical evidence on the role of leading firms in local economic growth and innovation development is not restricted to Italy. Analysis of the Chilean wine cluster (Giuliani & Bell, 2005) shows that more advanced firms tend to diffuse knowledge and provide advice to other firms located in the cluster, thus promoting positive externalities for the whole system. In the case of watch production in Switzerland, the large firm ETA was largely responsible for the re-founding of the industry, thanks to the development of digital technologies that in turn led to the birth of Swatch (Glasmeier, 1991). The Scandinavian clusters of wireless hardware firms benefitted greatly from the phenomenal growth of two major companies, Eriksson and Nokia (Breshanan,

Gambardella & Saxenian, 2001; Van Winden, Van Den Berg & Van Der Meer, 2004). There are similar examples of the role of key firms in development of clusters in the United States, such as the well-known cases of Fairchild Semiconductor and Intel in Silicon Valley (Utterback, 1994; Saxenian, 2004).

The literature has specifically identified a series of features that characterize such focal firms. Lazerson and Lorenzoni (1999: 362) define "focal" as "[. . .] those firms that occupy strategically central positions because of the greater number and intensity of relationships that they have with both customers and suppliers. This position is usually reinforced by both their technological and organizational skills and their greater access to capital." Similarly, Giuliani and Bell (2005) emphasize the superior stock of knowledge accumulated by such firms as a result of their intense R&D and assets of skilled human resources.

Analyzing the innovation process in regional clusters, Carbonara (2004) states that the presence of a leader firm in a cluster helps systemic innovation by favoring knowledge acquisition and diffusion processes among different actors. Leader firms make intense efforts to codify knowledge, especially technical knowledge, so that it is easier to control and transfer. This in turn helps continuous innovation, permits reduced lead times, and improves product quality and communication with external actors (Albino, Garavelli & Schiuma, 1999). Coherent with this argument, some authors affirm that leading firms can act as "technological gatekeepers" to an industrial cluster by leveraging their intellectual and social capital to enhance the absorption of new information and facilitate its dissemination (Munari, Sobrero & Malipiero, 2011). As gatekeeper, the leading firm carries out (Morrison, 2004, p. 8):

- knowledge searching functions, for capturing external sources of information;
- transcoding functions, for translating the meaning of such information;
- transferring functions, for disseminating accumulated knowledge at the local level.

Technological gatekeepers are characterized by the ability to diffuse re-elaborated knowledge to others, through a process that can be deliberate or not. Thus, focal firms can play a distinctive role in the diffusion of new knowledge from outside sources to other firms co-located in the district.

Some scholars use the term "anchor tenant", similar to the concept of the technological gatekeeper, to emphasize the important function of leading firms in favoring cluster growth.

There are a number of studies that explicitly examine the concept of anchor tenant and offer input towards a rigorous definition. In their studies of the biotechnology industry, Feldman and others (Feldman, 2003; Feldman & Lowe, 2008) define anchor firms as large, technologically sophisticated entities creating externalities (e.g. a pool of skilled labour, demand for specialized inputs) which could benefit smaller local firms. Agrawal and Cockburn (2003, p.1229) define an anchor tenant as a large, locally present firm that is heavily engaged in extensive R&D. Link et al. (2003) identify high-technology anchor tenants as large R&D-intensive firms, recognized from their patenting activity, that have a strong focus on a particular technological field. They argue that high-technology anchor tenants enhance regional innovation systems by stimulating technological externalities through their own actions. Niosi and Zhegu (2005) applied the concept of anchor tenant in analyzing the role of large aerospace firms in regional innovation systems of the Canadian aircraft industry. These firms have most often started the aircraft clusters observed, favoring processes of agglomeration of other smaller firms in the area. In a more recent work, the same authors (Niosi & Zhegu, 2010) collect empirical evidence for a series of aircraft clusters in the U.S. and show that some have failed because the leading firms transferred their activities to new geographic locations.

In recent years, the evolution of the aeronautical industry has been characterized by: i) greater production fragmentation among different actors in the chain (Kechidi & Talbot, 2010); ii) ever greater interdependence among the various actors of the system, which often favors development of networks that surpass national boundaries and unite enterprises and clusters operating in very distant areas (Biggiero & Samarra, 2010); iii) attention to innovation, which extends to processes of interaction with other sectors, such as the new materials sector (Benzler & Wink, 2010). Benzler and Wink also argue that the focal firm plays an even more central role than in the past. More than before and more than in other sectors, they must act as central players, able to coordinate productive processes and serve as knowledge gatekeepers, which acquire external knowledge and diffuse it within the cluster to favor development of innovation. This aspect is still more evident in aeronautics clusters formed in areas that lack a truly developed technological and industrial profile. In such areas, the larger firms often substitute for the lack of universities and other institutional actors, to assure development and diffusion of innovation within the cluster (Clifton, David, Ehret & Pickernell, 2011).

3. Methodology

In order to answer to paper research questions we adopted a single case design with multiple units of analysis (Yin, 1994). In particular we analyse the characteristics of Campania aeronautic cluster starting from the analysis of role occupying by single cluster firms. There are several specific reasons why Campania aeronautic cluster is an interesting case for the study of the role of focal firm for cluster development. First, structure of Campania cluster is characterised by one large company, Alenia Aeronautica, and by several medium and small firms so it represents an "ideal type" to analyse the role of leading firm in the cluster. Second, many authors have analysed the role of leading firm in aircraft cluster so it is simple to compare our results with existing contributors. Third, important findings can derive by the study of Campania's cluster because comparing to existing study carried on in developed regions, Campania cannot be considered a developed region and local government does not support cluster development.

To better describe the case, we identified the actors that compose the cluster, distinguishing among firms – small, medium, large-, universities and research centres, public institutions.

For each actor, we next identified the sector and specific activity carried out in the cluster. This analysis permitted definition of the role assumed by the various actors, and so identification of the subjects that carry out activities most oriented towards knowledge production, which thus take the role of key actors.

Next we reconstructed the relations between the various subjects. For this analysis we conducted open-ended interviews with managers and administrators of firms and organizations hosted in the Campania aircraft cluster. The interviews took place between 2006 to 2009, with the support of the *Associazione Studi e Ricerche per il Mezzogiorno* (Studies and Research Centre for the Southern Regions, SRM).

Every interview takes at least an hour and are conduced face-to-face. Generally the interviewed are not carried on with a structured questionnaire and the questions are changed according to respondents' answers. With this technique the respondent is left free to express his opinion and can easy raise many interesting points that could not emerge with a driven interview. The interviews are recorded and are then transcribed by two Phd students. Most relevant answers are translated in English and reported in paragraph 4.

The interviewed organizations (see table 1) are selected considering the relevance that the single units have in the cluster. In particular we interviews managers of the large and medium firms and of the all research and government institutions. Among the smallest companies we selected many organizations according the availability of the managers.

Table 1. Organizations interviewed

Respondent Category	Respondent Name
Firms	- Alenia Aeronautica - DEMA Group - FoxBit - Tecnam - SAM Consortium (established 1998; composed of the following SMEs: Carlo Gavazzi Space, CCM, FoxBit, Geven, Marotta AT, Maghaghi Aeronautica, Salver, Tecnam, Tecnoin, Techno System Development, Vulcanair)
Research Centers	- CIRA - Department of Aeronautical Design, University of Naples 'Federico II'
Associations	- Naples Union of Industries - AIAD - Italian Association of Aeronautic Companies - Engineers Association
Government Institutions	- Region of Campania

The empirical research was conceived as two phases:

The first phase was aimed at identifying the cluster's focal organizations. In keeping with Lazerson and Lorenzoni (1999: 362), who define focal organizations as "firms that occupy strategically central positions because of the greater number and intensity of relationships that they have with both customers and suppliers", we asked respondents to identify the cluster members they had relationships with, and how often these occurred. Then, using UCINET software and network analysis methodology, we plotted the cluster structure and identified the focal firm.

The second phase was aimed at understanding if the focal firm acts as a technological gatekeeper and anchor tenant in the manner described in the above mentioned studies (Section 1), favoring knowledge spillovers and driving cluster development. Thus we asked respondents if relationships with the focal firm provide exchange of technological know-how and if the focal firm favored cluster innovative processes. Then we asked same respondents what factors have facilitated or otherwise hindered the cluster growth.

4. Empirical evidence: the Campania aircraft cluster

The Campania aircraft cluster is characterized by the presence of numerous actors operating at different levels of the production chain. The most important productive reality for size, turnover, number of employees and innovation investments is Alenia Aeronautica; a leading company in the Italian aerospace industry. It was formed in December 1990 by fusion of the aircraft manufacturer Aeritalia with the high-technology electronics specialist Selenia. Alenia has now been reorganized into five areas: aeronautics, space and communications, aero engines and naval systems. Alenia's operations in the aerostructure segment bring it into competition with a considerable number of firms, following the entry of Southeast Asian countries and the conversion of other firms from military to commercial industry. In the 1970s, by establishing supply relationships with McDonnel Douglas and Boeing, Alenia laid the foundations for its current position in the international division of labor. It achieved a significant upgrading of its role in the 1980s through a co-operation agreement with French Aerospatiale for joint production of the ATR42 commuter transport: this was the first time Alenia had entered an international partnership agreement.

Alenia has three plants in Campania, with the main one in Pomigliano, where Alenia operates as a prime contractor for Boeing and Airbus: here it produces airplane fuselages, fuselage sections, tail cones, vertical stabilizers, rudders, winglets and noses. At the other plants, in Nola and in Casoria, the company produces small components such as electrical circuits and fuselage panels.

Over the years, many small and medium firms have established near Alenia's Pomigliano plant, to work in collaboration with the larger company. Several companies have played leading roles and have themselves gone on to become important players in the world aircraft industry. Notable examples are Tecnam and Magnaghi Aeronautica. Tecnam, a family firm founded in 1986, collaborates with Alenia on production of tail sections for the ATR 42/72, on fuselage panels for Boeing, and tail and structural elements for the Aermacchi SF260. Tecnam also produces components for helicopters and is a direct supplier to AgustaWestland, Learjet, Falcon and Dornier. Magnaghi designs and produces landing gear, hydraulic components and fuel tanks. With the exception of Geven, a world-leading firm specialized in the production of seats and interiors for aircraft and ships, the remaining companies are small and devoted to specific activities such as production of engines components (CMD and Avio), electronic circuitry (Technosystem), mechanical components (Oma Sud, Dema Group, Officine Aeronavali), design and prototyping (FoxBit), or aircraft maintenance (Atitech). VulcanAir is the only company in the cluster that works independently from Alenia on the production of its own aircraft, which are small twin-engine models. Many of the cluster firms are part of the SAM consortium. SAM consortium was established in 1998 as an association of the many Campania aircraft companies, Members of the SAM consortium are: Carlo Gavazzi Space, CCM, FoxBit, Geven, Marotta AT, Maghaghi Aeronautica, Salver, Tecnam, Tecnoin, Techno System Development, Vulcanair.

One of the most important characteristics of the aircraft industry is the importance of process and product innovation. To innovate, firms must necessarily cooperate with universities and research centers that offer specialties in mechanical and aerospace engineering, physics and new materials development. Firms belonging to the Campania aircraft cluster can benefit from the geographical proximity of leading research institutions, such as the Italian Centre for Aerospace Research (CIRA), founded in 1984. CIRA has a number of specialized facilities, including plasma and icing wind tunnels, for examining airplane resistance under icing conditions and simulation of high-temperature atmospheric reentry. These permit the center to enter into cooperation with NASA, ESA, General Atomics-ASI and many aircraft multinationals. Examples of its current activities include projects with Boeing for the realization of the 787 Dreamliner and a new generation of unmanned aerial vehicles,

and many European projects, such as for GMES (Global Monitor Environment Security), ATM (Air Traffic Management) and ATC (Air Traffic Control). Other important institutions for aerospace research include the University of Naples 'Federico II' (Department of Aeronautical Design) and the Second University of Naples (Department of Aerospace and Mechanical Engineering). To enhance cooperation between companies and research institutions, as necessary for development of the Campania aircraft industry, some of the aircraft firms (Alenia, Avio, Tecnam, Magnaghi, Piaggio and Vulcanair) have signed an agreement with certain research institutions (Federico II, Second University of Naples, CIRA) for the founding of the Campania Aerospace Research Network (CARN). The aim of CARN is to favor cooperation between companies and universities in the realization of joint research and training projects.

Associations, such as the Campania Chamber of Commerce and the Naples Union of Industries, also play important roles in the Campania cluster. As well, the various local government institutions have organized many programs aimed at financing the development of the Campania aircraft sector and have promoted many initiatives to facilitate cooperation between companies and research institutions. These initiatives include the founding of the Naples Science and Technology Park (Tecnapoli) and the creation of specialized technology transfer centers, such as the 'Transport' Regional Center for Competencies (CdC Trasporti) and the Technology Innovation Centre for New and Composite Materials (IMAST).

5. Results

Figure 1 shows the plot of network relationships in the Campania aircraft cluster, prepared by analyzing the responses collected in the first research phase.

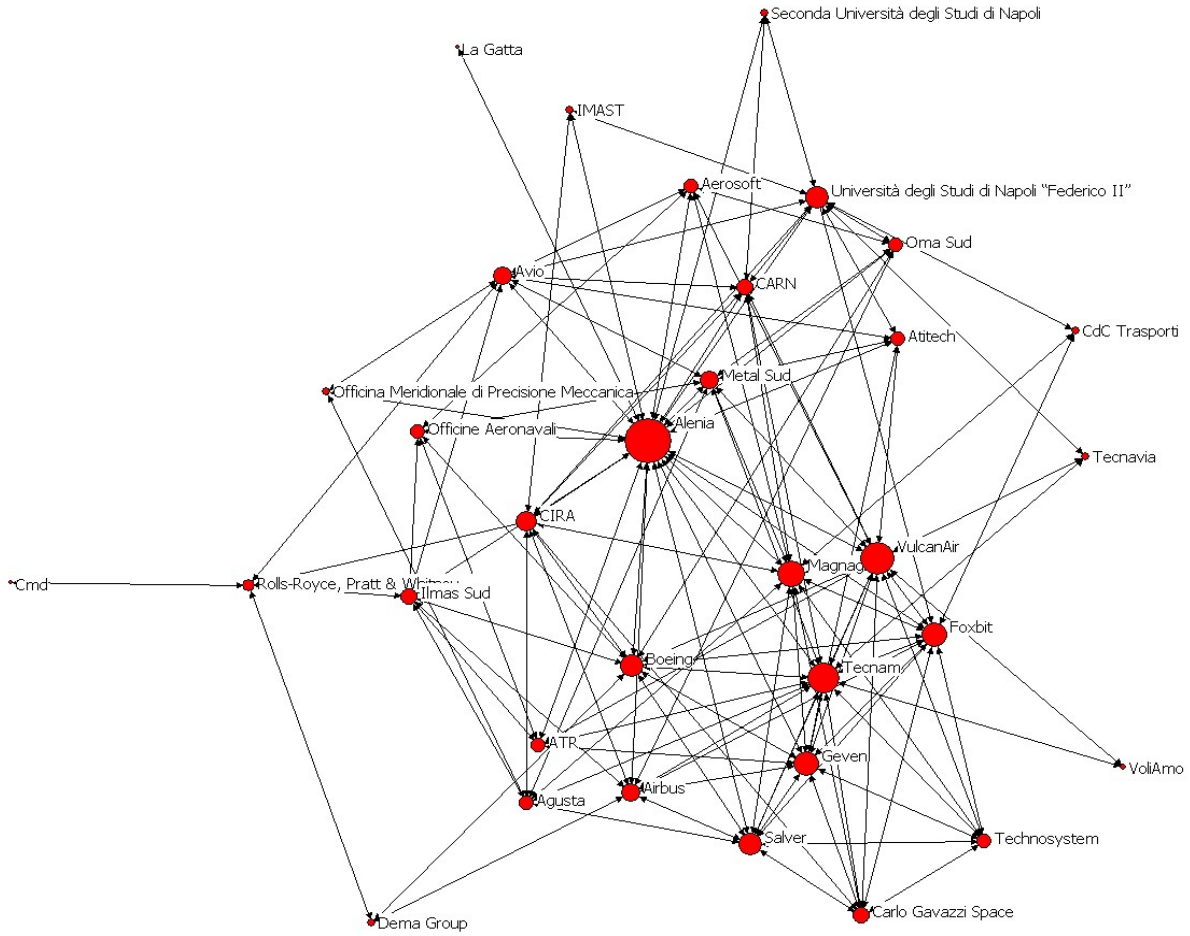

Figure 1. Map of relationships in the Campania aircraft cluster

The graph plots the relationships that companies, universities and government institutions have established with other actors of Campania aircraft system, whether these are at the national or international level.

We first mapped the relationships among the cluster actors without specifying partnership type or frequency. Figure 4 clearly shows that Alenia was involved in the largest number of relationships, so according to the definition of Lazerson and Lorenzoni (1999) it is the network focal firm. Alenia's focal role is also explained by its position in the world aircraft supply chain, where it is one of the top first-tier suppliers of world-leading OEMs: this position allows the Italian firm to create relationships with large international companies and favor the development of a wide network of local sub-suppliers and leading research institutions.

Other organizations like Magnaghi, Avio, Tecnam, FoxBit, Metal Sud and CIRA have central positions in the network and are linked to Alenia by stable relationships.

From this plot we can already detect how the Campania cluster extends beyond its territorial boundaries through consolidation of relationships between Alenia Aeronautica and foreign system integrators, thus following a well-established pattern for the aeronautics sector (Biggiero and Samarra, 2010; Kechidi and Talbot, 2010). However, more accurate analysis of the relationships makes it clear that the international relationships are concentrated on Alenia, and that the other firms in the region have relationships with foreign companies only through the single large Campania firm.

For a deeper analysis of the relationship network we replotted the structure considering the position assumed by the cluster companies in the aircraft supply chain (figure 2). Such production networks typically involve many actors with different functions:

- System integrators: large companies that assemble different parts of the airplane. These are involved in strategic activities like design, prototyping, vehicle-testing and marketing. Currently, the world's largest and most important system integrators are Boeing and Airbus.
- Prime contractors: large companies acting as first-tier suppliers of system integrators and producing complex subcomponents of aircraft, such as fuselages. The most important prime contractors of Boeing and Airbus are Alenia in Italy, Dasa in Germany and Casa in Spain. Engine production companies, such as Rolls Royce, Pratt & Whitney and General Electric, are also prime contractors.
- Second-tier suppliers: medium and small firms where prime contractors outsource some activities.
- Third-tier suppliers: small companies, often in the automotive sector, that realize small parts of the aircraft, such as electrical circuits and small mechanical components.

In addition to these actors that are directly involved in the productive process, an important role is played by research institutions, universities and government institutions.

In mapping the cluster relationships we highlighted the individual company positions in the supply chain according to two aspects:

- The nature of the organizations, indicated in different colors: red for system integrators, blue for prime contractors, orange for suppliers, grey for universities and research institutions;
- The manufacturing specializations of the different organizations, indicated by geometric shapes: circles for system integrators, squares for second- and third-tier suppliers that produce low value-added components; triangles for second- and third-tier suppliers that produce high value-added components (propellers, landing gear, etc.); boxes for organizations that provide low value-added services, circle/boxes for organizations that provide high value-added service.

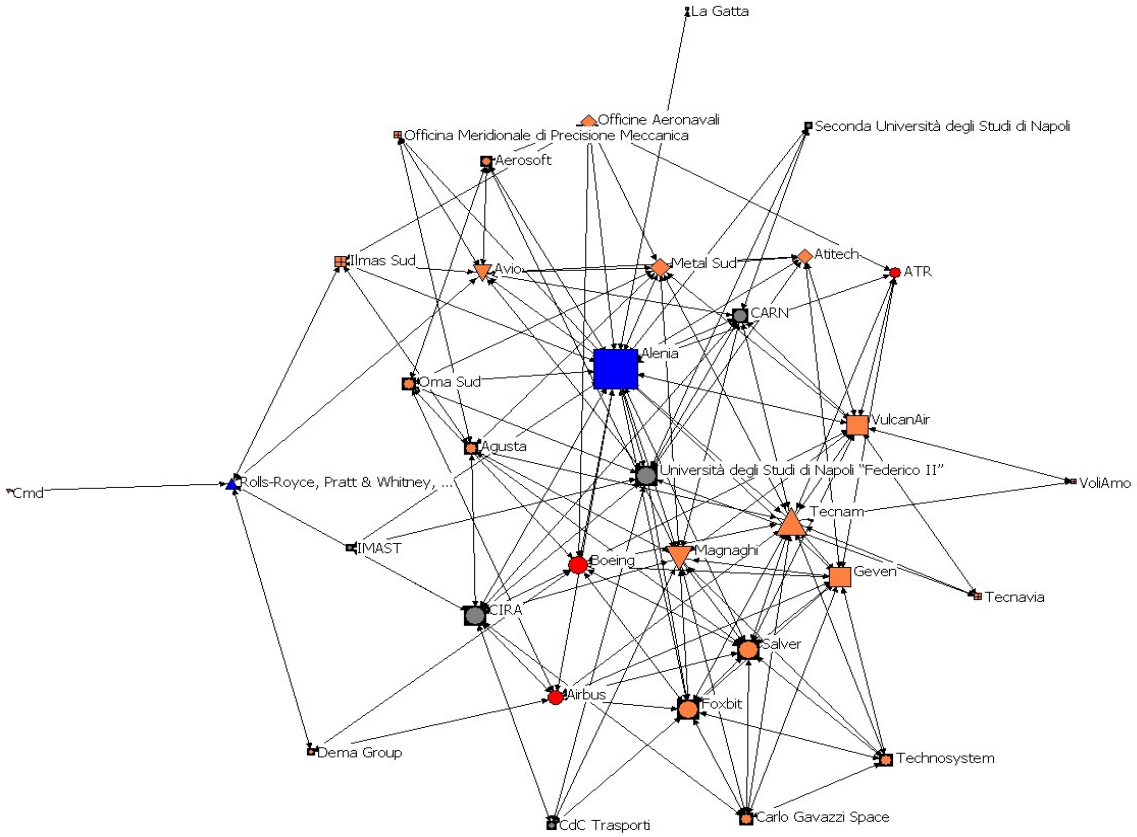

Figure 2. Map of relationships in the Campania aircraft cluster, with organizations distinguished by nature and activity

The graphic was elaborated on the basis of the identification of three principle types of relationships within the network:

- Risk sharing partnership: the relationship linking Alenia with Boeing and Airbus. This is the closest type of relationship, which obviously involves great responsibility and risks for the partners but at the same time favors knowledge exchange between the firms, with development of innovation on both sides.
- Supply: this can involve both goods (parts and/or components of high or low value added) and/or services (planning, engineering, etc.). This is the relationship that links the large part of the regional firms to Alenia. This type of relationship does not involve intense exchange of technological knowledge between the parties, particularly if the exchange is one of goods.
- Technological partnership: concerns the joint development of R&D projects, design and planning work, software development, and all other activities with high-intensity know-how. This type of link develops primarily between research institutions, or between research institutions and firms engaged in high value-added activity (FoxBit, Salver, others). The precise objective of the relationship is the exchange of knowledge between partners, ultimately aimed at achieving shared innovative projects.

Actors with fewer relationships are situated further from the center of the network, however their marginal position should not lead to hasty conclusions. For example, ATR, which is a consortium involving EADS and Alenia, is still fully inserted in the network, even though by indirect means through Alenia. Another example is the 'Transport' Center for Competencies, now in a peripheral position, but which is destined to assume a more central regional role thanks to its recent development of collaboration contracts.

Analysis of the roles occupied by the individual firms in the supply chain shows that modularity, the intrinsic form of production for the aeronautics industry (Frigant and Talbot, 2005), is fully present in the Campania cluster. However it is clear that the high value-added activities are concentrated in the hands of only a few large

firms, while a large part of the actors carry out low value-added activities. Figure 3 isolates the relationships that Alenia establishes with other cluster organizations.

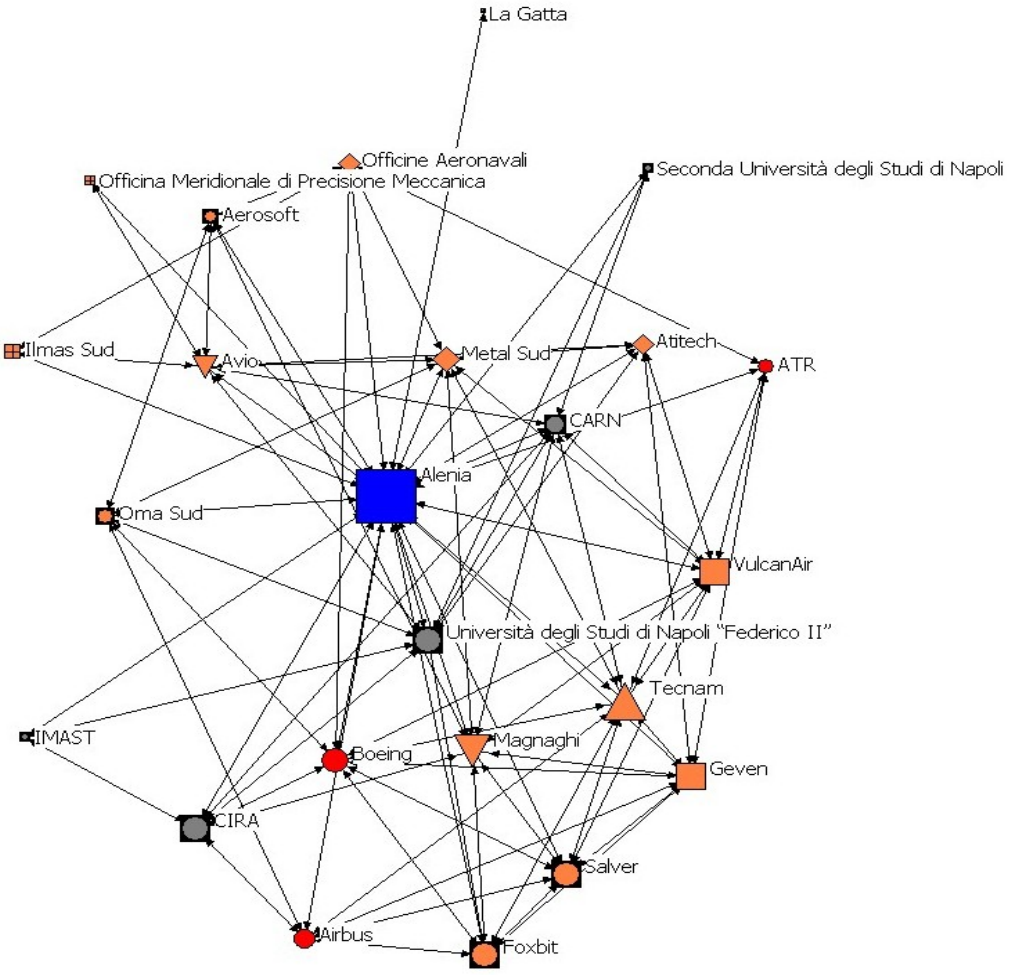

Figure 3. Map of Alenia Aeronautica's relationships

It is evident that Alenia occupies the central position in the Campania aircraft network. It is also in in an advantageous position to take on the role of technology gatekeeper because of its partnership with the main knowledge hubs localized outside the cluster, such as system integrators, and inside the cluster, such as universities and research centers.

Thus, according to the literature, if Alenia is able to absorb technological knowledge from the external sources then it should be able to transfer this knowledge to other cluster organizations, favoring SME innovation processes and driving development. To verify this statement we asked cluster organizations to describe the nature of their relationships with Alenia.

A large part of organizations state that they have a client-supplier relationship with Alenia, in which they sell products or services to the focal firm and, in exchange, receive money and in some cases suggestions on product development. These companies declare that Alenia does not transfer technological knowledge and does not favor their innovative processes. Indeed some companies claim that Alenia hinders their development of innovation because it acts as a barrier for their relationships with system integrators.

In expressing such considerations, the President of SAM Consortium said:

> "In the aircraft industry, innovation is a vital condition and the presence of a leading firm is an important element to favor innovation processes…but it is not a sufficient condition. In Campania, it seems the large companies like Alenia do not really want to cooperate with small companies".

Similarly, the director of CdC Trasporti, the technology transfer agency, explained:

> "Small companies in Campania act as suppliers of low cost components and in spite of their high potential their growth is limited by a lack of global vision…SMEs cannot grow alone but need to cooperate much more with large companies like Alenia".

Alenia managers also recognized that the Campania cluster needs better integration among different actors, but stated that this integration would require that local companies have "better levels of efficiency and lower risk aversion." Further, the managers state that the only Alenia partnerships that explicitly obligate transfer of technological knowledge are with research centers (e.g. CIRA) and a few service companies (e.g. FoxBit).

There were also interesting responses to a question we posed on the factors that have facilitated or otherwise hindered the cluster growth.

All the respondents report that the main weakness of the Campania aircraft cluster is the lack of collaboration among different actors, and highlight that cluster organizations have the necessary competencies to innovate but that these competencies are not transferred among organizations.

The President of TECNAM said:

> "….innovation in aircraft industries is a systemic phenomenon…the main weakness of Campania cluster is the lack of this systemic integration….government institutions have to define policies aimed at promoting cooperation among cluster members".

In a similar vein, the President of SAM consortium stated:

> "In Campania there are large and small companies, research centers and universities…but these actors do not cooperate with each other. Single organizations act on their own without following a common strategy or vision".

According to the most of respondents, another weakness of the Campania aircraft system is the fact that Alenia only produced low value-added components in Campania.

A representative of Campania Regional Government actually stated:

> "The Campania aircraft industry is totally based on subcontracting… to positively affect the regional economy it is necessary to transfer high value-added activities of aircraft production to Campania".

To summarize, Alenia is the focal firm of the Campania aircraft cluster but its relationships with other cluster organizations are not based on exchange of technological knowledge, thus Alenia does not leverage its central position to promote either knowledge spillovers among other members or systemic innovation in the whole network.

5. Discussion

The analysis of the Campania aircraft industry confirms the existing theory that many technological clusters, especially in the aircraft sector, are characterized by the presence of an institution, often a large company, that acts as a catalyzer of relationships among the participants.

However, contrary to what scholars have previously affirmed, the results indicate that the presence of a focal firm is not always sufficient condition to favor cluster growth and innovation. By applying network analysis and gathering opinions through interviews, we have shown that Alenia Aeronautica can be identified as the central firm of the cluster, but that it is unable to completely fulfill its role as anchor tenant. The literature has described several recent trends in the aeronautics industry, which also seem very evident in the Campania cluster: i) greater fragmentation among the various actors in the production chain (Kechidi & Talbot, 2010); ii) continually greater interdependence among the various actors, which favors the birth of relationship networks that go beyond national borders, to unite clusters and firms that operate in very distant geographic areas (Biggiero & Samarra, 2010); iii) attention to innovation, in part through interaction with the new materials sector and other sectors (Benzler & Wink, 2010). Faced with these phenomena, Alenia does not seem to have taken an adequate role.

The interviews with the other firms of the cluster indicate that Alenia, the focal firm, is indeed able to absorb knowledge from external sources such as system integrators and research centers, but it does not transfer this knowledge to other cluster organizations. Instead, in some cases Alenia hinders the development of supplier companies in the cluster, which are not encouraged to create relationships with other firms in the aircraft industry, such as system integrators and other prime contractors. In addition, Alenia only carries out low value-added activities in Campania, because the knowledge-intensive activities in its aircraft production are

completed in other locations. This decreases potentials for the region of Campania to become the innovative hub of the Italian aircraft sector.

These phenomena could seriously hamper the future of Campania cluster. Studies by Clifton, David, Ehret & Pickernell (2011) have demonstrated that in regions with weak economic growth, large firms substitute the typical research and institutional actors in leading development of the cluster, coordinating actors and facilitating the creation and diffusion of knowledge. Alenia's inability or lack of will to carry out this role will certainly be detrimental to the Campania cluster's development, since there is no other actor capable of substituting this large firm in its coordinating role. The unequal division of supply chain activity and scarce circulation of knowledge greatly limit the growth processes of local firms. If Alenia were to decide to transfer its activities to other regions, then the opportunities to learn would end, the Campania firms could be forced into failure and the cluster could disappear entirely.

The research results suggest that it is necessary to identity interventions to encourage innovation in the Campania cluster and thus avoid this lock-in phenomenon, which in the long term could lead to failure. These interventions inevitably involve the requalification of Alenia's role in the cluster.

6. Conclusions

Given that today's knowledge-based economy depends in part on innovation, and that it is produced less and less from the isolated actions of a single firm, many authors have investigated the role of technology clusters as places that encourage the development of innovation. Scholars have recently raised questions about the conditions that favor development of technology clusters, specifically the conditions for knowledge spillovers and circulation of ideas. A large part of these studies indicate a positive role for the focal firm in the cluster, defined as the organization that intercepts most of the relationships among cluster members, facilitating knowledge spillovers and avoiding lock-in phenomenon. The focal firm acts as an interface to absorb new knowledge from external sources and favors the diffusion of knowledge among cluster members.

In our study we verified this assumption by analyzing the role of Alenia Aeronautica Spa in the Campania aircraft cluster.

On the basis of our research results, we conclude that the presence of a focal firm in a technology cluster is not a positive factor if this firm does not act as knowledge hub with explicit intention to transfer knowledge to other cluster members. On the contrary, in some cases the presence of focal firm may even hinder cluster development by limiting the activity of other cluster companies.

The paper provides a major contribution to literature on technology clusters because, contrary to what is affirmed by previous studies, it shows that the presence of a focal firm in a cluster does not always positively affect cluster development. We reached this conclusion after posing research questions and analyzing the case of the Campania aircraft cluster. Previous studies on aircraft clusters in the U.S. and in Canada affirmed that the presence of a leading firm is a necessary and sufficient condition to guarantee cluster development in the aircraft industry. Our research showed that this affirmation is not consistent with the Campania cluster, where a leading firm exists but does not encourage cluster development.

Our paper gives important indications to policy makers, suggesting that in order to promote the birth of a technology cluster in a particular region, it will not suffice to define policies that encourage the localization of large companies, but it is also necessary to create a climate that favors cooperation and circulation of technological knowledge among cluster members. The absence of these policies can generate lock-in phenomenon: the cluster remains closed to innovation and will disappear if the focal firm relocates its activities. Moreover, we give specific and valuable suggestions to Campania policy makers, showing that sectorial development must involve a requalification of Alenia Aeronautica's role within the cluster. For example, interventions could favor requalification of the area's infrastructure, stimulating Alenia to transfer high value-added activity to Campania, and further developing as system integrator for small aircraft. There are concrete possibilities for implementation of this strategy due to the agreement between Alenia and Sukhoi on the production of a prototype regional jet with low environmental impact. Another possible initiative would be for regional government institutions to favor the development of international relationships for the SMEs, particularly for innovative firms such as Tecnam.

This study sheds light on the role of focal firms in technology clusters and offers a number of points of departure for deeper consideration. The same analysis can be applied to other clusters in other nations and industries to verify the general validity of the conclusions. Collecting further empirical evidence would help to define a general theoretical model of the conditions in which the presence of a focal firm will effectively drive cluster development.

References

Agrawal, A., & Cockburn, I. (2003). The anchor tenant hypothesis: exploring the role of large local R&D-intensive firms in regional innovation systems. *International Journal of Industrial Organization*, *21*, 1227–1253. http://dx.doi.org/10.1016/S0167-7187(03)00081-X

Albino, V., Garavelli, A.C., & Schiuma, G. (1999). Knowledge transfer and inter-firm relationships in industrial districts: the role of the leader firm. *Technovation*, *19*, 53–63. http://dx.doi.org/10.1016/S0166-4972(98)00078-9

Asheim, B.T. (1994). *Industrial districts, inter-firm cooperation and endogenous technological development: the experience of developed countries*. UNCTAD, Technological Dynamism in Industrial Districts: An Alternative Approach to Industrialization in Developing Countries?, United Nations, New York and Geneva, pp. 91–142.

Audretsch, D., & Feldman, M.P. (1996). R&D spillovers and the geography of innovation and production. *American Economic Review*, *86*(3), 630–640.

Baptista, R. (2000). Do innovation diffuse faster within geographical clusters? *International Journal of Industrial Organization*, *18*, 515–535. http://dx.doi.org/10.1016/S0167-7187(99)00045-4

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, *28*, 31–56. http://dx.doi.org/10.1191/0309132504ph469oa

Becattini, G. (1989), *Sectors and/or districts: some remarks on the conceptual foundations of industrial economics, in Goodman, E. and Bamford, J. (Eds)*. Small Firms and Industrial Districts in Italy, Routledge, London, pp. 123–135.

Benzler, G. & Wink, R. (2010). From agglomerations to technology- and knowledge-driven clusters: aeronautics cluster policies in Europe. *International Journal of Technology Management*, *50*(3,4), 318–336.

Biggiero, L., & Sammarra, A. (2010). Does geographical proximity enhance knowledge exchange? The case of the aerospace industrial cluster of Centre Italy. *International Journal of Technology Transfer & Commercialisation*, *9*(4), 283. http://dx.doi.org/10.1504/IJTTC.2010.035397

Boari, C., & Lipparini, A. (1999). Networks within industrial districts: Organising knowledge creation and transfer by means of moderate hierarchies. *Journal of Management and Governance*, *3*, 339–360. http://dx.doi.org/10.1023/A:1009989028605.

Breshanan, T., Gambardella, A., & Saxenian, A-L. (2001). Old Economy' Inputs for 'New economy' Outcomes: Cluster Formation in the New Silicon Valleys. *Industrial and Corporate Change*, *10*(4), 835–860. http://dx.doi.org/10.1093/icc/10.4.835

Camagni, R. (1991). *Local milieu, uncertainty and innovation networks: towards a new dynamic theory of economic space.* In Camagni, R. (Ed.). Innovation Networks: Spatial Perspectives, Belhaven Press, London.

Camuffo, A., Romano, P., & Vinelli, A. (2001). Back to the future: Benetton transforms its global network. *MIT Sloan Management Review*, *43*(1), 46–52.

Cantwell, J., & Iammarino, S. (2003). *Multinational Corporations and European Regional Systems of Innovation*. Routledge, London, New York.

Carbonara, N. (2004). Innovation processes within geographical clusters: a cognitive approach. *Technovation*, *24*, 17-28. http://dx.doi.org/10.1016/S0166-4972(02)00046-9

Clifton, N., David, R., Ehret, O., & Pickernell, D. (2011). An Analysis of Actual and Potential Clustering Structures, Stakeholder Governance Activities and Cross-locality Linkages in the Welsh Aerospace Industry. *European Planning Studies*, *19*(2), 279. http://dx.doi.org/10.1080/09654313.2011.532676

Dhanaraj, C., & Parkhe, A.(2006). Orchestrating innovation networks. *Academy of Management Review*, *31*(3), 659–669. http://dx.doi.org/10.5465/AMR.2006.21318923

Doloreux, D. (2002). What we should know about regional systems of innovation? *Technology in Society: An International Journal*, *24*, 243-263.

Feldman, M. P. (2003). The locational dynamics of the US biotech industry: knowledge externalities and the anchor hypothesis. *Industry and Innovation*, *10*(3), 311–329. http://dx.doi.org/10.1080/1366271032000141661

Feldman, M., & Lowe, N. (2008). Consensus from controversy: Cambridge's biosafety ordinance and the anchoring of the biotech industry. *European Planning Studies*, *16*, 395–410. http://dx.doi.org/10.1080/09654310801920532

Frigant, V., & Talbot, D. (2005). Technological Determinism and Modularity: Lessons from a Comparison between Aircraft and Auto Industries in Europe. *Industry and Innovation*, *12*(3), 337-355. http://dx.doi.org/10.1080/13662710500195934

Giuliani, E., & Bell, M. (2005). The micro-determinants of meso-level learning and innovation: evidence from a Chilean wine cluster. *Research Policy*, *34*, 47–68. http://dx.doi.org/10.1016/j.respol.2004.10.008.

Glasmeier, A. (1991). Technological discontinuities and flexible production networks: the case of Switzerland and the world watch industry. *Research Policy*, *20*, 469–485. http://dx.doi.org/10.1016/0048-7333(91)90070-7

Grabher, G. (1993). *The weakness of strong ties: the lock-in of regional development in the Ruhr area.* in Grabher, G. (Ed.).The Embedded Firm, Routledge, London (1993), pp. 1–32.

Kechidi, M., & Talbot, D. (2010). Institutions and coordination: what is the contribution of a proximity-based analysis? The case of Airbus and its relations with the subcontracting network. *International Journal of Technology Management*, *50*(3,4), 285-299.

Lang, J. (2009). Cluster Competitiveness: The Six Negative Forces. *Journal of Business and Management*, *15*(1), 73-93.

Lazerson, M., & Lorenzoni, G. (1999). The firms that feed industrial districts: a return to the Italian source. *Industrial and Corporate Change*, *82*(2), 235–266. http://dx.doi.org/10.1093/icc/8.2.235

Link, A., Scott, J. T., & Siegel, D. S. (2003). The economics of intellectual property at universities an overview of the special issue. *International Journal of Industrial Organization*, *21*, 1217–1225. http://dx.doi.org/10.1016/S0167-7187(03)00080-8

Lissoni, F. (2001). Knowledge codification and the geography of innovation: The case of Brescia's mechanical cluster. *Research Policy*, *30*, 1479–1500. http://dx.doi.org/10.1016/S0048-7333(01)00163-9

Lorenzoni, G., & Baden-Fuller, C. (1995). Creating a strategic center to manage a web of Partners. *California Management Review*, *37*(3), 146–163.

Malmberg, A., & Maskell, P. (2002). The elusive concept of localization economies: towards a knowledge-based theory of spatial clustering. *Environment and Planning A*, *34*(3), 429–449. http://dx.doi.org/10.1068/a3457

Morrison, A. (2008). Gatekeepers of knowledge within industrial districts: who they are, how they interact. *Regional Studies*, *42*(6), 817-835. http://dx.doi.org/10.1080/00343400701654178

Munari, F., Sobrero, M., & Malipiero, A. (2011). Absorptive capacity and localized spillover: focal firms as technological gatekepeers in industrial districts. *Industrial and Corporate Change*, Advance Access published September 8, 1-34.

Niosi, J., & Zhegu, M. (2005). *Aircraft systems of innovation, in Niosi J. (Ed.)*. Canada's Regional Innovation Systems, McGill-Queen's University Press, Montreal and Kingston, 61–86.

Niosi, J., & Zhegu, M. (2010). Anchor tenants and regional innovation systems: the aircraft industry. *International Journal of Technology Management*, *50*(3-4), 263-284. http://dx.doi.org/10.1504/IJTM.2010.032676

Saxenian, A. (1991). The origins and dynamics of production networks in Silicon Valley. *Research Policy*, *20*(5), 423–438. http://dx.doi.org/10.1016/0048-7333(91)90067-Z

Saxenian, A. (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Harvard University Press: Cambridge, MA.

Utterback, J. (1994). *Mastering the Dynamics of Innovation. How Companies can Seize Opportunities in the Face of Technological Change*. Harvard Business School Press, Cambridge, MA.

Van Winden, W., Van Den Berg, L., & Van Der Meer, A. (2004). The development of ICT clusters in European cities: towards a typology. *International Journal of Technology Management*, *28*, 356–387. http://dx.doi.org/10.1504/IJTM.2004.005293

Yin, R. K. (1994). *Case Study Research: Design and Methods. (2nd ed.).* Sage, Thousand Oaks, CA.