Teknoparklar Bağlamında Firmaların İşbirliği Ağlarının İnovasyon Performanslarına Etkisi

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Öz

Bu çalışmanın temel amacı, işbirliği ağlarının firmaların yenilik performansı üzerinde olumlu bir etkisinin olup olmadığını incelemek ve hangi işbirliği türünün yenilik üzerinde göreceli olarak daha fazla etkiye sahip olduğunu anlamaktır. İstanbul'da bulunan teknoparklardaki firmaların işbirlikçi ağ sıklığını ve yenilik performansını ölçmek için bir anket geliştirilmiştir. Araştırmanın amaçlarına ulaşmak için tek yönlü varyans analizi ve regresyon analizi gibi nicel yöntemler kullanılmıştır. Sonuç olarak, teknopark bünyesinde yer alan işbirliği ağlarının firmaların inovasyon performansı üzerinde pozitif ve anlamlı bir etkiye sahip olduğu tespit edilmiştir. Teknopark bünyesinde faaliyet gösteren aktörlere ve araştırmacılara gelecek araştırmalarına yön verecek önerilerde bulunulmuştur.

Anahtar Sözcükler: Yenilik; Üniversite ve Sanayi İşbirliği, Teknopark, Yenilik Performansı, İşbirliği Ağı.

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The Effect of Firms' Collaboration Networks on Their Innovation Performance in the Context of Technoparks

Abstract

The main purpose of this study is to examine whether collaboration networks have a positive effect on innovation performance of firms, and to understand which collaboration type has the more relative effect on innovation. A survey was developed to measure collaborative network frequency and innovation performance of firms in technoparks which are located in Istanbul. For achieving the objectives of the research, quantitative methods such as the one-way analysis of variance and regression analysis were used. As a result, it has been identified that collaboration networks within technopark have a positive and significant effect on innovation performance of the firms. Recommendations were presented for actors operating within technoparks and for researchers to guide their future researches.

Keywords: Innovation; University and Industry Collaboration, Technopark, Innovation Performance, Collaboration Network.

Introduction

Firms and governments look for different ways to assert the innovation system (Toreli, 2013; Beckman et al., 2004). In the modern global order, competitive advantage is based on the skills like knowledge and innovation (Porter, 1990; Lundvall, 1992), which is a socially integrated and interactive learning process (Lundvall, 1992). According to Bruque and Moyano (2007), "The ability to innovate new products and processes has been the engine of economic growth and technological progress".

Hassink (2001) states that the innovation system is affected by some factors including technology transfer, regional development agencies, technoparks and science parks. Technoparks are the main examples of regional development areas, which are found with or without a governing decree (Toreli, 2013). When firms, government bodies, and institutions are located at close presence in a regional focal point, the level of uncertainty for the firms decreases (Baptista, 1996).

According to Doloreux (2004), "Innovation is seen as a process which results from various interactions among different actors". Bruque and Moyan (2007) state that "There are significant positive relationships between inter-firm cooperation, cooperation with intermediary institutions, cooperation with research organizations and innovation performance of SMEs, of which inter-firm cooperation is the most significant". As a result of the literature research conducted, it was assumed that innovation performance could be increased if

effective collaboration networks were established between the actors operating in the technopark. With this approach, technoparks are used as an area for this study, since they contain all necessary interactions and collaboration to support innovation. In this study, the effects of collaboration networks on the innovation performance of firms, within technoparks in Istanbul are researched. The scientific results, which are obtained from the study, will be a beneficial source for firms, which want to improve their innovation performance.

The main purposes of this research are determining the level of collaboration of the firms and the level of innovation performance of the companies, which are operating in the technoparks. Followed by an examination of the effects of collaboration networks on innovation performance and lastly, to understand which collaboration network type should be implemented and developed.

Istanbul was chosen as the sample region because it hosts more than 50 universities, 8 active technoparks. It is also the potential driver of the Turkish economy and due to the high number of national and international firms in this city, the number of patents is the highest in Turkey (https://www.sanayi.gov.tr).

In the data collection process, the data collection tool was delivered to nearly 990 firms that constitute the population of the research. 137

questionnaires were taken back and the rate of return was 13.83 %. 22 survey answers were eliminated due to reliability and participant related problems. In this way, the study was carried out using 115 firms' data. The final response rate is 11.2%.

This paper consists of four chapters. Chapter 1 introduces the topic and the purpose of the research. Chapter 2 covers the literature review on innovation, innovation performance, collaboration network, technoparks and the relationship between collaboration network and innovation performance. Chapter 3 explains the methodology and gives information about the method and research findings. Lastly, in the final chapter, the results of the research were discussed.

Literature Review

Innovation and Innovation Performance

Innovation is an activity that is knowledge-intensive and mostly about information collection and information processing (Ahuja, 2000). According to the OECD Oslo Manual (2005), "An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". As it is understood from the literature, innovation is the transformation of new and creative ideas into products, processes and services, process of providing them to the customers and making the owners gain incomes as a means of creating resources.

Sole information does not make much sense without turning this information into knowledge and application. Therefore, firms depend mostly on innovation to sustain their competitiveness. Literature regarding the importance of innovation clearly states that most innovative firms have better performances than less innovative ones (Dosi, 1988).

For measuring innovation performance, it is necessary to determine the factors that increase the innovation performance and measure their effects. According to Alegre et al. (2006), "Innovation performance may be considered as an intermediate variable between certain business processes and general firm performance". Adler and Shenbar (1990) define innovation performance as the capability of implementing suitable process technologies to produce and adopt new products and technologies. Many studies use patents as a proxy to measure the innovation performance (Hagedoorn and Cloodt, 2003; Blomkvist et al., 2017).

Collaboration Networks

The network is an organizational practice that coordinates the efforts of its members without impeding their activities and processes (Frenken, 2000). According to Blomqvist and Levy (2006), a collaboration network can be described as being integrated into a community at cross-level and ability to manage network relationships that depend on trust, mutual benefits, cooperation and pledge. Furthermore, the collaboration network is providing

the partners of the cooperation a conduit that conveys knowledge that is vital for the innovation process. Continuous interaction is significant for providing sustainability of knowledge spillover and information flow with the help of frequent communication between stakeholders (Ahuja, 2000).

Many firms now are part of a different version of the collaboration network, which is named as a triple helix concept. The triple helix approach is a union of university, industry and government that develop classical research and teaching means by promoting innovation process with collaboration and cooperation (Etzkowitz and Leydesdorff, 1999). Sharing information between organizations through networks can lead to a greater organizational efficiency and thus increase the firms' innovation performance. Organizational networks help the firms to increase their competitiveness (Franco et al., 2015) and have a great potential to produce knowledge (Das and Teng, 2000).

Knowledge sharing is the main cause of clustering in inter-firm collaboration networks. Firms interact more with other firms if they have a geographic proximity or technological similarities (Rosenkopf and Almeida, 2003). Clustering makes firms and partners more willing and capable to swap knowledge (Ahuja, 2000). Firms with more and shorter links have better knowledge-sharing opportunities and ties than the other firms (Watts, 1999).

Technoparks

Governments see technoparks as a tool that can be used to create environments in which companies can access scientific-based information and

benefit from this information flow (Chan et al., 2010). The fact that the companies in the technopark operate closely within the same area encourages companies to cooperate (Malairaja and Zawdie, 2008). In many studies, it has been determined that various forms of cooperation have been formed within technoparks. According to D'este and Patel (2007), there are three main forms of cooperation, which are joint research, contract based research and consultancy services. Joint research is an official form of cooperation aimed at collaborating in R&D projects (Hall et al., 2001). Contract-based research is carried out by other companies related to the trade of companies in a way that their results can be used by the company in need (Van Looy et al., 2004). Consultancy is related to research or advice services offered by academic researchers to their clients (Perkmann and Walsh, 2008).

According to Quintas et al. (1996), it is possible to examine the connections and cooperation between those operating in the technopark in three categories: The relations between the tenant firm and the university, the relations between the tenant firm and other tenant firms, the relations between the tenant firm and the tenant firm's departments outside the technopark or other firms outside the technopark. Considering the cooperation activities, which are found in the establishment purposes of technoparks and revealed in various studies above, it can be said that many of these activities are among the activities that increase the innovation performance of companies (Sakarya et al., 2016).

According to Radosevic and Myrzakhmet (2009), linkages among firms within technoparks are part of the value-added offered to tenants and making the firms more cost-competitive when compared to firms outside technoparks. According to Seo (2006), in addition to upgrading the regional economy through network collaborations and being the center of regional R&D and innovation, some governments had also hoped the science parks would accelerate technology innovation through networking amongst industry, colleges, and research centers of the region and generate synergy effect while establishing clustered infrastructures of the region, allow reinforcing collaboration and fellowship between participants. Kalenov and Kukushkin (2018) also stated some benefits and additional functions of technoparks as provision of infrastructure for business and assistance in the promotion of projects and technologies to target markets, stimulating the flow of knowledge and technology between universities and industry, providing environments that enhance a culture of innovation.

Relationship Between Collaboration Networks and Firm's *Innovation Performance in Technoparks*

Innovations mostly stem from the expertise and complementary knowledge of a group of actors who have various types of proficiency (Seo, 2006). According to Edquist (1997), this dynamic collaboration makes up system of innovation by the participation of relevant stakeholders to this cooperative framework. The concept of innovation system depends not only on individual firm or organization performance but also their holistic effort which

will be created by firms, universities, governmental institutions, etc. (Seo, 2006).

Companies working in rapidly changing environments should try to establish their place in relevant business networks to accelerate the pace of their innovation (Johanson and Vahlne, 2009). A strong network position in the resource development process can enable the company to compensate for internal shortcomings. Rather than developing all resources and capabilities internally, the company may try to access the resources or capabilities of other actors in its network (Marchiori and Franco, 2020).

Seo (2006) states that innovations, technological upgrades and increased production capacity of the firms most efficiently achieved by the help of collaboration networks and interactions among the firms. Blomqvist and Levy (2006) posited that competitive advantage can be sustainable by integrating innovation systems into daily operations. Frenken (2000) states that efficacious applications of innovations are mostly performed by the collaboration of different actors like governments, universities, users and producers, etc. in network structures. According to Chesbrough (2003), "firms depend mostly on external sources of innovation by emphasizing the ideas, resources and individuals flowing in and out of organizations, searching for and using a wider range of external ideas, knowledge and resources, networks, which are becoming indispensable for the creation of successful innovations". Fukugawa (2006) posits that "networking is a way of speeding up innovation and affording easy access to expertise and resources".

Phillimore (1999) states that "the companies located in a science park usually form networks, and this interaction is considered to be important". According to Hanel and St-Pierre (2006), firms that cooperate with universities generally operate in knowledge-based technology sectors, and as a result of this cooperation, the innovation abilities of the companies are positively affected by transferring the scientific knowledge from the university. Ties between firms have some benefits for their innovation performance (Berg et al., 1982). According to Ahuja (2000), ties have a positive influence on firms' innovation output and performance more than they individually can spend in an innovation process.

In literature, there are also negative views regarding the innovation among the technopark's actors (Larsson and Malmberg, 1999). According to Kang (1996), lack of networking, institutional frameworks, public-private partnerships and the provision of consulting services caused problems in technoparks. Radosevic and Myrzakhmet (2009) emphasize the under-developed structure of regional large firms, which have to be the main element to force universities and local institutions for innovation systems. Also, as pointed out by Bigliardi et al. (2006), "a wide range of mission statements is the major cause of the difficulty in developing a rigorous approach to assessing their performance". According to Ahuja (2000), the level of collaboration among the partners of a firm affects the knowledge-sharing in contrary ways. According to Coleman (1988), "Without trust and shared norms of behaviour, sharing knowledge, combining skills, and making large joint investments are

likely to be difficult and unproductive in any context". Frishammar and Hörte (2005) state that technology scouting can have negative effects on innovation performance.

According to Seo (2006), the key to having successful technoparks in innovation is that partner firms have to build an effective collaboration network with the research institutions, government or local authorities. It is not sufficient for technoparks to provide only a physical infrastructure to build a successful regional innovation system. The more important thing is to provide a successful soft infrastructure such as diverse networks and collaboration networks among the counterparts. The diffusion, generation and application of information is more important in soft infrastructure than the physical infrastructure for establishing a successful innovation system (Seo, 2006).

Markman et al. (2005) state that successful technoparks are capable of finding resources that add extra value to that region. According to Basile (2011), "technoparks can become central actors in networking system for innovation, they can increase the number of linkages, can increase the diversity of ties and partner and could increase knowledge, critical mass, capabilities and innovation output". Löfsten and Lindelöf (2002) state that firms in technoparks are more closely cooperate with universities than the other firms.

Methodology

As a result of the literature review, it was assumed that innovation performance could be increased if effective collaboration networks were

established between the actors operating in the technopark. In this context, the main purpose of this study is to analyse whether collaboration network has a positive effect on innovation performance of firms, which are operating in technoparks, and to understand which collaboration type has more effect on innovation performance.

Based on the literature review and previous studies, the following hypotheses have been developed:

Hypothesis 1: As the level of collaboration networks between the companies and the university on education increases, the innovation performance of companies also increases.

Hypothesis 2: As the level of collaboration networks between the companies and the university regarding R&D and human resources increase, the innovation performance of companies also increases.

Hypothesis 3: As the level of collaboration networks among the companies with each other on R&D and human resources increase, the innovation performance of companies also increases.

Hypothesis 4: As the level of collaboration networks between the companies and the all other actors increase by the help of the Technopark infrastructures, the innovation performance of companies increases.

Hypothesis 5: As the informal collaborations between the companies and all the actors increase, the innovation performance of companies also increases.

The research model, which expresses the purpose, hypothesises and the details of research, has been developed as a result of the literature review (Figure 1).
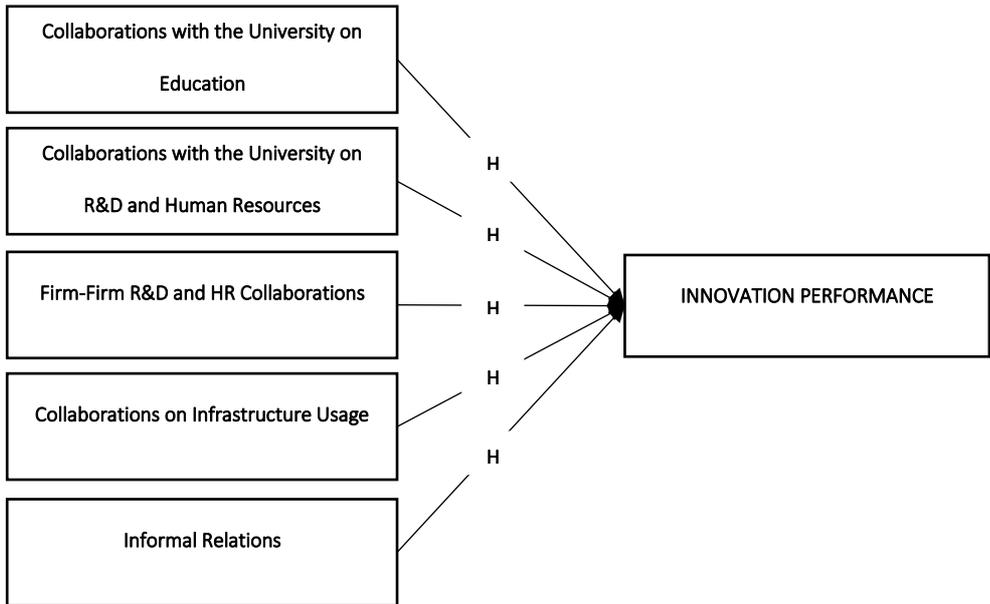
Figure 1. Research model

In the data collection process, the data collection tool was delivered to nearly 990 firms that constitute the population of the research, by e-mail. 137 questionnaires were taken back and the rate of return was 13.83 %. 22 survey answers were eliminated due to reliability and technical related problems. In this way, the study was carried out using 115 firms' data with a response rate of 11.2%. With the data obtained, research questions and hypothesis tests were analysed using the SPSS 22.0 program.

The "Intra-Technopark Collaboration Scale", which was developed by Erün (2012) is used to determine the types and levels of the collaboration of companies operating in technoparks. The 'Innovation Performance Scale" is

adapted from a research on firms' innovation performance which was conducted by Gunday et al. (2011).

In this study, two statistical tests were applied to data set to assess its suitability for factor analysis. The validity was measured by using Bartlett's test of Sphericity and Kaiser-Mayer-Olkin (KMO) measure of the sampling adequacy of individual variables. As a result of the analysis, it was found that the KMO value for the collaboration network scale was 0.946. Whether there is a high correlation between variables was tested by Bartlett test and the significance value is less than 0.05 (σ = 0.000). As a result of KMO and Bartlett test, it was concluded that the data set is suitable for factor analysis. The collaboration network has five subscales and the total variance should be more than 50% as stated by Hair et al. (2006). For this scale, total variance is 77.94 % which confirms the validity of the construct. In factor analysis, it is preferred that the factor load value, which shows the relation of the items in the scale with the factors, is 0.45 and higher (at some sources, it was stated as 0.5), but if the scale consists of a small number of items, the load value can be reduced to 0.30. That is why it was preferred to keep all questions due to lowest value is 0.364. Since the innovation performance scale is gathered under one factor, there is no need to perform factor analysis due to a low number of factors. The Cronbach's Alpha is found as 0.964 for the collaboration network scale and 0.859 for innovation performance which are above the threshold level of 0.70 and which means that the scales are quite reliable.

Findings

In the study, regression analysis was carried out to determine the possible effects of the independent variables on the innovation performance variable. Initially, the first hypothesis of the research tested whether there is a significant relationship between the level of collaboration networks between the university on education and the innovation performances of the companies in the technoparks. The findings of the simple linear regression analysis are shown in Table-1:

Table 1. The effect of collaboration networks concerning education with the university on the firms' innovation performance

Model	Beta (β)	t	Sigma	Mean	Correlation
Constant	2,607	12,179	0,000	-	-
UEC	0,354	6,079	0,000	3,50	0,496*
R2=0,246 **Anova F**=36,953 **Anova σ**=0,000					
Dependent variable: innovation performance					
* At 95% Level of Significance					

H1 revealed that collaboration of the companies with the university on their education has a positive relationship with innovation performance. The hypothesis received support from the empirical testing ($\beta = 0,354$; $p<0.05$). This means that the collaboration of the companies with the university on their education can explain 24.6 % of the change in the companies' innovation performance.

The second hypothesis of the research proposed that the level of collaboration networks with the University on R&D and Human Resources has

a positive association with innovation performance. The findings of the simple linear regression analysis are shown in Table-2:

Table 2. The effect of collaboration networks with the university on R&D and human resources on the firms' innovation performance

Model	Beta (β)	t	Sigma	Mean	Correlation
Constant	2,591	13,637	0,000	-	-
URDHR	0,360	6,982	0,000	3,87	0,549*
R2=0,301 **Anova F**=48,742 **Anova σ**=0,000					
Dependent variable: innovation performance					
* At 95% Level of Significance					

H2 hypothesis received statistical support (β = 0,360; p<0.05) and the collaboration with the University on R&D and Human Resources can explain 30.1 % of the change in the firms' innovation performance.

For the third hypothesis of the research, simple linear regression analysis method was used to test whether there is a significant relationship between the level of collaboration networks of firms operating in technopark with other firms within technopark regarding R&D and human resources and their innovation performances. The findings of the simple linear regression analysis are shown in Table-3:

Table 3. The effect of collaboration networks of firms with other firms within technopark regarding R&D and human resources on the firms' innovation performance

Model	Beta (β)	t	Sigma	Mean	Correlation
Constant	2,551	14,284	0,000	-	-
FFC	0,383	7,676	0,000	4,127	0,585*
R2=0,343 **Anova F**=58,915 **Anova σ**=0,000					
Dependent variable: innovation performance					
* At 95% Level of Significance					

While verifying the H3 hypothesis (β = 0,383; p<0.05), the collaboration of firms operating in technopark with other firms within technopark regarding R&D and human resources can explain 34.3 % of the change in the firms' innovation performance.

For the fourth hypothesis, it was tested that whether there is a significant relationship between the level of collaboration networks of the firms with the usage of infrastructure facilities (UIF) and their innovation performances. The findings of the simple linear regression analysis are shown in Table-4:

Table 4. The effect of collaboration networks of the firms operating in technopark with the use of infrastructure facilities on the firms' innovation performance

Model	Beta (β)	t	Sigma	Mean	Correlation
Constant	2,406	13,676	0,000	-	-
UIF	0,424	8,629	0,000	4,44	0,630*
R2=0,397 **Anova F**=74,460 **Anova σ**=0,000					
Dependent variable: innovation performance					
* At 95% Level of Significance					

While verifying the H4 hypothesis (β = 0,424; p<0.05), the collaboration of the firms operating in technopark with the use of infrastructure facilities can explain 39.7 % of the change in the firms' innovation performance.

Lastly, simple linear regression analysis method was used to test whether there is a significant relationship between the informal collaboration (IC) among all the actors in the technopark and their innovation performances. The findings of the simple linear regression analysis are shown in Table-5:

Table 5. The effect of informal collaboration (IC) among all the actors in the technopark on the firms' innovation performance

Model	Beta (β)	t	Sigma	Mean	Correlation
Constant	2,319	11,680	0,000	-	-
IC	0,441	8,051	0,000	4,26	0,604*
R2=0,364 **Anova F**=64,812 **Anova σ**=0,000					
Dependent variable: innovation performance					
* At 95% Level of Significance					

While verifying the H5 hypothesis (β = 0,424; p<0.05), the informal collaboration among all the actors in the technopark can explain 36.4 % of the change in the firms' innovation performance. When the informal collaboration among all the actors in the technopark by one unit, the innovation performance can increase by 0.441 units, indicating that there is a very strong cause and effect relationship between the two variables.

Table 6. The results of the hypothesis

Number	Hypothesis	Result
1	As the level of collaboration networks between the companies and the university on education	Accepted
2	As the level of collaboration networks between the companies and the university regarding R&D and	Accepted
3	As the level of collaboration networks among the companies with each other on R&D and human	Accepted
4	As the level of collaboration networks between the companies and the all other actors increase by the	Accepted
5	As the informal collaborations between the companies and all the actors increase, the	Accepted

Conclusion

This research was carried out to empirically demonstrate the possible effects of collaboration networks applications on the innovation performances of firms in technoparks. In the literature review, while significant number of studies stated that there are positive relationships between inter-firm cooperation, cooperation with intermediary institutions, cooperation with research organizations and innovation performance of SMEs (Bruque and Moyano, 2007), some other studies stated that it does not have a positive impact on the innovation performance of firms (Larsson and Malmberg, 1999). Alternatively, as Frishammar and Hörte (2005) stated technology scouting can have negative effects on innovation performance.

After the analysis, our findings indicate that there is a significant relationship between the collaboration practices and the innovation performance. The main reason behind this strong cause-and-effect relationship is that companies make use of collaboration networks in technoparks sufficiently. It is thought that this may be due to the firms' excessive willingness in this regard, as well as the collaboration practices in technoparks.

In light of all the findings, a significant relationship is detected between the collaboration of the companies with the university on their education and the innovation performance of the firms in the technoparks. This strong cause-and-effect relationship indicates that the level of collaboration between the firms and the university in technoparks can contribute to the innovation performance of the firms.

Based on the literature review (Etzkowitz and Leydesdorff, 1999; Keeble, 1997), it has been considered that the collaborations with the university on R&D and human resources can contribute to the innovation performance of the companies. As a result of the analysis, it has been observed that such collaborations have a positive and strong effect on the firms' innovation performance.

According to Lin et al. (2009), it was determined that when firm-firm collaborations are applied intensely, the market advantage is provided in the context of innovation performance, and the findings determined as a result of

the research are considered to be compatible with the literature. In our research, it has been detected that there is a significant relationship between the collaboration of firms operating in technopark with other firms within technopark regarding R&D and human resources and the innovation performance of the firms in the technopark.

Within the technopark, the presence of information and technology dissemination channels could have an important contribution to the innovation performance of the firms as stated in the literature review (Keeble, 1997). In our study, significant relationship between the collaboration of the firms operating in technopark with the use of infrastructure facilities and the innovation performance of the firms in the technoparks is explored.

Finally, it is expected that human relations, will positively affect the innovation performance by making a positive contribution to the cooperation process as Ahuja (2000) and Rodan and Galunic (2004) stated. Considering this strong cause-and-effect relationship, it is thought that increasing the level of informal collaboration among all the actors in the technopark can contribute to the innovation performance of the firms.

To contribute to the current high level of innovation performance, it has been evaluated that collaboration between the firm R&D and Human Resources and infrastructure usage should be improved. In this context, it has been evaluated that certain measures should be taken by all actors in technoparks to benefit more from the applications of collaboration networks. It

has emerged that both the technopark administrations and the companies in the technoparks should be more willing to cooperate about their collaboration network and increase the level of their cooperation in education both in terms of quantity and quality. It is thought that increasing the level of informal collaboration among all the actors in the technopark can contribute to the innovation performance of the firms. Therefore, it has emerged that both the technopark administrations and the firms in the technoparks should be more willing to cooperate in informal activities.

However, some implications and several limitations of this study should be addressed. This research was conducted on technoparks operating in Istanbul and it was evaluated that the results of the research can be generalized to other technoparks throughout the country. Furthermore, it has been evaluated that performing similar studies in other technoparks and different countries may contribute positively to the research results.

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