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Between Technology- Intensive Organizations:  
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Parks**

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# **Cooperation and Cluster Strategies Within and Between Technology- Intensive Organisations: How to Enhance Linkages among Firms in Techno-Parks**

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## **ABSTRACT**

World today is characterized by rapid transformations in all aspects of human's life where innovation, technological change and technological progress play the most significant role. Therefore, technology-intensive organizations by engaging in strategic alliances, clusters and networks tend to extract maximum benefits i.e. to enable entry into the international markets and to develop core competences. Even though clusters have become a highly popular strategy, many of them fail to realize their intended goals. Thus, under the scope of this paper we explore why choosing a clustering strategy can be beneficial for technology-intensive organizations. Main focus will be on investigating if there are inter-firm and firm-university linkages among the actors located in a particular techno-park i.e. METU Techno-park and Bilkent Cyber-park. Results of the analysis showed certain extent of firm-university relationships and low level of inter-firm interactions. This further implied necessity of the policy interventions for enhancement of those interactions if the studied techno-parks are to become successful in the sense of the theoretical techno-park model, and if the tenant firms are to extract maximum benefits associated with cluster concept in theory.

Key words: Clusters; Networks; Innovation; Techno-parks; Policy

## INTRODUCTION

Concepts of technology, knowledge and innovation play huge importance in today's theoretical and practical world. Their importance in every aspect of human's life is evident from the beginning of the civilization. Understanding these concepts is crucial in order to understand new collaborative strategies for the firms that struggle to survive in rapidly changing environment that created global markets and global economy. In present, creation of technological innovation, its diffusion and adoption are being central to the economic development.

Simply put, technology is a dynamic process that changes continuously and innovation is a complex, social activity. Hence, technological innovation is not an isolated instance (Castells, 1996: 37). For a new technique and/or product to be implemented, company has to interact with its environment that is comprised of competitors, partners, universities, research centres, suppliers, public authorities, and so forth. Innovation itself is becoming more costly and often more risky than before and there is now greater inter-firm collaboration and networking in innovative effort (Lall, 2003: 3).

The dynamics of the competition are shifted to the global scale due to the rapid development and diffusion of the new technologies. In order to survive in such an increasingly competitive environment and markets, firms, organizations, governments and countries in general, must adjust and adapt themselves to the changes. Firms have to follow the technology trends and adopt their businesses to the high-tech environmental challenges if they are to become competitive and sustain their superior performance. The most successful ones will be the leaders of technological change and innovation, while the others will remain followers or even losers whose survival is threatened by competition and changing technology.

From the 1970s, vast amount of academic studies have been oriented towards the concept of regional clusters, networks and other forms of joint-ventures. Consequently, a growing body of literature is directed towards the creation of new policies and examination of industrial districts composed of small technology-intensive firms that struggle in the global competition.

The idea of the industrial districts and advantages of agglomeration dates back to century-old theory of Alfred Marshall in the 1890s. Emphasis in his work are on understanding the role of external economies, knowledge transfer, skills and learning among firms in geographical proximity (Cooke, 2002). The ideas of Marshall have been further developed by the number of industrial and innovation economists. As a result of growing research and policy experiments, a number of different theoretical frameworks have been developed to analyse geographical dimension of innovation and its implications for clustering (Breschi and Malerba, 2005: 2). Yet, all of the

perspectives share a common conception: formal and informal relationships; interactions and networks among diverse actors and institutions; and their geographical proximity. It is believed that all of these contribute to the more advanced learning, knowledge exchange, firm innovation and success of a cluster. Moreover, inter-firm embeddedness and agglomeration between the firms and other organizations is likely to reduce costs of innovation and knowledge transmission, and to lower risk and uncertainty among the technology-intensive firms in the cluster.

The importance of clusters and networks for innovation and competitiveness is increasingly recognized by policy-makers (De Propris, 2002). Accordingly, the apparent vitality of small firm agglomerations has resulted in SMEs and networking being one of the main targets of various policies, e.g. industrial, regional, innovation and technology, in many industrialized countries since 1980s (Isaksen, 1996).

This paper will hence take into consideration the main aspects of the innovation, knowledge and learning in order to provide better understanding of the contemporary trend towards the cooperative strategies in the highly competitive environment. Particular features of clustering and networking will be further discussed with emphasis on benefits of such linkages and social relationships for technology-intensive firms. Lastly, in the scope of theoretical presentation, techno-parks will be discussed as entities consisting of technology-intensive firms with potential of having clustering and networking advantages. The empirical part of the paper encompasses a field study in the two most popular techno-parks in Ankara. Thus, our study contributes to comprehending the implementation of the techno-park concepts in Turkey.

## **2. IMPORTANT ASPECTS OF INNOVATION**

The collaborations between small and medium technology-intensive enterprises, as well as co-operation between them and other institutions, are comprehended as means for more effective competition on the local, regional and global scale. In regard to this, vast amount of researchers put their accent on the importance of innovation, technology and learning in today's global economy referred as knowledge-based economy. More specifically, careful analyses are directed towards the fact that real sources of contemporary innovation are residing in neither the individual entrepreneur nor the research laboratories of large firms but in networks of social relationships between such organizations and others (Cooke, 2002).

Mytelka and Farinelli (2000: 7) emphasized that the 1990s witnessed radical and global technological changes which have significantly altered the competitive environment for firms in all sectors and placed a greater burden on small and medium-sized enterprises to engage in a

continuous process of innovation. The number of literature points out that small, technology-intensive firms which favour networking and clustering, proliferated in high-tech sectors. They have found the ways to develop innovative solutions through the collaboration and linkages with the other public and private enterprises, and/or knowledge institutions. Hence, we want to emphasize that small technology-intensive organizations can be active in the process of innovation if they are engaged in the cluster or network, and that they can extract benefits of clusters and networks if they tend to engage in the inter-organizational relationships.

While various authors focus on a variety of aspects of the clustering, in this study, three overlapping issues important for understanding the concept and benefits of clustering and networking will be shortly discussed. These matters refer to importance of innovation, knowledge and collective learning.

### **2.1. Innovation as an Interactive Process**

The basic assumption in the theoretical literature is that innovation is social, complex and interactive process where emphasis is on the importance of interactions among various actors. Innovation results from increasingly complex interactions at the local, national and global levels among individuals, firms and other knowledge institutions (OECD, 2001:3). Increasing complexity of the innovation process requires more face to face communication and informal linkages among the firms. Successful innovation demands access to specialised regional research and professional labour markets, university and research institute, technology competences, and existing networks of innovative high-tech firms (Longhi and Keeble 2000: 51). The evolutionary economists, such as Schumpeter in 1939, Nelson and Winter in 1982, and later the systematic theories of technical change, at national level by Lundvall in 1992 and Nelson in 1993, regional level by Saxenian in 1994, sectoral level by Carlsson and Stankiewicz in 1991, and firm level by Kline and Rosenberg in 1986, emphasized that firms do not innovate in isolation but in continuous interaction with other sources of knowledge (OECD, 2001:91).

Innovation has evolved from a single-act philosophy of innovation (Fischer, 2006) to a systemic approach where innovation is seen as an interactive activity in which learning is a fundamental process and knowledge the fundamental strategic resource (Lopez M. R., 2000). After transition from Fordism to post-Fordism, innovation process has changed and innovation activity is characterized with two features: 1) there is increased significance of incremental innovations compared to the linear model of innovation, and 2) innovation became a process of interactive learning between firms and their external environment where this environment is conceptualised in terms of "national or regional systems of innovation" (Smith, 1994). Vast amount of economic and

managerial studies in the last decade have emphasized importance of innovation for the competitiveness of not just a single firm but clusters and regions as well. The interactive nature of innovation process leads to a model of spatial system of innovation which underlines importance of co-operation between firms and institutions, and thus, the role played by networks involving different actors (Fischer, 2006).

Findings of Powel (1990), Powel et al. (1996), Oerlemans et al. (2001), Mytelka and Farinelli (2000), Wilkinson and Moore (2000), De Propriis (2002), Kitson and Michie (1998) and many others tend to provide the evidence that firms do not innovate in isolation. Innovation, technology, knowledge, their creation, utilization and diffusion, together with inter-firm and firm-organization linkages are all interconnected, intertwined and mutually interdependent. Moreover, they must be studied as such entities.

Hence, firms do not innovate in isolation. Innovation is closely linked and intertwined with tacit knowledge, technology and learning. Interaction became a central element in the process of innovation since innovation requires learning and since co-operation among the firms and organizations is crucial for exchange of tacit knowledge. Thus, innovation is fostered and enhanced inside the network and due to inter-firm collaboration. Moreover, innovation is bounded to the geographic proximity where proximity of various actors eases the inter-organizational co-operation and exchange of tacit knowledge, and, thus, supports the development of innovation. Firms, interconnected in the geographic proximity, can extract the benefits of innovation that became one of the most important sources of competitive advantage.

## **2.2. Innovation, Knowledge and Collective Learning**

At the dawn of the twenty-first century, process of networking, innovation, knowledge development and collective learning within European and US regional clusters of technology-intensive firms appears to lie at the heart of these regions' undoubted economic success (Longhi and Keeble 2000: 52). Here, learning from the others and knowledge, particularly tacit knowledge, play huge importance in development of the firm's competences.

The basic assumption in the theoretical literature is that firms located in close proximity to other firms and knowledge institutions are given opportunity to access and exchange tacit knowledge with the other entities throughout collaboration and inter-firm linkages, as well as to develop codes of collective learning and collective knowledge generation. Tacit and informal knowledge, widespread in the local area, play a fundamental role in the innovative process and in the industrial

development of clusters: human relationships, trust, common language and beliefs allow faster transfer of information and easy knowledge sharing (Carbonara, 2002). Tacit knowledge is bounded to people and is transferred through informal learning in local communities (Isaksen, 1996) and, thus, important elements of tacit knowledge are collective rather than individual (Johnson and Lundvall, 1995).

Moreover, transfer of tacit knowledge and know-how often necessitate development of long-term relationships. Hence, small technology-intensive firms need to develop ability of collective learning and networking with other related companies, knowledge institutions, governments and other financial organizations in order to access missing resources and become innovative. Making use of external knowledge and using partners to access lacking assets have consistently been stressed in the innovation literature as key to innovative success.

Information exchange and adoption of new technologies from others allow small businesses to develop specific competences and improve on others methods (Baptista, 2001: 32). If the small technology-intensive firms are interconnected in the web of networks and at the same time in close proximity to each other and knowledge institution they can produce more efficient and more effective innovation output. Thus, for small and medium enterprises (SMEs), clustering is believed to offer unique opportunities to engage in the wide array of domestic linkages among various actors (e.g. users, buyers, universities, R&D institutes, etc.) of an economy that stimulates learning and innovation (Mytelka and Farinelli, 2000).

Technology, innovation, knowledge and learning are concepts that are interweaved and tightly connected to concepts of networking, clusters and inter-firm relationships. Clustering and networking approaches help in comprehending the importance of collaboration between diverse economic units and collective learning for the sake of technology progress and innovation.

### **3. NETWORKS, CLUSTERS, SOCIAL RELATIONSHIPS AND BENEFITS OF THE LINKAGES**

General conception of the innovation process supports the relevance of networking and clustering of resources (OECD, 2001:91). Many authors emphasized that networking is central to the innovation process. Here, cluster approach emerged as useful framework within which to analyse the networks linking diverse agents (OECD, 2001:91).

The growth of regional clusters of mainly small and medium enterprises in Western Union and North America since the 1970s has gained great interest among both academics and policy makers

(Isaksen, 1996). Some of the remarkable examples include Silicon Valley, Orange County, and Boston's Route 128 in USA; Cambridge, Oxford, Grenoble, and Sophia-Antipolis in Europe, and many others. In the '70s and '80s such clusters established a strong position in the world market for both more traditional products (e.g. Third Italy) and high technology products (e.g. Silicon Valley), and in some industrial sectors they proved as more competitive than large firms (Isaksen, 1996). Since then, much of the literature is centred around inter-firm collaboration and cooperation, strong links with local knowledge centres such as universities, and the development of a regionally-embedded capacity for collective learning (Keeble 2000: 1).

It is believed that in '90s globalization and technological change led to the growing importance of the cluster and network concepts. Analyses of clusters have emerged as key issues in the research agenda of scholars from quite diverse economic fields (Breschi and Malebra, 2005:1). Following successful cases in the United States and Europe, many regions have been trying to imitate these examples, setting up science parks, technopoles, venture capital and financial innovation support schemes (Breschi and Malebra, 2005:1). However, there is neither a standard cluster approach, nor fixed policy recipe for implementing the cluster approach in practice (Bergman et al., 2001).

It must be emphasized that clusters come in many forms, each of which has a unique development trajectory, principles of organization and specific problems (Mytelka and Farinelli, 2000: 11). One broad distinction can be made between clusters that are 'spontaneous agglomerations of firms and other related actors' and those that are 'induced by public policies' (Mytelka and Farinelli, 2000: 11). The latter is also referred to as 'constructed clusters' (Mytelka and Farinelli, 2000: 11) and encompasses techno-parks, industrial parks, incubators, and so forth.

### **3.1. Impact of Geographical Proximity on Innovation Capability, Clusters and Networks**

Case studies conducted in the Third Italy and Silicon Valley, among the other successful cases, illustrate that territorial uniqueness is highly profound and crucial for innovation inside these 'clusters'. Findings of Gulati (1995), Mowery et. al. (1996) and the others, suggest that obstacles to inter-firm knowledge transfer are produced by distance, cultural differences, and other factors. All authors that favour positive effects of geographic proximity, e.g. Staber (1996a, 1996b), Piore and Sabel (1984), Camagni (1991), Keeble and Wilkinson (2000), Keeble (2001), Von Hippel (1994), Porter (1990, 1998, 2000), Cuerco-Garcia et al. (2008), Lundvall (1992), Mowery et al. (1996), Baptista (1996), Baptista and Swann (1998), highlight that it is one of the factors that explain enhanced and accelerated transfer of tacit knowledge, innovation creation and diffusion in the clusters (industrial districts or science and technology parks). Positive effects of the geographic proximity may be summarized as follows:

- geographic proximity of the agents participating in innovation process is a powerful reducer of learning and communication costs (Von Hippel, 1994), it improves communication and facilitates the flow of information (Porter, 1998 and Cuerco-Garcia et al. 2008) and it increases the speed of information flow and rate at which innovation diffuse (Porter, 1990);
- exchange of tacit knowledge between firms and/or other institutions, and hence interactive learning, are facilitated;
- geographic proximity raises the visibility of competitor behaviour and awareness of matching improvements (Porter, 1990);
- proximity raises the number of spin-offs as they have tendency to locate near the original company and attracts talented people (Porter, 1990);
- geographic proximity of companies and institutions, and the repeated exchanges among them, fosters better coordination and trust (Porter, 1998). Thus, creation of social capital i.e. trust, common language and common culture is supported;
- geographic, cultural, and institutional proximity leads to special access, closer relationships, powerful incentives, and other advantages in productivity and innovation that are difficult to utilize from distance (Porter, 1998);
- proximity fosters direct contacts with a variety of sources, e.g. competitors, suppliers, customers, universities and research laboratories (Baptista and Swann, 1998); face-to-face interaction is eased which further may foster development of inter-firm and firm-organization linkages;
- Access to specialized workforce is eased and mobility of the labour is facilitated;
- Diffusion of knowledge spillovers and academic research spillovers are eased.

Further, positive factors of geographical proximity may highly contribute to creation of relationships and/or strengthening of inter-firm and firm-university cooperation and networking. In turn, networking among the actors located in close proximity can contribute to the innovative capacity and competitiveness of both, individual firms and clusters.

However, Kirat and Lung (1999) emphasized that proximity that is merely geographic can provide the basis for agglomeration of firms, yet not necessarily the presence of an innovation system. They stressed that potential for such a system depends on technological proximity as well as on geographic proximity where collective action rationale, shared rules and collective learning are from crucial importance. Cooke (2002:128) asserts that embeddedness and geographic proximity go together to create cluster. This implies necessity of cooperation and networking among the actors situated in the geographic proximity if the utilization of cluster advantages is to be achieved.

### 3.2. Networks Amongst the Firms

Recent work on the growth of small, high-tech firms in the US and Northern Italy suggests the model of externally-driven growth in which network of relationships enable small firms to gain and establish foothold almost overnight (Powel, 1990).

The extent of networks between companies located in the cluster is related to the set of interdependent relations that are willingly established between the companies, or between individuals, or among business units. Network building is a social process through which the actors gradually and voluntarily establish close relations of long-term duration (Sorensen, 1996: 8). According to Sorensen (1996), actors throughout daily interactions attain personal experience of the other actors which in turn (if the interaction is successful) lead to cooperation, trust, commitment, mutual adaptation and even routinization of the relationships.

Sorensen (1996:11) summarized network mechanism as follows:

- *Interaction creates personal experience and information flow, and may lead to cooperation;*
- *Cooperation incurs intensive social relationships which, in turn, may result in the creation of trust and mutual orientation;*
- *Trust opens up for commitment, mutual adaptation which further generates interdependence;*
- *Trust also opens up for asset specific investments and thus asymmetrical relationships.*

Powel (1990) contributes to the network theory by emphasizing three factors as critical components of networks. These are: *know-how*, *demand for speed* and *trust*. Sorensen (1996) stressed the importance of concepts of "cooperation" and "trust" as key concepts in the Network Theory. He also relates cooperation to the concepts of "*competition*", "*power*", "*coordination*", "*opportunism*", and "*commitment*".

Trust between networks' actors can minimize the need for planning as well as transaction costs which to a large extent are incurred to prevent opportunistic behaviour and breakdown of cooperative relations (Staber, 1996b). Sorensen (1996) also emphasized that cooperation and trust are mutually interdependent in the sense that they enforce each other. Most of the scholars argue that trust is a necessary and critical condition for the long-term relationships, exchange of resources (e.g. tacit knowledge, information, technical know-how, personnel and so forth), making risky investments, reducing uncertainty and sharing novel ideas. Trust is important when business

activities involve uncertainty, resources are scarce, and information is limited (Staber, 1996b). Trust is a key resource for holding actors in network together (Staber, 1996b).

Network is a flexible but changeable mode of organization and network building is a complex exercise in balancing:

- *Independence/interdependence against dependence*
- *Cooperation against conflict*
- *Trust against opportunism*
- *Mutual orientation against power*
- *Access to resources against control over resources, and*
- *Flexibility against interlocking rigidity (Sorensen, 1996:11).*

### **3.3. University-firm linkages**

Cooperation between the firms and knowledge institutions, namely universities, is perceived in the literature as highly important and beneficial. This is due to the fact that knowledge centres serve as a means of disseminating research, providing services, and educating and training future workforce (Cuerco-Garcia et al. 2008). Smith and de Bernardy (2002) assert that universities are: a) source of highly skilled labour (i.e. they supply graduates, they train the existing local workforce through continuing education departments, and they attract highly qualified workforce from outside); b) source of new firms (i.e. they provide ground for university spin-offs and encourage academic entrepreneurship); and c) sources of technology (i.e. they can stimulate innovative activity of the firms). Camagni (1991), in the innovative milieu theory, argues that proximity to university means proximity to sources of highly skilled labour which are highly mobile within a cluster. According to Camagni (1991), Keeble (2000) and Smith, and de Bernardy (2000) this proximity, together with university-firm relationships, accounts for much of collective learning inside the cluster. According to Keeble (2000), the role of the knowledge institutions, namely universities, in promoting collective learning in the cluster encompasses:

- creating preconditions for regional collective learning in terms of informal networks of former students and researchers, and SME research cultures of collaborative innovation
- generating local technology-based spin-offs as a source of new innovative firms and regional technology competences
- training scientists, engineers, researchers and other graduates where recruitment of this highly-qualified labour by cluster firms is seen as one of the most crucial ways in which local universities can shape and foster the growth of a cluster
- collaborating with cluster firms in R&D.

Further, Keeble (2000) emphasizes that process of knowledge diffusion and development which leads to dynamic process of regional collective learning is fostered by the movement of key individuals and skilled workers carrying technological and managerial know-how and 'embodied expertise' between firms and other organizations (e.g. universities, research institutes, etc). New spin-offs are seen as important type of this movement not just for the knowledge transfer and development but for the generation and sustainability of inter-firm and firm-university linkages. According to Keeble (2000), founders of these spin-offs often maintain close relationships with their 'parent' organization, creating, thus, opportunities for networking, collaboration and the development of further 'untraded interdependences'. The successful examples studied by Keeble and Wilkinson (2000) show the high percentage of spin-offs. One of them is Cambridge cluster where 88% of high-tech SMEs are spin-offs or new start-ups founded by entrepreneurs formerly working for a local firm (56%) or university (19%).

Table 2, below lists the types of knowledge interactions that are believed to be especially relevant for the university-firms interactions. For the purpose of this study, 'employment of graduates by firms', 'new firm formation by university members', 'training of firms members', 'collaborative research, joint research programmes', 'contract research and consulting', 'use of university facilities by firms', and 'licensing of university patents by firms' are considered as the main factors that determine relationship between university and firms, whereas the other factors will be used for the policy and future work recommendations.

Table 2. Types of knowledge interaction between university and firms

Types of knowledge interaction	Formalization of interaction	Transfer of tacit knowledge	Personal (face-to-face) contact
Employment of graduates by firms	+/-	+	-
Conferences or other events with firm and university participation	-	+/-	+
New firm formation by university members	+	+	+/-
Joint publications	-	+	+
Informal meetings, talks, communications	-	+	+
Joint supervision of PhDs and Master thesis	+/-	+/-	+/-
Training of firm members	+/-	+/-	+
Mobility of researchers between university and firms	+	+	+
Sabbatical periods for university members	+	+	+
Collaborative research, joint research programmes	+	+	+
Lectures at university held by firm members	+	+/-	+
Contract research and consulting	+	+/-	+
Use of university facilities by firms	+	-	-
Licensing of university patents by firms	+	-	-
Purchase of prototypes developed at university	+	-	-
Reading of publications, patents, etc.	-	-	-
+ (interaction that typically involves formal agreements, transfer of tacit knowledge, personal contacts)	- (interaction that typically does not involve formal agreements, transfer of tacit knowledge, personal contacts)		
+/- (interaction with varying degree of formal agreements, transfer of tacit knowledge, personal contacts)			

Source: M.M.Fischer et al. (2006:138)

### 3.4. Motives for Networking

Hence, we can list the following rationales for cooperation that has been mostly emphasized in the literature (Kogut 1988, Powel 1990 and 1996, Camagni 1991, Hagedoorn 1993, Eisenhardt and Schoonhoven 1996, Mowery 1996, Gulati 1998, Fischer 2006):

- To obtain greater pay-off when firm is in a vulnerable strategic position (i.e. highly competitive industry, new markets, many competitors or pioneering technology);
- To benefit from economies of scale in joint R&D and production;
- To improve strategic position;
- To gain market power, to enter quickly to new markets or to obtain entry to foreign markets;
- To create new products or to expand the existing product range;
- To share costs and risks (e.g. costs and risks of the research in high tech-industries are high);
- To reduce, minimize and share uncertainty (which is inherent to R&D and innovation);
- To capture competences, innovative and technological capabilities of partners;
- To obtain critical resources quickly (such as, tangible resources – financial assets, or intangible ones – know-how, reputation, skills) and synergies of resource sharing;
- To gain visibility and information about buyers, suppliers, employees, customers, manufacturing, etc.;
- To improve or advance technological innovation (e.g. by joint product development, transfer of technology, etc.);
- To reduce the total period of the product life-cycle and shorten the period between invention and market introduction;
- To gain fast access to new technologies of partners (e.g. transfer of technology) and to advance technology development;
- To tap into sources of know-how and new knowledge located outside the boundaries of the firm;
- To share and advance basic scientific and/or technological knowledge (e.g. joint research activities, sharing the technology, etc.);
- To access technological synergies, near-future results of general scientific knowledge and relevant complementarities of technologies.

The need for cooperation and networking among the firms and other institutions stems from the tacit nature of knowledge, increasing importance of learning, technology and innovation, costly and risky R&D, changes in environment, globalization, and intensified competition in knowledge-based economy, to name some of them. This is especially significant for small, technology-intensive

organizations that want to become competitive in today's uncertain environment. Therefore, current literature stresses the importance of networking and clustering if these organizations are to proliferate and obtain advantages of networks and clusters.

### **3.5. Advantages of Clusters/Networks**

There is an agreement in the contemporary literature that clusters became a leading model for economic development in the knowledge-based economy of today. Hence, business economists promote clusters and networks as specific modes especially where rapid productivity and innovation gains are key features of global competitiveness (Cooke, 2002). Policies that aim at promoting clustering and networking are actually directed towards the utilization of advantages that these strategies can generate at the firm, region and/or national level of analysis.

Advantages of clustering defined by Marshall are the basic point of departure for almost all scholars. Furthermore, two immensely popular and interrelated literatures, namely 'innovative milieu' by Camagni (1991) and Keeble (2000), and industrial clustering by Porter (1990) have been highly influential. The central hypothesis of this literature is that sub-regional clustering of related activities has the potential, if suitably encouraged, to generate stronger social networks between businesses, which would promote successful innovation and competitive advantage (Gordon and McCann, 2005).

Sorensen (1996) argues that network provides the following advantages:

- *Trust reduces transaction costs and uncertainty*
- *Experience and knowledge about the partners' needs increase the innovative potential*
- *Intensive information flows increase the opportunity to engage in the new business opportunities*
- *Voluntary cooperation assures flexibility*
- *Commitments assure access to resources controlled by the others.*

We can also add the advantages of collective learning capacity for creating, exchanging and diffusing new, tacit knowledge reinforced by frequent contacts and developed trust among the various actors engaged in network. This particular advantage is mostly emphasized by 'innovative milieu' literature and it argues that networking between the firms, and among the firms and other institutions, generate better opportunities for learning which is a prerequisite for improvements in productivity and economic performance.

Another important advantage of networking and clustering, often mentioned in the literature, refers to the time. The time necessary to establish expertise or to gain market share will be shortened in the network of partners (Fischer, 2006). Moreover, firms that are part of the network are more likely to be able to exploit developments in a technology in a timely manner and to facilitate problem-solving tasks through sharing of experience gained by dealing with similar technologies (Baptista and Swann, 1998). Hence, quicker access to required resources, capabilities and know-how, new markets or new technologies can speed up innovation and ensure competitive advantage of small technology-intensive firms being engaged in the network.

One of the most widely cited theories referring to cluster advantages for firms and countries is that of Porter (1990, 1998). Porter (1998) stressed out that a cluster of independent and informal linkages among the companies and institutions represents a robust organizational form that offers advantages in efficiency, effectiveness and flexibility. Porter (1998) describes a number of advantages derived from clustering that has been emphasized and discussed by many authors, such as Oerlemans et al. (2001), Cooke (2002), and others. These benefits mainly encompass an *increase in the productivity of firms* based in the cluster due to better access to employees and suppliers, access to specialized information, complementarities, access to institutions and public good, and better motivation and measurement; *innovation gains and company's ongoing ability to innovate* due to proximity and interactions among the firms, and between firms and other entities; and *new business formation* that is fostered in cluster environment where information about innovative potential, knowledge and market opportunities is locally available. (Porter, 1998).

We argue that important advantages that firms, specifically small technology-intensive firms, can obtain from inter-firm and firm-organisation networks inside the cluster is through capturing the external knowledge, resources, competences and information. Further, tacit knowledge obtained and diffused through collaboration can lead to the generation of new products and processes. Collective learning and trust are fostered by frequent cooperation and close proximity. Inter-firm and firm-institution networks can open up new opportunities for success that SMEs would not be able to capture if operating in isolation.

We also argue that clustering can generate advantages for SMEs such as, higher level of innovativeness, growth, flexibility, ability to deal with complexity, uncertainty and risks, higher levels of productivity, increased profitability, and increased competitiveness.

However, it is important to remind the significance of external linkages for the success of cluster and constituent firms. Some scholars, such as Camagni (1991) and Keeble (2000), stressed the importance of external linkages with other clusters and/or regions. According to them, regional collective learning, in order to be sufficient, requires some inflow of expertise, know-how and new

embodied knowledge from other technologically innovative regions and countries. This is due to the fact that high-tech clusters in order to be successful need to be linked into wider national and international labour markets.

In such circumstances of contemporary world, where interactions and proximity are highly essential, networking and clustering are seen as the most suitable strategies for SMEs that aim to grow and proliferate in high-tech sectors.

We argue that firms that develop and maintain linkages with other firms and institutions, and firms that are settled in the close geographical proximity have a potential to enjoy the benefits of clusters. Small technology-intensive firms need to access external sources of information, knowledge, know-how and technologies, in order to build their own innovative capability and to reach their markets, and they must also engage in networks, particularly those that nurture the tacit knowledge and other non-tradable competencies that are critical for pursuing innovation-based competitive strategies (OECD, 2004:5). Notwithstanding the importance of knowledge and innovation in contemporary environment, the benefits that firms can obtain from cluster go beyond the transfer of knowledge and innovation which was presented above.

#### **4. TECHNO-PARKS**

*When an inventor in Silicon Valley opens his garage door to show off his latest idea, he has 50% of the world market in front of him. When an inventor in Finland opens his garage door, he faces three feet of snow.*  
J.O. Nieminen, CEO of Nokia Mobira, 1984

Techno-parks as a form of 'constructed' clusters (Mytelka and Farinelli, 2000) play an important role in promoting and strengthening the cooperation between two different environments: academic and business. The role of techno-parks in fostering local development has been object of a number of studies and analysis (European Commission, 2007:54). Since the early 1950s many countries took policy initiatives to encourage the development of techno-parks in order to facilitate growth and innovativeness of SMEs and NTBFs. The aim of these policies is mainly directed towards bridging together high technology, industry, and research and development into specific locations (Bass, 1998).

Hence, the establishment of an increasing number of techno-parks in Western countries as well as in newly industrialised economies (such as Southeast Asia, South Korea, Singapore, Taiwan and China) since the 1980s have been motivated by the economic contributions of some high

technology industrial clusters, both spontaneous and planned ones (European Commission, 2007:62). The phenomenal growth in the number of technology-based firms around, for example, Stanford University in Palo Alto and Massachusetts Institute of Technology (MIT) in Boston (Saxenian, 1994) in the US provided a role model for the development of techno-parks all over the world. The result was emergence of high-tech centres such as Silicon Valley and Route 128 in the United States, Cambridge in UK, Sophia-Antipolis in France, Tsukuba in Japan, just to name a few.

Despite the efforts sparked by the so called "Silicon Valley fever", not many planned techno-parks have been successful (Malecki, 1991). Thus, in the following sections we will identify some of the most common characteristics of the techno-park concept, its linkages and advantages, which will be used as a starting point for policy recommendation.

#### **4.1. Characteristics of Techno-Parks: Definition, Typology and Objectives**

Techno-parks are thus planned developments (Castells and Hall, 1994) and are seen as providers of a dynamic and attractive environment for innovation (Westhead and Batstone, 1998). They are promoted by governments (central, local or regional), often in association with universities and private companies, in order to help the generation of the basic materials of the information economy (Castells and Hall, 1994). Despite their long-history in the United States as well as in other countries, there is no generally accepted definition of a techno-park. This is largely due to the diversity of development forms of techno-parks in different countries which makes it difficult to provide one, widely applicable characterization of these infrastructures (European Commission, 2007:52).

Operationally techno-parks are a group of research organisations and businesses devoted to development of scientifically proven concepts from the laboratory stage to the factory production stage (Benko, 2000). Physically, they are a group small- to medium-sized office and laboratory-type buildings in an attractive landscaped setting (Benko, 2000). The first technology park in the world, Stanford Research Park, was created in 1951. This attracted and spun off numerous high-tech firms in the surrounding region and subsequently led to the formation of the famous Silicon Valley (Wang et al., 1998).

The differences in techno-parks mainly arise because of different actors that initiate the techno-parks: government, regions, universities, high-tech companies, investors/developers (European Commission, 2007:57-58). Moreover, techno-parks differ according to geographical scale they operate on: entire regions and cities, e.g. Japan's 'technopolis' projects and large scale urban

developments known as science cities; or smaller property developments such as technology parks also known as research or science parks (Bass, 1998).

From the various attempts of researchers to identify the possible objectives of techno-parks, according to Westhead and Batstone (1999:132) the most common ones seems to be:

- *promotion of university<sup>1</sup>-industry linkages by fostering cooperation between university and constituent firms, and the transfer of technology from university to techno-park firms;*
- *promotion of the formation of new technology-based firms;*
- *encouragement of spin-off firms by academics;*
- *encouragement of the growth of existing technology-based firms;*
- *attraction of the firms involved in leading-edge technologies;*
- *creation of synergy between constituent firms<sup>2</sup>;*
- *improvement of the performance of the local economy;*
- *improvement of the image of the location, particularly for areas of industrial decline;*
- *creation of new jobs directly as well as indirectly; and*
- *enhancement of the competitiveness of new as well as existing firms in the region.*

#### **4.2. Advantages Offered by Techno-parks**

In general, techno-parks are constituted of three main actors: public research centres and/or university, large firms, and SMEs (Castells and Hall, 1994)<sup>3</sup>. We can add to this, management of the techno-park often in the form of Management Company, as an important actor of techno-parks. The combination of these actors, territorially concentrated, may provide numerous clustering benefits for the constituent firms, as well as for region in general.

According to the literature (Castells and Hall, 1994, Benko, 2000, European Commission 2007, Ferguson and Olofsson, 2004, Monck et al., 1988, Castells, 1996) we identified four different levels of benefits that can be generated by techno-parks:

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<sup>1</sup> University or Higher Education Institute (HEI).

<sup>2</sup> Where synergy is seen in terms of networks connecting individuals from many different organizations within a system that encourages the free flow of information and generation of innovation (Castells and Hall, 1994:224).

<sup>3</sup> It should be highlighted that majority of the firms located in techno-parks is usually of small and medium size. Moreover, firms in techno-parks are technology-intensive because they operate in high-tech sectors.

- Techno-parks may provide the visibility and hence attraction to wider local strategies aiming at the creation of encouraging conditions for high-tech industries to prosper. Example of these strategies can be favourable tax and credit incentives. Techno-parks can contribute to the 'right mix' of research excellence, entrepreneurial activity and public support strategies that is prerequisite for region to be identified as a 'region of knowledge', 'science region', or 'creative region'. At the same time, techno-parks can generate an environment where new ideas, valuable information, pool of skilled labour and technological innovation can emerge and be available for and easy accessible by the constituent firms. Hence, techno-park offers benefits and support for both, local high-tech base and constituent firms.

- Techno-parks provide the advanced infrastructure on which research-intensive and technology-intensive enterprises rely. Here, high priority is given to the presence of research and training institutions, access to university's facilities and resources, a good transportation system, an adequate telecommunications, environmental quality, and prestige and image of the site. For example, techno-parks have been identified as 'centres of knowledge and innovation' and they are becoming increasingly an image of high-tech regions offering hence technological and commercial reputation to the constituent firms. This is why many firms look for the image of quality and innovation that is associated with techno-parks. Besides the location factors, being in close proximity to a university and possible partners creates proper conditions for informal exchanges between enterprises, and between enterprises and university, creating thus a specific social milieu. Proximity of various actors in techno-park eases access to information, finding a collaborator, and access to market knowledge (Benko, 2000). In addition to this, proximity further facilitates new company creation and mobility of workers. Thus proximity allows establishment of a specific infrastructure dedicated to the creation and transfer of technology (Benko, 2000).

- Techno-parks provide complementary services and support to constituent firms. Techno-parks provide wider support services that allow constituent firms (spin-offs, SMEs, technology-intensive firms) to better focus on their core business and on research for the development of innovations. These services range from administrative matters and management support, to technology brokering. Stronger development and growth of techno-park firms can be supported by help of techno-parks in managing transfer of technology and business skills of constituent firms (Ferguson and Olofsson, 2004). At the same time, techno-park contributes to greater interactions between different actors. Thus, the role of techno-parks is also in facilitating access to other firms located in the same techno-park (or near by) and to their clients, in contributing to the strengthening of diverse institutions within the local innovation system, and in stressing the innovation process and the knowledge exchange (European Commission, 2007:53).

- Techno-parks are usually associated with strong networking effects, creation of synergy and high levels of social capital, as mentioned above. Social networks allow informal exchange of technological information and new ideas which prove to be essential ingredient for the formation of a self-sustaining techno-park (Castells and Hall, 1994). Thus techno-parks have impact on both informal as well as formal networks<sup>4</sup> of creative interaction among various actors. The social capital developed in techno-parks can facilitate the exchange of tacit knowledge, collective learning, the development of 'community atmosphere', or the greater access to specialized human resources. Moreover, networks and relationships between firms and local universities (or research institutes), that are of great importance to local knowledge networks, emerge and are supported in the techno-park. The most important roles of universities are seen in the: generating of new knowledge (both basic and applied); training of the highly skilled labour; and supporting the process of spin-off of their research into the network of industrial firms and business ventures (Castells and Hall, 2004:230-231).

Benefits and characteristics of the techno-parks have triggered in recent years great attention among the researchers and policy makers. Even though few successful cases in the strongest sense of that concept can be found in the literature, Castells and Hall (1994:111) after studying many examples in various locations asserted that:

“...the existence of a technology park in its various forms triggered a process of industrial growth and technological upgrading of the local economy, literally putting these areas on the map of the new industrial geography.”

#### **4.3. Techno-park Success Factors**

Various authors (Castells and Hall 1994, Benko, 2000, UKSPA Annual Report 1996) have proposed different techno-parks' success factors. The most extensive presentation of success factors can be seen in the Figure 2. However, for the purpose of our study we have concentrated on the following ones:

- networks and interactions between the constituent firms;
- relationships with university; and
- highly skilled labour force and mobility of workers.

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<sup>4</sup> These networks are heterogeneous and can include diverse actors (e.g. knowledge producers, users, disseminators), diverse disciplinary backgrounds or even industrial sectors (European Commission, 2007:53).

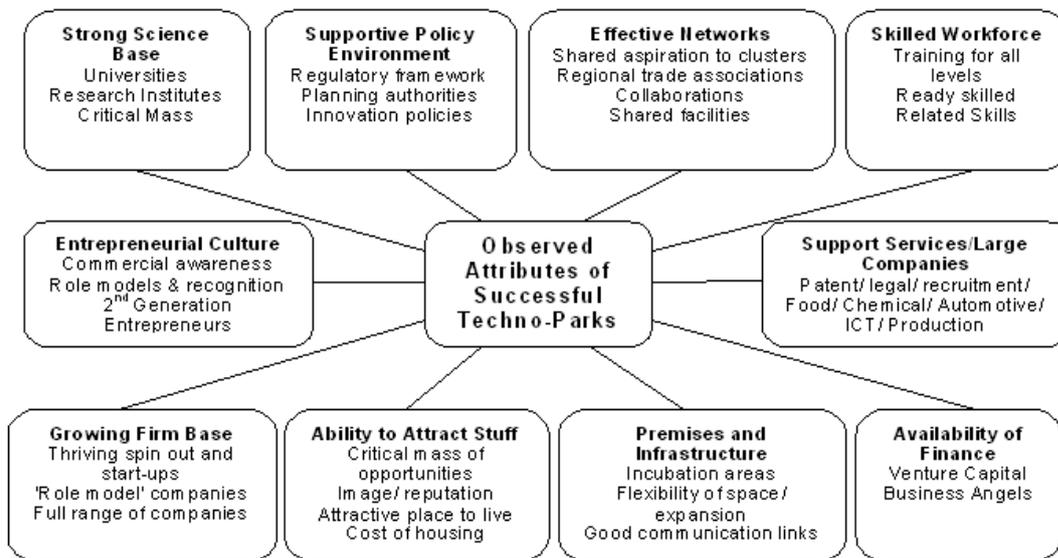


Figure 2. Techno-park success factors

Source: Modified from the UKSPA 1996 and European Commission 2007

#### 4.3.1. Networks and Interactions Between the Constituent Firms

According to Vyakarnam et al. (2005) the nature of techno-parks can be described as a network environment built on collaboration, exchange of information and sharing of resources (both physical and human) among constituent firms. Here, techno-parks offer opportunity for constituent firms to locate in close proximity to other similar and non-similar enterprises. On this way, techno-parks provide an important resource network for NTBFs. (Löfsten and Lindelöf, 2002). Close proximity of firms can support and ease formation of formal as well as informal interactions, and creation of shared identities and mutual trust. Even though technology-intensive firms are usually highly international and possibly linked to the similar regional clusters elsewhere, local relationships inside the techno-park are strategically vital (Saxenian, 1994). This is due to the timeliness significance and enabled frequent face-to-face communication that facilitate rapid product development, development of territorial synergy and collective learning. Hence, in this manner, we argue that techno-parks endow constituent firms with the possibility to generate dynamic networks among themselves.

Even though formal networks have proved as a productive interactions in some instances of innovative clusters (e.g. in the Japanese model), informal networks place a crucial role in the

generation of new, valuable information and tacit knowledge (Castells and Hall, 1994). Moreover, informal networks among the constituent firms can lead to easier knowledge and information exchange, more innovation, and effective management, which in turn can enhance firms' long-term competitiveness (European Commission, 2007). Informal linkages, as in the example of Silicon Valley, can increase in complexity and importance over time and they can simultaneously convey communication of technological innovation, form organization of the job market, and shape the culture that emphasize the values of technological excellence and free-market entrepreneurialism (Castells and Hall, 1994:18).

Equally important are personal relationships and networks. The example of Silicon Valley shows that its vitality and flexibility over time as well as its level of technological excellence were only achievable because the Valley itself created social networks among engineers, managers, and entrepreneurs, generating creative synergy that transformed the drive for business competition into the desire to cooperate for technological innovation (Castells and Hall, 1994:28). In Silicon Valley restaurants, bars and even parties were place where engineers met to exchange ideas and gossip (Saxenian, 1994). These informal conversations were pervasive and served as an important source of up-to-date information about competitors, customers, markets, and technologies (Saxenian, 1994:33). Moreover, people with similar interests and experiences came together in various users' groups and hobbyists' clubs (Benner, 2003:1815). Economic actors in the Silicon Valley have become more conscious about the importance of these social interactions and, thus, they put deliberate efforts to create the formal infrastructure to support these 'networking' opportunities (Benner, 2003:1815). As a result, in Silicon Valley there are hundreds of professional associations and similar users groups that make up the dense network of occupational relations (Benner, 2003:1819). Especially striking is the cooperation among the competitors that Saxenian (1994:33) illustrates in the following way:

“...competitors consulted one another on technical matters with a frequency unheard of in other areas of the country...in Silicon Valley, competitors will not only sit down with you, but they will share the problems and experience they have had....”

Although firms' integration and interactions have been important for the growth of spontaneous high technology industrial clusters, and can aid a techno-park to achieve more economic benefits, they have not yet been fully applied in developing techno-parks (European Commission, 2007). Castells and Hall (1994) argue that creation of linkages and synergetic interaction between techno-park's constituent firms is most difficult to achieve.

### **4.3.2. Relationships with Universities**

On one side, universities have played a critical role in the development of the techno-parks. Some of the most examined cases in the literature embrace the role of Stanford University at the origin of Silicon Valley, Cambridge University or MIT starting the spin-off process in their area of influence, or the catalytic function of the Ecole Nationale des Mines in the birth of Sophia-Antipolis (Castells and Hall, 1994).

On the other side, techno-parks provide mechanisms that continually encourage university-firm relationships, whether they are in the form of formal links or informal networks. It is argued (Benko, 2000, Vedovello, 1997) that geographical proximity between actors, as provided by techno-parks, has contributed to the improvement of their interaction.

Universities are providers of both the raw material (new information and knowledge) and the labour force (engineers and scientists) that techno-park firms need (Castells and Hall, 1994). According to Westhead and Batstone (1998), by linking with a university, techno-park firms, in many instances, were able to minimize the 'direct' personal cost and risk associated with R&D. For example, by utilizing the resources and skills of an adjacent university, techno-park firms were able to assimilate and exploit available technical information which could be commercially exploited in association with the university and/or other firms (Westhead and Batstone, 1998). Linkages with universities thus enable firms to enhance their technology, market information gathering and dissemination of such knowledge and information. This in turn can positively contribute to firms' innovative ability and capacity, and hence improve their competitive performance (Vedovello, 1997:501). Thus, both universities and companies motivated by different purposes have been stimulated to promote and strengthen their links inside the techno-park.

The forms of linkages between individual firms and universities inside a cluster have been discussed previously. Consequently, the same implies for the techno-parks. Throughout the relationships among universities and companies, techno-parks have a larger indirect impact on the training of skilled labour, the support of scientific networks, the provision of social knowledge, the collective learning and the establishment of informal networks (between firms' employees and employees and academicians) through which tacit knowledge is usually exchanged (European Commission, 2007). Additionally, geographical proximity plays, if not critical, then a facilitating role in building and sustaining these relationships.

### **4.3.3. Highly Skilled Labour Force and Mobility of Workers**

Highly skilled labour force is perceived as an important precondition for the growth of technology-intensive firms inside the techno-park (Bresnahan and Gambardella, 2004, Saxenian, 1994, Castells and Hall, 1994). According to Castells and Hall (1994:231) the ability to build a local labour market of good-quality engineers and scientist is critical for all start-up technological centres. It can be add to this that local labour market and movement of highly-skilled labour (i.e. highly-skilled employees, researchers, scientists, engineers and managers) among local firms, universities, research institutes and other organizations within the techno-park is important mechanism for collective learning (Keeble and Wilkinson 2000). Moreover, employing the graduates from the nearby university can enhance both transfer of knowledge from university and formation of networks. According to Keeble (2000:210) such intra-regional recruitment diffuses technological and organizational knowledge, strengthen personal networks, and enables new combination of knowledge to be assembled and deployed to develop new innovative products.

In studying inter-firm and firm-university relationships it is, thus, crucial to highlight the importance of mobility of qualified workforce. Mobile workers represent the carriers of knowledge which is an essential type of 'untraded interdependences' between the firms, resulting in the transfer of 'embodied expertise', enhanced informal links and a deepening and broadening of the regional pool of knowledge (Keeble, 2000). Here, universities with their continuous output of young qualified workforce (e.g. scientists, engineers, researchers) may play vital role if cluster firms recruit this labour. On this way, firms help in the dissemination and commercialization of new scientific knowledge derived from university (Keeble, 2000).

Mobility of workers among the firms in the techno-park is seen as a facilitating factor for knowledge spillovers and information sharing, development of the local pool of knowledge, and collective learning. Mobility of workers among the firms can enhance personal relationships that further can be important source of knowledge and technology transfer and sharing. This is due to the fact that each individual carries information, knowledge, skills and experience acquired at their previous work (Saxenian, 1994) and could potentially utilize it in whichever way she/he likes (Athreye, 2004). Mobility of workers also encourages interactions and linkages between the firms in techno-park. In the Cambridge case for example, it was estimated that 46% of firms reported links with other firms because of personnel that had moved between firms (Keeble 2000, Athreye, 2004). Further, 77% of these firms said that these links were important or crucial to the firm's development (Keeble 2000, Athreye, 2004:149). In the same manner, mobility of workers in Silicon Valley was so frequent that it become not just socially acceptable, but the norm (Saxenian, 1994:34). Moreover, in Silicon Valley example, mobility of people led not just to the strengthening of the networks among the firms but to the accelerated diffusion of the technological capabilities, skills, information

and know-how within the region (Saxenian, 1994). Shared technical culture and loyalty to network became indirect products of the workers mobility in Silicon Valley.

In addition, new spin-offs are one type of mobility of workers, as discussed previously. Here, entrepreneurs with research, engineering, or managerial know-how take ideas, expertise or potential products which they have developed in a 'parent' company (or university) and establish a new business inside the techno-park in order to further develop and exploit them (Keeble, 2000: 207). By leaving their existing firms to establish new ones in order to exploit a new technology, innovation or market opportunity, these individuals diffuse high-level expertise and competences inside techno-park, thereby developing the local pool of knowledge (Keeble, 2000: 207). The Cambridge case also showed that a large proportion of firms spun out by former employees continued to maintain formal and informal linkages with the parent firm (Athreya, 2004:149).

Thus, mobility of the workers within techno-park results in the transfer of 'embodied expertise', enhanced informal links and inter-firm networks inside techno-park, and a deepening and broadening of the regional pool of knowledge. All of these further contribute to the success of the techno-park and tenant firms shifting innovativeness and competitiveness of the individual firms and region as a whole to higher levels.

## **Summary**

Techno-parks are perceived in the literature as innovation and competitiveness enhancing regional policy tools in contemporary knowledge-based economy. Thus various efforts and policy recommendations were directed to develop and create techno-parks all over the world. Success stories, such as that of Stanford Research Park in the heart of Silicon Valley, have been prime motivator for other regions to emulate the same success. However, not all techno-parks had shown the real effects in the practice. Thus a growing number of researchers in recent years has been exploring this phenomena, providing particular theoretical proposals for policy makers and governments who desire to promote regional economic development by setting-up techno-parks. Yet, there is general impression of the confusion in the literature as well as lack of the empirical evidence that would verify all theoretical assumptions behind the concept.

Techno-parks are highly diverse and take considerable time to be fully developed and operational. Having this in mind, in the preceding section, we have discussed some of the most commonly emphasized elements of the techno-park concept in the literature. From the theoretical point of view, techno-parks are seen as a form of planned innovative clusters or innovative milieus. They embrace various, geographically concentrated, actors. They provide structural elements which promote a variety of linkages and networks (e.g. between university and industry, inter-firm

networks, personal relationships), and which encourage synergy between technology-based firms settled in techno-park. Networks further lead to development of an open, flexible and more innovative environment that can enhance the level of economic activity of tenant firms and of the techno-park as a whole. Techno-parks stimulate R&D; encourage knowledge and technology transfer and diffusion among techno-park actors (e.g. inter-firm exchange of information, university-firm transfer of know-how); generate advanced technological capabilities and regional pool of knowledge; and create environment for higher levels of innovativeness through development of more innovative products and processes.

Here, innovation is viewed as arising from the linkages of the milieu as a whole, rather than from individual firms. Thus techno-parks can be perceived as “innovative milieu” that performs the role of a system which increases the potential for organizational efficiency within firms. The dynamic environment and cooperative culture of techno-parks may further attract more actors locating their businesses near the park. This may lead to the emergence of an industrial cluster. In such a way, techno-parks create a development potential for the region. (European Commission, 2007). Their impact is therefore evident on different levels, i.e. individual firm, techno-park as a whole, and entire region.

Number of scholars has been conducting different studies aiming at verifying or disproving the positive impact of techno-parks on the performance of new technology-based companies. The conclusion, however, have differed among different authors, with some finding little evidence of direct contribution to innovation from the firms located within the park (e.g. Felsenstein, 1994; Siegel at al., 2003a) and others concluding the opposite (e.g. Ferguson and Olofsson, 2004; Lindelöf and Löfsten, 2002).

Despite various findings available in the literature we support attitude that techno-parks, as one form of clustering, provide small technology-intensive firms with the potential of becoming more innovative and competitive in the local and international markets. We argue that geographical proximity of actors facilitate formation of inter-firm and firm-university networks and interactions. Even though innovation linkages do not necessarily need to be spatially constituted, as Castells (1996:390) pointed out:

“At least in this century, spatial proximity is seen as a necessary material condition for the existence of such innovative milieu, because of the nature of the interaction in the innovation process”.

## 5. PURPOSE, THE DATA AND RESEARCH METHODOLOGY

The purpose of the field study is to explore whether there are intensive linkages and networks in the two most important techno-parks in Ankara: METU Techno-park and Bilkent Cyber-park. More specifically, we examine if tenant firms employ a high level of highly-qualified personnel that is highly mobile within a techno-park, whether there are intensive inter-firm networks among the tenant firms, and whether there is high level of firm-university alignment in METU and Bilkent techno-parks. The primary objective of the study is to put forward adequate policy recommendations directed towards the promotion and intensification of inter-firm and firm-university networks in the techno-parks in order to obtain maximum benefits of the clustering concept.

METU Techno-park and Bilkent Cyber-park, as the two largest and most successful techno-parks in Turkey, are suitable cases for our analysis. Both techno-parks are placed in the close proximity to an university, Middle East Technical University and Bilkent University, respectively. Moreover, they are settled in the close proximity to each other. They accommodate firms operating in high-tech sectors (such as, software development, electronics industry, and other high-tech sectors) where the majority of firms is of small and medium size. The objective and mission of these two techno-parks correspond to the general premises of the techno-park concept in the literature. Considering techno-parks as important infrastructures in contemporary knowledge-based economy, promotion of these infrastructures has high importance in enhancing firm's as well as local competitiveness and innovativeness.

Inside the boundaries of our research, data was collected at two different levels: firm level and techno-park level. Apart from the general background and contextual information, questions, both in questionnaires and interviews, were designed in order to identify the existence and frequency of inter-firm networks; university-firm linkages; structure of employees and inter-firm mobility of workers; as well as types of co-operation, motives for cooperation or reasons for non-cooperation.

The questionnaires designed for conducting the survey among the firms, embrace following categories: general information about the surveyed firm; information about the employees; and information about the cooperation between the firms.

Analytical software SPSS is used for statistical analysis of collected data. Statistical and descriptive analysis of the information collected throughout the questionnaires and interviews provide the basic and general indicators about the mobility of labour, inter-firm and firm-university relationships.

Results of the field study will be used for testing the validity of hypotheses defined for this study. Moreover, this analysis will further shape the direction of the policy recommendations aimed at the intensification of collaboration among the actors settled in the studied techno-parks.

Certain constraints are expected to be encountered, such as lack of data, or questions on the accuracy and recentness of the data. More specifically, constraints such as time, language and inability to access certain documentation available in Turkish language, firms' limited openness and less positive attitudes towards this kind of study, and exclusion of certain sectors (such as defence sector) are other factors that will influence our research and policy-making proposals.

## **6. FINDINGS**

After reviewing the basic characteristics of METU Techno-park and Bilkent Cyber-park it can be concluded that two techno-parks are to a great extent alike. Their objectives and structure correspond to the basic concept of techno-parks given in the conceptual framework of this study. Both techno-parks are deliberately planned areas with the main objectives to support: university-industry relationships; formation of the technology-intensive enterprises; birth of spin-offs; creation of networks among the tenant firms; generation of new jobs for highly qualified labour pool; and growth of R&D activities. Along with these objectives, both techno-parks directed their efforts towards the promotion of technological innovation, and generation of scientific synergy and economic productivity (i.e. enhancing techno-parks). Both techno-parks are placed in the university's campus and are mainly comprised of small and medium technology-intensive enterprises. Close geographical proximity to two best universities in Turkey is perceived as a great advantage for the creation and sustainability of university-industry collaboration. Management Companies of these techno-parks provide a variety of services that aid the development of technology-intensive tenant enterprises. Having this in mind, we argue that METU Techno-park and Bilkent Cyber-park offer to their tenant firms advantages attributed to techno-parks that are discussed previously. In accordance with the established logical framework, we also argue that dense networks among the tenant firms as well as intense university-firm collaboration among these geographically close actors can generate clustering benefits for the tenant firms. Moreover, we argue that close geographical proximity of METU Techno-park to Bilkent Cyber-park, as well as their close proximity to the Hacettepe Techno-park, can facilitate the formation of 'Cyber-city' or 'Silicon Valley' of Ankara. For this to happen, efforts from both techno-parks, their mutual collaboration, and right policy tools must be carefully generated and implemented.

## **6.1. General Information and Characteristics of the Surveyed Firms**

At the time of the survey, it was projected that METU Techno-park accommodates 171 enterprises (excluding 20% of the firms that belong to defence sector), and Bilkent Cyber-park is being host to the 160 enterprises. A total number of 70 firms has been surveyed, out of which 36 firms belong to METU Techno-park and 34 firms to the Bilkent Cyber-park. Thus, the sample of the surveyed firms counts for 21% of the total number of firms in both techno-parks.

From the 36 surveyed firms in the METU Techno-park, 69% of the firms operate in the IT and/or Electronics whereas 31% of the firms operate in other areas. Of the total number of surveyed firms in the Bilkent Cyber-park, 76% operate in the IT and/or Electronics while 24% belongs to the other areas. These sub-sectoral characteristics of the tenant firms obtained from our survey correspond to the documented data, discussed earlier in this section, regarding the main areas in which tenant firms operate in the METU and Bilkent techno-parks. Hence, our survey has showed that the tenant firms of the METU and Bilkent techno-parks are in the category of the technology-intensive enterprises according to the field of their activity.

In METU Techno-park 80% of surveyed firm were founded after the year 2001. In Bilkent Cyber-park 70% of surveyed firm is founded after the year 2001. This fact matches the rapid development of the both techno-parks after the year 2001.

From the whole number of surveyed firms, 94% can be considered as of micro and small size regarding the number of employees in the techno-parks firms. Only 6% of the surveyed tenant firms in both techno-parks reported to have more than 50 employees. This finding is in the harmony with the documented characteristics of the tenant firms in METU and Bilkent techno-parks.

Moreover, from the analysis of the general information about the surveyed firms, we concluded that firms in METU and Bilkent techno-parks are much alike. This fact enabled us to apply some of the analysis on two techno-parks as a whole along with the individual analysis for each of the surveyed techno-parks.

## **6.2. Testing the Hypotheses**

After analyzing the basic information about the tenant firms' in both techno-parks, we can continue with testing the hypotheses of this study.

### Hypothesis 1

*If small technology-intensive firms are settled in the techno-park as a particular form of cluster then due to the proximity to university these firms will employ a high level of highly-qualified personnel that is highly mobile within a techno-park.*

Our results (question 6 – 8) indicate that small technology-intensive firms from both techno-parks have more problems in finding highly qualified employees in comparison with the middle size (between 11 and 50 employees) and large size (above 50 employees) tenant companies. These results also depict the necessity for small technology-intensive firms inside the techno-parks to develop strong inter-firm and firm-university relationships in order to overcome a variety of difficulties such as, the problem of finding the highly qualified workforce (see Appendix B).

Our results (question 9, 11 – 14), indicate that there is very low level of mobility of workers between techno-parks' tenant companies. Even when the firm reported that they had an experience of employee who had left a particular company and found a job in another company within the same or another techno-park, the number of such employees was very few. On the other hand, very few percentage of the surveyed tenant companies practice employment of the personnel from the tenant firms settled in the same or another techno-park. Hence, the mobility of the workers among the tenant companies within the same techno-park (METU and Bilkent individually) and mobility of workers among various techno-parks is neither common nor frequent event. The same can be said for the spin-offs from the existing companies (see Appendix B).

Not so high level of 'highly qualified workers', and low level of 'mobility of workers' and 'spin-offs from existing companies' among the tenant firms in the same techno-park (METU or Bilkent), or among tenant firms settled in the two geographically close techno-parks, implies the following conclusions according to the theory:

- There is no ground for developing informal links and enhancing personal relationships inside the METU and Bilkent techno-parks;
- Knowledge spillovers, information sharing, exchange of tacit knowledge, development of local pool of knowledge and collective learning are not facilitated in the studied techno-parks; and
- Informal interactions and formal linkages among the tenant firms inside the techno-park, METU or Bilkent, as well as interactions and linkages among the tenant firms from different techno-parks, METU and Bilkent, are neither encouraged nor supported.

## Hypothesis 2

*If the technology-intensive firms are settled in the techno-park then there will be high level of firm-university alignment.*

From our analyses and results (see Appendix C) it can be concluded that the vast majority of both small technology-intensive firms and big companies settled in studied techno-parks comprehend proximity to university as a beneficial factor that aids them in accessing the professional employees. Employing graduates from the near-by university by tenant firms is one type of interaction between the university and companies. According to our logical framework this kind of interaction has a positive influence in the sense of formal agreements and transfer of scientific, as well as tacit knowledge.

Moreover, management companies of the studied techno-parks can be seen as mediators that enhances interactions between the university and tenant firms. From the interviews with the representatives of the Management Companies we can conclude that in METU and Bilkent techno-parks there are:

- 'formation of new firms by university members' which influence the development of formal interactions, transfer of tacit knowledge, and varying degree of personal contacts;
- 'training of firm members', through various seminars and training courses organized by the management companies, have influence on interactions that typically involve personal contacts and varying degree of transfer of tacit knowledge and formal agreements;
- 'collaborative research, joint research programmes', through projects that management companies conduct with academicians and tenant companies, which lead to the development of the interactions that typically involve formal agreements, transfer of tacit knowledge and creation of personal contacts ;
- 'contract research and consulting', through matching the academicians with the tenant companies that necessitate professional advices, creates interactions that are based on formal agreements, personal contacts and varying degree of transfer of tacit knowledge;
- 'use of university facilities by firms', such as library, contributes the development of the interactions through formal agreements; and
- 'licensing of university patents by firms' that also creates interactions through formal agreements.

Hence, we can say that there is a certain degree of university-firm interactions in the studied techno-parks. METU and Bilkent techno-parks, through their management companies, provide mechanisms that continually encourage universities-firms relationships, whether they are of formal or informal character. According to our logical framework, direct personal interactions by university

members and firms' employees (such as, face-to-face communication facilitated by geographic proximity) generate social capital, such as trust, common language and common culture, which further contributes to eased exchange of knowledge and information.

Even though university-firm interactions in studied techno-parks can be enhanced, it seems that METU and Bilkent techno-parks have established a solid base for the further improvements of these interactions. The right policy mechanisms would contribute to the improvement and reinforcement of university-firm relationships in the studied techno-parks.

#### Hypothesis 3 and Hypothesis 4

*Hypothesis 3: If the technology-intensive firms are settled in the techno-park then these firms will have higher level of developed inter-firm linkages.*

*Hypothesis 4: If the technology-intensive firms are settled in the techno-park, and if they have tight inter-firm and firm-university affiliations, they can extract maximum benefits of the techno-park concept and of clustering and networking in general.*

From our results (see Appendix D), we can make the following observations regarding METU and Bilkent techno-parks as a whole:

- Project-based cooperation is not very frequent in the studied techno-parks (53% of the tenant firms in both techno-parks had project-based cooperation with the other firms from the same techno-park). Moreover, number of joint projects is not significant. However, majority of the firms that work on common projects belongs to firms that have up to 10 employees. Great majority of the firms that do not have common projects with other firms from the techno-parks also did not develop long-term cooperation and networks with both firms from the same or from other techno-parks.
- Similarly, majority of the firms do not develop long-term cooperation with other companies from the same techno-park. Great majority of the firms that reported they "do not collaborate" belongs to the small tenant firms (78% of the small tenant firms from the METU and Bilkent techno-parks as a whole).
- Long-term networks are even less developed among the firms from different techno-parks. Here, great majority of the firms that do not develop this kind of collaboration also belongs to the small tenant firms.
- Inter-firm networks with the firms from other techno-parks are even less developed than inter-firm networks among the firms from the same techno-park. Majority of the firms that develop networks with the other firms from the same techno-park tend to develop networks with the firms from other techno-parks. On the other hand, great majority of the firms that do not have

any long-term cooperation with the firms in the same techno-park is not apt to developing long-term cooperation with the firms settled in other techno-parks.

- Furthermore, from the whole number of the firms in METU and Bilkent techno-parks, 34 of them (48%) have developed inter-firm networks either with the firms from the same techno-park or with the firms settled in other techno-parks or both.

From the results of the questions 20 to 24, we can make the following conclusions regarding the firms that reported any form of cooperation with other firms:

- Majority of the firms in both techno-parks collaborate for the R&D. The lowest importance, in both techno-parks, is given to the collaboration on fairs, exhibitions, and publishing. Considering both techno-parks as a whole, sharing know-how, information and consultancy are more frequent types of cooperation than collaborations in production/service, NPD, ToT, marketing and education/training of the employees.
- 'Trust' is the most important parameter for developing inter-firm networks in both techno-parks. Collaboration for achieving 'product/process development' is also a highly important reason for inter-firm networks in both techno-parks. On the other hand, the least number of firms choose to cooperate because of the unfavourable market conditions. Considering both techno-parks as a whole it is surprising that 'access to network of the partners' is not one of the main reasons for inter-firm cooperation.
- Firms in METU Techno-park develop inter-firm linkages equally with the firms from same and different sectors, while in Bilkent Cyber-park firms mainly develop inter-firms networks with firms from the same sector. This implies that in METU Techno-park complementarity between firms in R&D projects is high.
- Majority of the firms (68%) in both techno-parks cooperate often, very often or permanently. Similarly, majority of the firms (56%) comprehend networking as very important or vitally important. Almost half of the firms (41%) see networking as of middle importance. Great majority of the firms that cooperate often or very often comprehend networking as a very important whereas all the firms that see networking as of "little importance" cooperate "rarely".

According to results of the questions 25 and 26 (regarding the firms that do not have developed inter-firm networks with other firms) we conclude that:

- From the whole number of the firms that do not cooperate, 55% in METU Techno-park and 56% in Bilkent Cyber-park intend to establish inter-firm networks. On the other hand, high percentage of the firms in both techno parks is not in favour of networking.
- In METU Techno-park, 35% of the firms will not cooperate because of the firm's policy, because cooperation is risky, or because there is no firm in the same field. This percentage is much higher in Bilkent Cyber-park where 62% of the firms will not cooperate for the same reasons.

According to our results, we conclude that in the case of METU and Bilkent techno-parks firms, even though in close geographic proximity to each other, do not cooperate intensively. This is opposite to our postulated hypotheses. Considering the profile of the firms and fact that they are located in the most developed techno-parks in Turkey, it was expected that there will be a higher level of inter-firm networking. Moreover, we argue that developed inter-firm networks can be characterized as weak. This is due to the fact that in developed inter-firm networks exchange of information and know-how among the firms has low priority, whereas collaboration in the production/service, ToT, NPD, marketing and education of employees are even less established types of inter-firm networks. Additionally, according to our logical framework, trust is an important facilitating factor for establishing formal and informal networks. In METU and Bilkent techno-parks almost half of the firms that have inter-firm networks reported trust as a reason for networking. This implies that even though trust is most commonly reported reason for networking, half of the firms that cooperate were not able to develop trust relationships. Similarly, access to partner's networks and sharing human, physical and financial resources is not comprehended as an important reason for networking among the firms. In addition to this, we can add previous findings about mobility of the highly qualified workers. Low levels of 'mobility of workers' and 'spin-offs from existing companies' also indicate weak networking among the tenant firms.

Hence, we perceive that there is a necessity of enhancing developed inter-firms networks in the studied techno-parks if the tenant firms are to extract maximum benefits of the clustering and networking and if studied techno-parks are to be more successful. Consequently, there is high necessity of policy recommendations directed towards the fostering and encouraging networking among the firms that do not cooperate in the studied techno-parks. In line with our theoretical framework, we believe that tenant firms can become more innovative and competitive if they will pursue network form of organization. At the same time, by forming robust inter-firm networks inside the techno-parks, firms can contribute to the advancement of techno-parks into high-tech clusters. Furthermore, METU and Bilkent techno-parks as a high-tech cluster can enhance the success and performance, not only of the tenant firms and hosting techno-parks, but of the region as whole.

### **6.3. Additional Findings and Remarks**

From the interviews conducted with the representatives of the techno-parks' management companies, it can be concluded that management companies conduct initiatives directed towards intensification of inter-firm cooperation. METU Techno-park's management company perceives clustering as a strong brand image. It also sees fostering cooperation among the tenant firms and encouraging entrepreneurship as their daily job. METU techno-park, through Management

Company, organizes various seminars, training courses and meetings where people can meet and discuss particular issues, as well as social gatherings (e.g. parties). Bilkent Cyber-park's management company goes even further in their vision to create robust high-tech cluster not only among the tenant companies, but among the near-by techno-parks as well. They plan to apply to particular EU funds that would enable them to launch initiatives in this direction. Likewise the METU techno-park's management company, they provide free trainings, seminars and free consultancies, and they organize various projects and study groups where employees of the tenant companies can meet and exchange their knowledge and information. Hence, we assume that METU and Bilkent techno-parks offer potential to the tenant firms to establish robust and intensive inter-firm cooperation, yet there is necessity for policy interventions that would alter this potential into reality.

Even though tenant firms in METU and Bilkent techno-parks perceive proximity to university as highly beneficial in order to access professional employees, they still have problems in finding highly-qualified personnel. Especially this is the case with small technology-intensive tenant firms. We assume that small tenant firms do not want to invest in the highly-qualified labour or do not want to offer attractive wages, due to the fear of losing employee and, thus, losing their investments. Hence, we assume that this could be enhanced in the cooperative environment of the small technology-intensive tenant companies. Otherwise, circulation of the scientific knowledge and development of the local pool of knowledge inside the studied techno-parks will be low.

METU and Bilkent techno-parks' tenant companies thus have potential of forming a cluster with dense inter-firm networks, yet, our previous results indicate that there are no dense inter-firm networks in the studied techno-parks. According to formal and informal information gathered through the field survey, we assume that majority of the firms is not aware of the benefits that they can obtain through inter-firm networks. Additionally, we assume that firms who set up their policies against networking comprehend sharing information and know-how as a high-risk activity. On the other hand, small technology-intensive firms in the studied techno-parks that tend to cooperate are not able to access the other tenant companies easily. Very small percentage of the cooperation among the tenant firms in the activities such as, marketing, fairs, exhibitions, and education or trainings of the employees implies low possibility of the tenant firms to establish informal networks and friendships with the other companies. We can also assume the low level of informal networks due to the rare mobility of the employees among the tenant firms. Consequently, while conducting the survey, in informal conversations with the interviewees we could often hear the following opinion:

"...other companies in the techno-park are so closed for the firms in their environment....for example, we even do not know what kind of job our next-door neighbour is doing..."

Hence, we assume that firms in the studied techno-parks do not comprehend that dense networking, open labour markets and learning from each other can bring more competitive advantage than independency and secrecy. We believe that rising awareness about benefits of collaboration practices and informal exchange can alter the current situation in the studied techno-parks.

In addition, it is important to mention that one of the key features of success of techno-parks, discussed previously, is the availability of the capital ready to take risk of investing in innovation (Castells and Hall, 1994:237), R&D and new technologies. In order to conduct R&D and to be innovative new and small technology-innovative enterprises must find ways of generating funds to keep them alive (Castells and Hall, 1994:232). This capital can further enable technology-intensive firms to prosper and sustain their competitive advantage. According to our analysis (see Appendix E), majority of the firms in METU and Bilkent techno-parks (73%) has EU or TUBITAK-funded projects, or both. Moreover, there are other institutions that provide R&D funds for techno-park tenant companies which indicate that techno-parks in Turkey offer small technology-intensive tenant companies opportunity to access more easily domestic and foreign capital needed to pursue R&D and innovation. Thus, we assume that these funds can aid small technology-intensive firms by providing finance for their development. If used efficiently, these funds can enable firms to become more self-sustaining over the time and create more high-risk capital that can be utilized for future R&D and innovation. We also assume that high-risk capital, and local pool of labour and knowledge concentrated inside the techno-parks, will in turn encourage networking, entrepreneurship and experimentation. As in the case of Silicon Valley, this mixture of social networks among the engineers, managers and entrepreneurs can generate creative synergy and desire to cooperate for technological innovation which further may lead to techno-park's vitality, resilience and technological excellence.

## **7. POLICY RECOMMENDATIONS**

In the line with the techno-park's features that have been examined in the field study, we will propose certain policy needs, policy goals and policy instruments. By doing so, we intend to contribute to overcome the weaknesses in the studied techno-parks and promote their potential using the theoretical concepts of techno-parks and clusters.

According to the logical framework, we argued that:

- If development of inter-firm interactions inside the techno-parks would be fostered, and if intensification of existing inter-firm networks would be promoted, tenant firms would be able to utilize advantages of clustering concept in the sense of the theory.
- If inter-firm networks among tenant companies from two techno-parks would be encouraged and enhanced, cooperation among METU and Bilkent techno-parks would be strengthened, and formation of high-tech cluster would be possible.

Policy recommendations process entailed: identification of policy needs; definition of policy goals according to identified policy needs; and suggestions for policy instruments in order to achieve defined objectives. Needs, objectives and policy instruments were designed according to the lacking or weak features of METU and Bilkent techno-parks compared to the successful techno-park model.

The following policy needs have been identified:

- *Need to increase level of highly qualified labour;*
- *Need to enhance firm-university cooperation;*
- *Need to encourage development of inter-firm networks inside the techno-park; and*
- *Need to encourage and enhance development of inter-firm networks among the near-by techno-parks' tenant companies.*

Hence, the following specific policy goals have been postulated:

- *Reinforcement of the highly qualified labour pool;*
- *Strengthening the firm-university networks;*
- *Rising awareness of the benefits of dense networks; encouraging learning from each other; and fostering formal as well as informal exchange of information and know-how; and*
- *Promotion of cooperation among METU and Bilkent techno-parks' tenant companies for the sake of forming robust high-tech cluster.*

Consequently, the following policy instruments have been proposed:

- 1) In order to increase level of highly-qualified personnel in METU and Bilkent techno-parks, it has been proposed:
  - *Organizing various events pointing out importance of the high-qualified labour for technology-intensive companies settled in the techno-parks' (by management companies);*
  - *Organizing study in order to discover why tenant firms have problems in finding professional employees (by management companies);*

- *Offering part-time jobs to the MS and PhD students from the near-by university by tenant companies;*
  - *Supervision of MS and PhD thesis by tenant companies;*
  - *Creating platform for exchange of knowledge and information among tenant companies' members and MS and PhD students;*
  - *Increasing cooperation among tenant companies and their participation in the joint educational and training programmes;*
  - *Project-Based Employment of industry/business experienced advisors (holding MS or PhD degree).*
- 2) In order to increase level of firm-university interactions in METU and Bilkent techno-parks, it has been proposed:
- *Increase 'employment of near-by university's graduates' by tenant companies;*
  - *Joint participation of tenant companies' and universities' members on various conferences and other similar events;*
  - *Encourage of 'new firm formation' by university members;*
  - *Joint publications by tenant firms and university;*
  - *Organizing informal gatherings and social events by management companies and universities;*
  - *Increasing number of university members who held trainings and seminars organized by management companies for tenant firms;*
  - *Lecturing at university by tenant firm members;*
  - *Mobility of researchers between university and tenant firms;*
  - *Increase utilization of university facilities by tenant companies;*
  - *Licensing of university patents and purchase of prototypes developed at university by tenant firms;*
  - *Increasing the number of joint projects between tenant firms and universities.*
- 3) In order to increase elaboration of inter-firm interactions in METU and Bilkent techno-parks, it has been proposed that management companies should:
- *Develop activities for 'raising awareness of each other' among tenant firms through various forums and meetings organized by management companies;*
  - *Develop activities for 'raising awareness' of the tenant firms about benefits of the concepts of clustering and techno-parks in general, and networking and cooperation in particular;*
  - *Undertake activities for increasing knowledge and information about 'How to establish cooperation' for tenant firms that have not developed inter-firm networks and relationships;*

- *Undertake initiatives towards intensification of ‘exchange of know-how and information’, ‘cooperation in ToT’, ‘collaboration in marketing’, ‘cooperation in education and training of employees’, and ‘cooperation in exhibitions, fairs and publishing’ for tenant companies with developed inter-firm networks;*
  - *Foster engagement of tenant firms in project-based cooperation;*
  - *Initiate formation of professional associations according to types of the sector and sub-sectors in techno-parks, or according to more specific common interests of tenant companies’ members;*
- 4) In order to encourage development of more intense and more dense inter-firm networks among METU and Bilkent techno-parks’ firms, it has been proposed:
- *Development of joint cooperation among METU and Bilkent techno-parks’ management companies in order to generate joint actions for promotion of inter-firm networks among two techno-parks;*
  - *The same instruments proposed for fostering and strengthening inter-firm networks within each techno-park, can be implemented for the encouragement and support of inter-firm networks between two techno-parks;*
  - *Increasing the number of joint projects between METU and Bilkent techno-parks.*

According to conclusions of this thesis, if the identified missing elements of METU and Bilkent techno-parks would be carefully addressed and promoted by proposed policy instruments, small technology-intensive tenant firms would be able not just to survive but to achieve higher level of innovativeness and growth, and to improve their competitive performance as argued in the theoretical framework of this article.

## **SUGGESTIONS FOR FUTHER RESEARCH**

Our study presents general approach for evaluation of METU and Bilkent techno-parks’ characteristics. Results of the field study have been designed in order to form general perception of existence and intensity of inter-firm and firm-university networks in the studied techno-parks. Hence, we recognize necessity of the future research in the same field in order to improve effectiveness and accuracy of our research and results. We propose the following:

- 1) In our study we have been investigated if tenant companies have problems in finding professional employees. High percentage of the surveyed firms has reported this problem. We, thus, perceive importance of additional analysis to further explore concrete reasons

and difficulties that firms encounter when searching for professional workers. Results of such analyses would provide more in-depth information that would further enable development of more effective policy recommendations for enhancing the level of highly-qualified personnel in the tenant companies.

- 2) Through our survey and interviews we have obtained more general information about the firm-university linkages inside METU and Bilkent techno-parks. Our results indicate existence of these networks and necessity for their intensification. Yet, we identify the need for more detailed analysis of particular types and intensity of developed firm-university interactions. Besides investigating more closely how firms cooperate with near-by university, future research should also encompass analyses regarding: frequency of firms cooperation with near-by university; how firms perceive importance of firm-university cooperation; and what are concrete benefits that firms gain from firm-university interactions. Results of such analyses would provide more detailed information that would further enable creation of more effective policy instruments for enhancing the level of firm-university cooperation.
- 3) Moreover, we perceive importance of future work that would have main objective of analyzing tenant companies' level of innovativeness in relation to the developed inter-firm networks. Additionally, comparing innovativeness among METU and Bilkent techno-parks' tenant companies that have developed and that have not elaborated inter-firm networks is one more important subject of the future research. This research should incorporate more quantitative data and quantitative methods for analyzing collected data. Results of such analyses would provide more detailed information that would further shape direction of policy instruments regarding inter-firm cooperation inside the techno-parks.
- 4) Our analyses depict low level of mobility and spin-offs in METU and Bilkent techno-parks. Thus, we propose future research among the tenant firms' employees that would investigate the reasons of why they do not prefer to change the jobs and switch from one to another company inside the techno-park. Results of such analyses would provide more in-depth information about the low mobility of skilled workers inside the techno-parks. Accordingly, these results would shape direction of policy recommendations and would contribute to more effective policy instruments for enhancing the level of informal inter-firm cooperation and exchange of tacit knowledge among the techno-parks tenant companies.

Moreover, one closely related future research suggestion is the evaluation and follow-up of the results from the operational phase if our policy recommendations will be put into the practice.

**APPENDIX A**  
**Field Survey - Enterprise Questionnaire<sup>5</sup>**

**PART I: GENERAL INFORMATION ABOUT THE SURVEYED FIRM**

1) Name of the firm: \_\_\_\_\_

2) Sector:

1. IT
2. Electronics
3. Other: \_\_\_\_\_

3) Year of establishment:

1. Before year 2001
2. Between the 2001 and 2005
3. After the 2005

4) Please explain organizational structure of your firm:

1. Family – Limited Firm (Ltd.)
2. Local partner excluding Family (As. Corporation – A.Ş.)
3. Foreign partner or Liaison office of foreign company
4. Other: \_\_\_\_\_

5a) Please explain the size of your mother (main) firm:

1. Till 50 employees
2. Between 51 and 250 employees
3. Above the 250 employees
4. There is no mother firm

5) Please explain the size of your techno-park firm:

1. Till 10 employees
2. Between 11 and 50 employees
3. Above the 50 employees

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<sup>5</sup> The Questions for the interviews with the representatives of the techno-parks' management companies can be obtained from the author upon request

## PART II: INFORMATION ABOUT THE EMPLOYEES

6) Please explain the level of education of the personnel that work in your firm?

1. Phd. (how many) : \_\_\_\_\_
2. MS. or MBA : \_\_\_\_\_
3. BS : \_\_\_\_\_
4. High School : \_\_\_\_\_
5. Other : \_\_\_\_\_

7) What is the distribution of personnel that work in your firm?

1. Management : \_\_\_\_\_
2. R & D : \_\_\_\_\_
3. Production – Implementation - Test : \_\_\_\_\_
4. Other (Sales-Purchase-Account-Sec) : \_\_\_\_\_

8) Do you have problems in finding the professional employees?

1. Yes
2. No

9) How do you find your professional employees?

1. From other firms in the techno-park
2. From firms settled in other techno-park
3. From other firms outside the techno-parks
4. Abroad
5. Technical education schools/programmes (e.g. University)
6. Other: \_\_\_\_\_

10) Do you find it beneficial to be near the University in order to access professional employees?

1. Yes
2. No

11) Did you have an experience of losing the employee who left your company and went to another company located in **the same** techno-park?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those employees)
2. No

12) Did you have an experience of losing the employee who left your company and went to another company located in **the other** techno-park?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those employees)
2. No

**13)** Did you have an experience of the employee who left your company and established his own company in **the same** techno-park?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those employees)
2. No

**14)** Did you have an experience of the employee who left your company and established his own company in **the other** techno-park?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those employees)
2. No

### **PART III: INFORMATION ABOUT THE COOPERATION BETWEEN THE FIRMS**

**15)** Does your company have and/or had an EU project / EU financed project?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those projects)
2. No

**16)** Does your company have and/or had TUBITAK project / TUBITAK financed project?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those projects)
2. No

**17)** Is there any project that your company is working and/or had worked on with other companies within the techno-park?

1. Yes: \_\_\_\_\_ (Please indicate the approximate number of those projects)
2. No

**18)** Have your firm cooperated with the other firm/firms from **the same** techno-park?

1. Yes
2. No

**19)** Have your firm cooperated with the other firm/firms from **the other** techno-park?

1. Yes
2. No **[If both 18<sup>th</sup> and 19<sup>th</sup> questions are answered as "NO", PLEASE GO TO THE QUESTION no. 25]**

**20)** If 18<sup>th</sup> and/or 19<sup>th</sup> is answered as "YES", please explain the type of cooperation [feel free to mark as many types as applicable for your case]:

1. Sharing information
2. Sharing know-how

3. Research and Development (R&D) and/or design
4. Production/Service
5. Transfer of technology
6. New product development
7. Marketing
8. Education – Trainings
9. Cooperation in the fairs, exhibition, publishing
10. Consultancy
11. Other: \_\_\_\_\_

**21)** If YES (18<sup>th</sup> and/or 19<sup>th</sup>) please explain the reasons of the cooperation:

1. Sharing physical and human resources
2. Having access to the network of the partner
3. Financial advantages (lowering the costs and/or rising the profits)
4. Product/process development
5. Market conditions (new markets, high-tech environment, high risks) force us
6. Trust between firms
7. Other: \_\_\_\_\_

**22)** If YES (18<sup>th</sup> and/or 19<sup>th</sup> question) please explain do you cooperate with the firms in the same techno-park from the same sector?

1. Yes
2. No

**23)** If YES (18<sup>th</sup> and/or 19<sup>th</sup> question), please explain how frequent do you cooperate with the other firms from the techno-parks?

1. Very rarely
2. Rarely
3. Often
4. Very often
5. Permanently

**24)** If YES (18<sup>th</sup> and/or 19<sup>th</sup> question), please explain how beneficial cooperation with the other firms from the techno-parks is?

1. Not important
2. Little importance
3. Middle importance
4. Very important
5. Vitally important

**25) If 18<sup>th</sup> and 19<sup>th</sup> questions are answered as NO, please explain do you think that cooperating with the other firms from the same techno-park can be beneficial?**

1. No
2. Yes, but we are not in favour of it
3. Yes, it can be very important; we are working on establishing such cooperation

**26) If you do not cooperate with the firms from the same and/or other techno-park, but if you think that cooperation would bring benefits to your (and the partner's) firm, please state the reasons why do you not cooperate:**

1. Policy of our company do not allow us to establish cooperation with the other firms in the same and/or other techno-park
2. We do not know how to establish the cooperation
3. We tried, but we could not receive positive feedback
4. We tried, but the other firms did not want to share their information and know-how
5. Other: \_\_\_\_\_

**Appendix B**  
**Testing the Hypothesis 1<sup>6</sup>**

Table B1. Education level of the personnel in the tenant companies

Total number of surveyed firms: 70				
	PhD personnel (%)	MS/MBA personnel (%)	BS personnel (%)	High School & Other personnel (%)
<b>METU T.P.</b>	6	23	59	12
<b>Bilkent C.P.</b>	4	19	61	16
<b>TOTAL (METU &amp; Bilkent)</b>	5	21	60	14

Table B2. Problems in finding the professional employees in the tenant companies

Total number of surveyed firms: 70		
	Having problems in finding professional employees (%)	NOT having problems in finding professional employees (%)
<b>METU T.P.</b>	53	47
<b>Bilkent C.P.</b>	60	40
<b>TOTAL (METU &amp; Bilkent)</b>	56	44

Table B3. Finding the professional employees from the other tenant companies

Total number of surveyed firms: 70		
	Finding employees from another firms in the same techno-park (%)	Finding employees from the firms settled in another techno-park (%)
<b>METU T.P.</b>	3	3
<b>Bilkent C.P.</b>	15	11
<b>TOTAL (METU &amp; Bilkent)</b>	9	7

<sup>6</sup> Detailed tables and figures can be obtained from the author upon request

**Appendix C**  
**Testing the Hypothesis 2<sup>7</sup>**

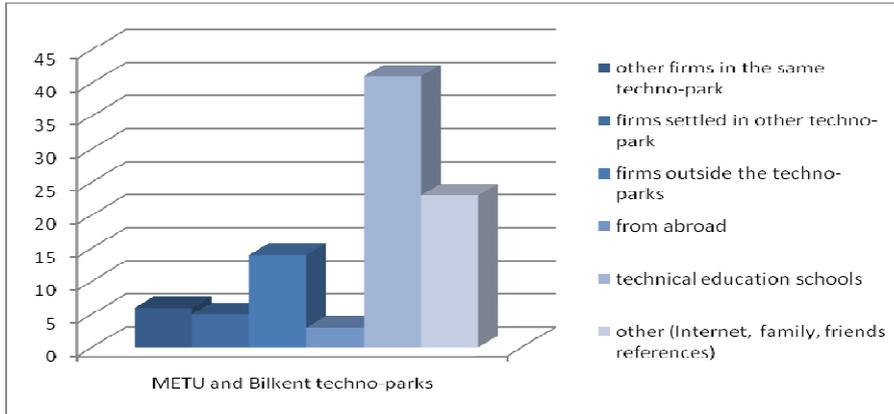


Figure C1. Number of METU and Bilkent techno-parks' tenant companies according to their ways of finding employees

Table C4. Cross-Tabulation 1 (METU and Bilkent techno-park as a whole; Questions 5 and 8)

**TP\_firm\_size \* problem\_in\_finding\_employees Crosstabulation**

			problem_in_finding_employees		Total
			yes	no	
TP_firm_size	till 10 employees	Count	31	21	52
		% within TP_firm_size	59.6%	40.4%	100.0%
		% within problem_in_finding_employees	83.8%	63.6%	74.3%
	11 to 50 employees	Count	5	9	14
		% within TP_firm_size	35.7%	64.3%	100.0%
		% within problem_in_finding_employees	13.5%	27.3%	20.0%
	above 50 employees	Count	1	3	4
		% within TP_firm_size	25.0%	75.0%	100.0%
		% within problem_in_finding_employees	2.7%	9.1%	5.7%
Total	Count	37	33	70	
	% within TP_firm_size	52.9%	47.1%	100.0%	
	% within problem_in_finding_employees	100.0%	100.0%	100.0%	

<sup>7</sup> Detailed tables and figures can be obtained from the author upon request

## Appendix D

### Testing the Hypothesis 3 and Hypothesis 4<sup>8</sup>

Table D1. Project-based cooperation among the tenant firms from the same techno-park

Total number of surveyed firms: 70		
	Common projects among the firms settled in the same techno-park (%)	NO project-based cooperation among the firms settled in the same techno-park (%)
<b>METU T.P.</b>	53	47
<b>Bilkent C.P.</b>	53	47
<b>TOTAL (METU &amp; Bilkent)</b>	53	47

Table D2. Long-term cooperation among the tenant firms from the same techno-park

Total number of surveyed firms: 70		
	Cooperation among the firms settled in the same techno-park (%)	NO cooperation among the firms settled in the same techno-park (%)
<b>METU T.P.</b>	42	58
<b>Bilkent C.P.</b>	41	59
<b>TOTAL (METU &amp; Bilkent)</b>	41.5	58.5

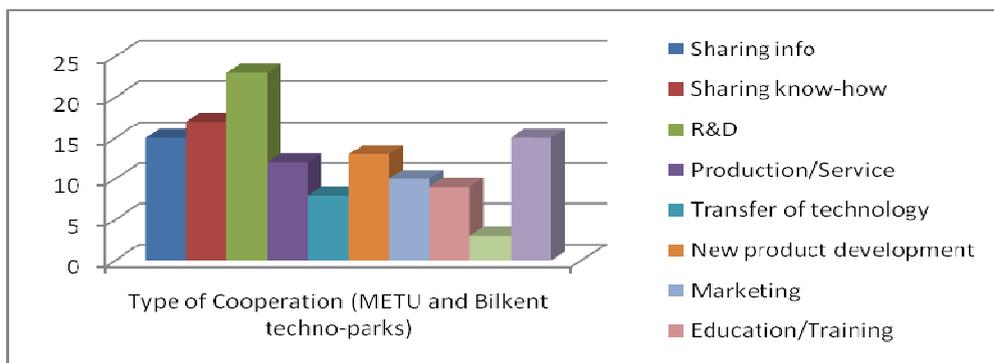


Figure D3. Type of Cooperation reported by METU and Bilkent techno-parks' firms

<sup>8</sup> Detailed tables and figures can be obtained from the author upon request

Table D7. How important tenant firms that did not establish inter-firm networks perceive cooperation

Applicable for the 36 of surveyed firms			
	<b>Not beneficial (%)</b>	<b>Beneficial, but we are not in favour of it (%)</b>	<b>Very beneficial, we are working on establishing cooperation (%)</b>
<b>METU T.P.</b>	0	45	55
<b>Bilkent C.P.</b>	13	31	56
<b>TOTAL (METU &amp; Bilkent)</b>	6.5	38	55.5

Table D8. Reasons for not cooperating

Applicable for the 36 of surveyed firms					
	<b>Policy (%)</b>	<b>Do not know how to establish cooperation (%)</b>	<b>No positive feedback (%)</b>	<b>Unwillingness of other firms to share info, know-how, etc. (%)</b>	<b>Other (%)</b>
<b>METU T.P.</b>	10	0	20	0	70
<b>Bilkent C.P.</b>	37	13	19	0	31
<b>TOTAL (METU &amp; Bilkent)</b>	23.5	6.5	19.5	0	50.5

**APPENDIX E**  
**EU and TUBITAK Funded Projects**

Results regarding the EU and TUBITAK-funded projects - questions 15 and 16 in the questionnaire:

Table E1. EU and TUBITAK-funded projects

Total number of surveyed firms: 70			
	<b>EU projects (%)</b>	<b>TUBITAK projects (%)</b>	<b>Both EU and TUBITAK (%)</b>
<b>METU T.P.</b>	20	78	14
<b>Bilkent C.P.</b>	38	53	29
<b>TOTAL (METU &amp; Bilkent)</b>	29	65.5	21.5

From the Table 24 it can be seen that majority of the firms in studied techno-parks has TUBITAK projects. TUBITAK funded projects are more popular among the firms than EU projects. In this matter, there is dissimilarity between METU and Bilkent techno-parks: while tenant firms in METU Techno-park have greater number of TUBITAK projects, tenant firms in Bilkent Cyber-park have more EU projects and higher percentage of the both funded projects.

From the whole number of surveyed firms in both techno-parks (70), only 27% do not have neither EU nor TUBITAK funded project (37% in Bilkent Cyber-park and 17% in METU Techno-park).

## REFERENCES:

- Acs Z. J., Audretsch D. B. and Fledman M. P. (1994)**, *R&D Spillovers and Recipient Firm Size*, The Review of Economics and Statistics, Vol. 76, No. 2, pp. 336-340;
- Albaladejo M. (2001)**, *Determinants and Policies to Foster the Competitiveness of SME clusters: Evidence from Latin America*, QEH Working Paper Series – QEHWPS 71;
- Albino V., Carbonara N. and Giannoccaro I. (2005)**, *Industrial Districts as Complex Adaptive Systems: Agent-based models of Emergent Phenomena*, in the Karlsson C., Johansson B., and Stough R.R. (eds), *Industrial Clusters and Inter-Firm Networks*, Edward Elgar, Cheltenham, UK;
- Association of University Related Research Parks (AURRP) (1997)**, *Worldwide research & science park directory*, 1998 (BPI Communications);
- Athreye S. (2004)**, *Agglomeration and Growth: A Study of the Cambridge High-Tech Cluster*, in the Bresnahan T. and Gambardella A. (eds), *Building High-Tech Clusters: Silicon Valley and Beyond*, Cambridge University Press;
- Atila M. (2004)**, *Technology Infrastructure: Science and Technology Parks in Turkey*, paper presented at Knowledge Economy Forum IV, Istanbul, Turkey;
- Baptista R. (1996)**, *Research Round Up: Industrial Clusters and Technological Innovation*, Business Strategy Review, Vol. 7, No. 2, pp. 59-64;
- Baptista R. (2001)**, *Geographical Clusters and Innovation Diffusion*, Technological Forecasting and Social Change 66, 31-46;
- Baptista R. and Swann P. (1998)**, *Do firms in Cluster Innovate More?* Research Policy, 27(6): 525-540;
- Beckman C.M., Haunschild P.R. and Phillips D.J. (2004)**, *Friends or Strangers? Firms Specific uncertainty, Market uncertainty and Network partner selection*, Organization Science, Vol. 15(3): 259-275;
- Belussi F. (2006)**, *In Search of a Useful Theory of Spatial Clustering: Agglomeration versus Active Clustering*, in the Asheim B., Cooke P., and Martin R. (eds), *Clusters and Regional Development: Critical reflections and Explorations*, Routledge, London and New York;
- Benko G. (2000)**, *Technopoles, High-Tech Industries and Regional Development: A Critical Review*, GeoJournal 51: 157-167;
- Benner C. (2003)**, *Learning Communities in a Learning Region: The Soft Infrastructure of Cross-Firm Learning Networks in Silicon Valley*, Environment and Planning A, Vol. 35: 1809-1830;
- Bergman E. M., den Hertog P. and Charles D. (2001)**, *In Pursuit of Innovative Clusters*, International Conference on "Measuring and Evaluating Industrial R&D and Innovation in the Knowledge-based Economy", Taipei, R.O.C.;
- Bergman E. M. and Feser E. J. (2002)**, *Industrial and Regional Clusters: Concepts and Comparative Applications*, presented in the R. W. Jackson West Virginia University, Regional Research Institute;

**Bass S. J. (1998)**, *Japanese Research Parks: National Policy and Local Development*, Regional Studies, Vol. 32.5: 391-403;

**Bigliardi B., Dormio A. I., Nosella A. and Petroni G. (2006)**, *Assessing Science Parks' Performances: Directions From Selected Italian Case Studies*, Technovation 26: 489-505;

**Boari C. (2001)**, *Industrial Clusters, Focal Firms and Economic Dynamism: A Perspective from Italy*, World Bank Institute;

**Breschi and Malebra (2005)**, *Clusters, Networks and Innovation*, Oxford University Press Inc., New York;

**Bresnahan T. and Gambardella A. (2004)**, *Old-Economy Inputs for New-Economy Outcomes: What Have We Learned?*, in the Bresnahan T. and Gambardella A. (eds), *Building High-Tech Clusters: Silicon Valley and Beyond*, Cambridge University Press;

**Camagni R. (1991)**, *Local 'Milieu' and Innovation Networks: Towards a New Dynamic Theory of Economic Space* in the Camagni R. (eds), *Innovation networks: Spatial Perspectives*, Belhaven Press, London and New York;

**Can Ö. (2008)**, *Design of Public Support for R&D: A Study Of Turkish Technoparks*, paper presented at the 16<sup>th</sup> "High Technology Small Firms Conference", Doctoral Workshop, University of Twente, The Netherlands,

**Caniels M. And Romijn H. (2001)**, *Small-industry Clusters, Accumulation of Technological Capabilities, and Development: A Conceptual Framework*, ECIS Working Paper Series 01.05, Eindhoven University of Technology, The Netherlands;

**Carbonara N. (2002)**, *Innovation Process within Geographical Clusters: A Cognitive Approach*, Technovation;

**Castells, M. (1996)**, *The Information Technology Revolution in The Rise of the Network Society*, Cambridge, Mass: Blackwell Publishers;

**Castells M. and Hall, P. (1994)**, *Technopoles of the World: The Making of Twenty-First-Century Industrial Complexes*, London: Routledge;

**Cooke, P. (2002)**, *Knowledge Economies: Clusters, Learning and Cooperative Advantage*, London: Routledge;

**Cuervo-Garcia A., Montoro-Sanchez A. and Romero-Martinez (2008)**, *Clusters and Business Networks*, in the Galindo M.A., Guzman J., Ribeiro D., *Entrepreneurship and Business: A Regional Perspective*, Springer Berlin Heidelberg;

**De Propriis L. (2002)**, *Types of Innovation and Inter-firm Co-operation*, Entrepreneurship and Regional Development, 14, 337-353;

**Dosi G. (1988)**, *Sources, Producers and Microeconomic Effects of Innovation*, The Journal of Economic Literature Vol. 26, No. 3, 1120-1171;

**Dyer J.H. and Nobeoka K. (2000)**, *Creating and Managing a High-Performance Knowledge-Sharing Network: The Toyota Case*, *Strategic Management Journal*, 21: 345-367;

**Eisenhardt K. M. and Schoonhoven C. B. (1996)**, *Resource-based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms*, *Organizational Science*, Vol. 7, No. 2, pp. 136-150;

**Ernest D. and Kim L. (2002)**, *Global Production Networks, Knowledge Diffusion, and Local Capability Formation*, *Research Policy*, 31: 1417-1429;

**European Commission (EC) Report (2007)**, *Regional Research Intensive Clusters and Science Parks*, Belgium;

**Felsenstein D. (1994)**, *University-Related Science Parks – ‘Seedbeds’ or Enclaves of Innovation?*, *Technovation* 14(2): 93-110;

**Ferguson R. and Olofsson C. (2004)**, *Science Parks and the Development of NTBFs – Location, Survival and Growth*, *Journal of Technology Transfer*, 29: 5–17;

**Fischer M. M. (2006)**, *Innovation, Networks, and Knowledge Spillovers*, Springer, Germany;

**Gordon I. R. and McCann P. (2005)**, *Clusters, Innovation and Regional Development: An Analysis of Current Theories and Evidence*, in the Karlsson C., Johansson B., and Stough R.R. (eds), *Industrial Clusters and Inter-Firm Networks*, Edward Elgar, Cheltenham, UK;

**Gulati, R. (1995)**, *Social Structure and Alliance Formation Patterns: A Longitudinal Analysis*, *Administrative Science Quarterly*, Vol. 40, No. 4: 619-652;

**Gulati, R. (1998)**, *Alliances and Networks*, *Strategic Management Journal*, Vol 19, No. 4: 293-317;

**Hagedoorn J. (1993)**, *Understanding the Rationale of Strategic Technology Partnering: Interorganizational Modes of Cooperation and Sectoral Differences*, *Strategic Management Journal*, Vol. 14, No. 5, pp. 371-385;

**Hakansson H. and Johanson J. (1992)**, *A model of Industrial Networks*, in Axelsson B. and Easton G. Eds *Industrial networks: A New View of Reality*, London: Routledge, pp. 32-46;

**Isaksen A. (1996)**, *Regional Clusters and Competitiveness: The Norwegian Case*, STEP report, Oslo, Norway;

**Jaffe A. B. (1989)**, *Real Effects of Academic Research*, *The American Economic Review*, Vol. 79, No. 5, pp. 957-970;

**Johnson B. and Lundvall B.A. (1993)**, *Catching-up and Institutional Learning under Post-Socialism*, in J. Hausner, B. Jessop and K. Nielsen (eds) *Institutional Frameworks of Market Economies*: 68–86. Aldershot, Hants: Avebury

**Johnson B. and Lundvall B.A. (1995)**, *The Learning Economy*, *Journal of Industry Studies*, 1, 23-42;

**Johnson B. and Nielsen K. (1998)**, *Introduction: Institutions and Economic Change*, in the Nielsen K. and Johnson B. (eds), *Institutions and Economic Change*, Edward Elgar, Cheltenham, UK;

- Johanson J. and Mattsson L.G. (1992)**, *Network Positions and Strategic Actions: An Analytical Framework*, in the Axelsson B. and Easton G. (eds), *Industrial Networks: A New View of Reality*, London: Routledge;
- Karlsson C., Mellander C. and Paulsson T. (2003)**, *Spatial ICT in Sweden – An Empirical method to Identify a Necessary Condition for Existence*, Jonkoping University, Sweden;
- Keeble, D. and Wilkison, F. (2000)**, *High -Technology Clusters, Networking and Collective Learning in Europe*, Ashgate, England;
- Keeble, D. (2000)**, *Collective Learning Process in European High-Technology Milieux*, in the *High -Technology Clusters, Networking and Collective Learning in Europe*, Ashgate, England;
- Keeble D. and Nachum L. (2001)**, *Why Do Business Service Firm Cluster? Small consultancies, Clustering and Decentralisation in London and Southern England*, ESRC Centre for Business Research, University of Cambridge, Working Paper No. 194;
- Kirat and Lung (1999)**, *Innovation and Proximity: Territories as Loci of Collective Learning Process*, *European Urban and Regional Studies*, 6(1): 27 – 38;
- Kitson M. and Michie J. (1998)**, *Market, Competition and Innovation*, ESRC Centre for Business Research, Working Paper, 84;
- Kogut, B. (1988)**, *Joint Ventures: Theoretical and Empirical Perspectives*, *Strategic Management Journal*, Vol. 9, No. 4, pp. 319-332;
- Kogut, B. (2000)**, *The Network As Knowledge: Generative Rules and the Emergence of Structure*, *Strategic Management Journal*, 21: 405-425;
- Krugman, P. (1991)**, *Geography and Trade*, Leuven, Leuven University Press;
- Kızıltaş M. (2006)**, *The Dilemma of Flexibility in the Spatial Development of Science Parks: The Case of Metu-Technopolis*, MSc dissertation, METU, Ankara;
- Lall, S. (2003)**, *Investment and Technology Policies for Competitiveness: Review of Successful Country Experiences*, United Nations, New York and Geneva;
- Larsson S. and Malmberg A. (1999)**, *Innovations, Competitiveness, and Local Embeddedness a Study of Machinery Producers in Sweden*, *Geografiska Annaler, Series B, Human Geography*, Vol. 81, No. 1, pp. 1-18;
- Longhi C. and Keeble D. (2000)** *High -Technology Clusters and Evolutionary Trends in the 1990s*, in the *High -Technology Clusters, Networking and Collective Learning in Europe*, Ashgate, England;
- Lopez M. R. (2000)**, *Innovation, Competitiveness and Development: Searching for the Linkages to Economic Development*, Alborg University, Denmark;
- Lundvall B.A. (1992)**, *User-producer Relationships, National Systems of Innovation and Internationalization* in Lundvall B. A. (eds) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter Publisher, London;

- Lundvall B.A. (2007)**, *National Innovation System: Analytical Focusing Device and Policy Learning Tool*, Working Paper R2007:004, Department of Business Studies, Aalborg University;
- Löfsten H. and Lindelöf P. (2002)**, *Science Parks and the Growth of New Technology-Based Firms – Academic-Industry Links, Innovation and Markets*, *Research Policy* 31: 859–876;
- Maillat D. (1995)**, *Territorial Dynamic, Innovative Milieus and Regional Policy*, *Entrepreneurship and Regional Development*, 7: 157-165;
- Malecki E. J. (1991)**, *Technology and economic development: The Dynamics of Local, Regional, and National Change*, England: Longman Scientific and Technical;
- Malecki E. J. and Veldhoen M. E. (1993)**, *Network Activities, Information and Competitiveness in Small Firms*, *Geografiska Annaler. Series B, Human Geography*, Vol. 75, No. 3: 131-147;
- Marshall (1920)**, *Principles of Economics*, 8<sup>th</sup> edition, Macmillan, London;
- Martin J.C.M. (1994)**, *Managing Innovation and Entrepreneurship in Technology-Based Firms*, New York: A Wiley-Interscience Publication, John Wiley & Sons;
- Monck C.S.P., Quintas P., Porter P., Storey D., and Wynarczyk P. (1988)**, *Science Parks and the Growth of High Technology Firms*, London: Croom Helm;
- Mowery D.C., Oxley J.E. and Silverman B.S. (1996)**, *Strategic Alliances and Interfirm Knowledge Transfer*, *Strategic Management Journal*, Vol:17., Special issue: Knowledge and the Firm, 77-91;
- Mytelka L. And Farinelli F. (2000)**, *Local Clusters, Innovation Systems and Sustained Competitiveness*, Discussion Paper Series, The United Nations University, INTECH, The Netherlands;
- Oerlemans L. A. G., Meeus T. H. and Boekema F. W. M. (2001)**, *Firm Clustering and Innovation: Determinants and Effects*, *Papers in Regional Science*, 80, 337-356;
- OECD (2001)**, *Innovative Clusters: Drivers of National Innovation Systems*, Paris;
- OECD (2004)**, *Networks, Partnerships, Clusters and Intellectual Property Rights: Opportunities and Challenges for Innovative SMEs in a Global Economy*, Paris;
- Piore M. J. and Sabel C. F. (1984)**, *The Second Industrial Divide: Possibilities for Prosperity*, Basic books, New York;
- Porter, M. E. (1990)**, *Competitive Advantage of Nations*, London: MacMillan:
- Porter, M. E. (1998)**, *Clusters and the new economics of competition*, *Harvard Business Review*, 76, 77-90.
- Porter, M. E. (2000)**, *Location, Competition, and Economic Development: Local Clusters in a Global Economy*, *Economic Development Quarterly*, Vol. 14, No. 1, pp. 15-34;
- Powel W. W. (1990)**, *Neither Market Nor Hierarchy: Network Forms of Organization*, *Research Organizational Behaviour*, Vol. 12: 295-336;

- Powel W. W., Koput K. W. and Smith-Doerr L. (1996)** Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology, *Administrative Science Quarterly*, Vol. 41, No 1, 116-145;
- PWC Consulting and Tsagaris Consult (2002)**, *Involving regions in the European Research Area*, Final Report to the European Commission, EUR20477/3.
- Ritter T. and Gemünden H. G. (2003)**, *Interorganizational Relationships and Networks: An Overview*, *Journal of Business Research* 56, 691-697;
- Saxenian, A. (1994)**, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, Massachusetts and London, England;
- Siegel D. S., Westhead P. and Wright M. (2003a)**, *Science Parks and the Performance of New Technology-Based Firms: A Review of Recent U.K. Evidence and an Agenda for Future Research*, *Small Business Economics* 20: 177–184;
- Siegel, D. S., Westhead, P. and Wright, M. (2003b)**, *Assessing the Impact of University Science Parks on Research Productivity: Exploratory Firm-Level Evidence From the United Kingdom*, *International Journal of Industrial Organization* 21: 1357–1369;
- Simmie J. (2006)**, *Do Clusters or Innovation Systems Drive Competitiveness?*, in the Asheim B., Cooke P., and Martin R. (eds), *Clusters and Regional Development: Critical reflections and Explorations*, Routledge, London and New York;
- Smith H. L. and de Bernardy M. (2000)**, *University and Public Research Institute Links with Regional High-Technology SMEs*, in the Keeble, D. and Wilkison, F., *High -Technology Clusters, Networking and Collective Learning in Europe*, Ashgate, England;
- Smith, K (1994)**, *New Directions in Research and Technology Policy: Identifying the Key Issues*, STEP report 1-94; STEP group, Oslo;
- Sorensen O.J. (1996)**, *The Network Theory: An Introduction to its Conceptual World*, *International Business Economics*, Study Material Series, No. 8, Aalborg University;
- Squicciarini, M. (2008)**, *Science Parks' Tenants versus Out-of-Park Firms: Who Innovates More? A duration model*, *J Technol Transfer* 33:45–71;
- Staber U. (1996a)**, *Networks and Regional Development: Perspectives and Unresolved Issues*, in the *Business Networks: Prospects for Regional Development*, edited By Staber U. H., Schaefer N. V., and Sharma B., Berlin: Walter de Gruyter;
- Staber U. (1996b)**, *The Social Embeddedness of Industrial District Networks*, in *Business Networks: Prospects for Regional Development*, edited By Staber U. H., Schaefer N. V., and Sharma B., Berlin: Walter de Gruyter;
- Teubal, M. (2002)**, *What is the Systems Perspective to Innovation and Technology Policy and How Can We Apply It to Developing and Newly Industrialized Economies?*, *Journal of Evolutionary Economics*, Volume 12, Numbers 1-2;

**Thamhain, H. J. (2005)**, *Management of Technology: Managing Effectively in Technology-Intensive Organizations*, New Jersey: John Wiley & Sons;

**United Kingdom Science Park Association (UKSPA) (1985)**, Science park directory, UKSPA, Sutton Coldfield;

**United Kingdom Science Park Association (UKSPA) (1996)**, The United Kingdom Science Park Association Annual Report, Birmingham;

**Vedovello C. (1997)**, *Science Parks and University-Industry Interaction: Geographical Proximity Between the Agents as a Driving Force*, *Technovation*, 17(9): 491-502;

**Von Hippel E. (1994)**, "Sticky Information" and the Locus of Problem Solving.: *Implications for Innovation*, *Management Science*, Vol. 40, No. 4, 429-439;

**Vyakarnam S., Myint Y.M. and Marino L. (2005)**, *Research Parks and Incubators: Re-defining the Role of the Incubator*, in *Advancing innovation and entrepreneurship*, Technology Transfer Society Annual Conference, 28-30 September 2005, Kaufmann Foundation, Kansas, MO;

**Wang S., Wu Y. and Li Y. (1998)**, *Development of Technopoles in China*, *Asia Pacific Viewpoint*, Vol. 39, No. 3, pp281–301;

**Westhead P. and Batstone S. (1998)**, *Independent Technology-based Firms: The Perceived Benefits of a Science Park Location*, *Urban Studies*, Vol. 35, No. 12, 2197-2219;

**Westhead P. and Batstone S. (1999)**, *Perceived benefits of a Managed Science Park Location*, *Entrepreneurship & Regional Development*, 11: 129 – 154;

**Wilkinson, F. and Moore, B. (2000)**, *Concluding Reflections: Some Policy Implications*, in the *High - Technology Clusters, Networking and Collective Learning in Europe*, Ashgate, England;

**Wilkinson I. and Young L. (2002)**, *On Cooperating: Firms, Relations and Networks*, *Journal of Business Research* 55, 123-132;

**Yasuda, H. (2004)**, *Formation of Strategic Alliances in High-technology Industries: Comparative Study of the Resource-based Theory and the Transaction-cost Theory*, *Tchnovation*, Japan: Tokyo Institute if Technology;