Technology Transfer Collaborations and Organizational Innovation: A Study on YTU Technopark

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Abstract

This study aims to explore the relationship between different types of collaborations and organizational innovation in technoparks. Data was collected through survey from Yıldız Technical University Technopark, Istanbul, Turkey employers and employees. Implications of this study may contribute to better understanding of collaborations that improve innovative activities in technoparks. The results of the study show that collaboration of firms with university has significant effect on behavioural innovation and strategic innovation; collaboration of firms with each other has significant effect on product-marketing innovation, and their collaboration with Technopark Administrative Office has significant effect on strategic innovation. It is also found that firms collaborate mostly with university and technopark administrative office, and that the most frequently observed type of innovation in technopark is

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behavioural innovation. According to findings, technopark companies do not very often make collaborations with university or other parties. However, they are found to have a good level understanding and application of innovation. It is also worth examining the other sources of innovation in technoparks rather than collaborations.

Keywords: Technology transfer collaborations, organizational innovation

Öz

Bu çalışmanın amacı, Yıldız Teknik Universitesi Teknopark'ta bulunan farklı işbirlikleri ile örgütsel inovasyon arasındaki ilişkiyi incelemektir. Örneklem olarak Yıldız Teknik Universitesi Teknopark çalışanları ve işverenleri seçilmiştir. Bu çalışma, inovasyonu artıran işbirliklerinin daha iyi anlaşılmasına katkı sağlayabilir. Çalışmanın sonuçlarına göre firmaların üniversite ile yaptıkları işbirlikleri davranışsal ve stratejik inovasyon, diğer firmalarla yaptıkları işbirlikleri ürün-pazar inovasyonu, ve Teknopark Yönetim ofisi ile işbirlikleri ise stratejik inovasyon üzerinde anlamlı ve olumlu etkiye sahiptir. Firmalar en çok üniversite ve Teknopark yönetim ofisi ile işbirliği yapmaktadır. Teknoparkta en çok gözlemlenen inovasyon türü ise davranışsal inovasyondur. Teknopark şirketleri üniversite veya başka taraflarla işbirliğini çok sık yapmamaktadırlar. Ancak, inovasyon uygulamalarında iyi bir seviyededirler. Teknoparklarda, işbirlikleri dışında da inovasyonu gelişiren faktörlerin araştırılması faydalı olacaktır.

Anahtar Kelimeler: Teknoloji transferine yönelik işbirlikleri, organizasyonel inovasyon

1. Introduction

Technoparks stand as the most important areas for the achievement of technology transfer that is accomplished through establishment of strong university-industry relations (Kılıç, 2011), and the goal of technoparks is the commercialization of successful R&D studies by technology- focused small enterprises (Töreli, 2013).

In this study; technology transfer collaborations taking place in Yıldız Technical University technopark companies are examined, and the effects of these collaborations on organizational innovation are researched. In technoparks, not only university-industry relations, but also other types of cooperations exist. All these cooperations enhance technology transfer. The important collaborations for technology transfer that are in the scope of this study are; the collaborations of technopark firms within themselves, university-firm collaborations and firm-technopark administrative office collaborations. These collaborations take different forms; one way is making common R&D projects under TUBITAK (Scientific and Technological Research Council of Turkey), KOSGEB (Small and Medium Size Enterprises Development Organization) or similar programs, in order to receive funding. In technoparks, such funding programs, both Turkish and European, are encouraged; conferences related to these programs are given in technoparks, and technology transfer offices are ready to help technopark firms for project proposal preparation, partner search, and some other services. Regarding such collaborations existing within technoparks, and the importance of innovative activities through technology transfer. Thus, this study aims to reveal how often technopark companies build such collaborations, and their effects on organizational innovation.

YTU Technopark was chosen for the study considering the importance of the university due to being among prestigious universities in Turkey, and the metropolitan characteristic of the location; Istanbul. The technoparks located in Istanbul are YTÜ Technopark (located in Yıldız Technical University Campus, Davutpaşa), Bogaziçi Teknopark (located in Bogazici University Campus Sarıyer), ITU ARI Teknokent (located in Istanbul Technical University Campus, Şişli) and Istanbul

Teknopark (located in Istanbul University Campus Avcılar). The study initially introduces a broad literature about technoparks in general, and organizational innovation. After literature review, methodology section is presented where measures, research questions, sample, conceptual model, procedure and hypothesis are presented. Methodology section is followed by research findings, discussion of findings and the conclusion sections.

Previous research shows positive relationship between technology transfer collaborations and innovation, or concepts associated with innovation (Erün, 2012; Sakarya, 2012); Previous empirical research especially in Turkey, is very limited. One such study investigates the relationship between university-industry collaborations and innovation which is the study of Çelik, 2011. Not only university-industry, but also other type of collaborations exist in technoparks focusing on technology transfer which has also been subject to research; one example being the study of Erün, 2012. In this study, the existing collaborations within technoparks, and the effect on technology transfer performance is investigated.

As stated above, studies examining the effect of university-industry relations on innovation and related concepts in technoparks are limited. A study investigating other collaborations including university-industry relations, as a whole, on innovation, is not found. Besides, in the scope of collaborations and innovation in technoparks, a study that takes both different types of collaborations and different types of innovation into consideration is not found either. This study aims to contribute to technoparks in the way to enhance the type of collaborations that increase their innovative ability. Technoparks have an important contribution to the science and technology capacity of Turkey. This study also intends to contribute to technoparks by revealing their innovation capability, and the dominant types of collaborations; where all these concepts are significant for them to enhance their competitiveness in the market.

2. Literature Review

2.1 Technoparks

2.1.1. Technoparks in the World

According to United Kingdom Science Park Association (UKSPA), technoparks are centers that consist of buildings, land and high-technology-based firms; associating with universities, higher education institutions or R&D centers, designed in a way to encourage the establishment and improvement of technology-based firms within, having their own administrative offices assisting technology transfer activities (UKSPA, 2008; Kılıç& Ayvaz,2011). The name "Technopark" take different forms depending on the country; "research park" is used in USA, "science park" in Britain, "technology center" in Germany, "technopol" in France, and "technopolis" in Japan (Alkibay, Orhaner, Korkmaz, Sertoğlu, 2012).

The first technopark in the world was established in 1950, today known as Silicon Valley, located in Stanford University Campus in the U.S state of California, today called North California (Haxton & Meade, 2009). After World War II, American companies evaluating the effect of scientific developments contributing to their victory, wanted to strengthen university- industry collaborations. Companies approaching universities for this purpose led to creation of science parks, Silicon Valley being the first (Vila & Pages, 2008). The establishment of technoparks initiated in 1970s in Europe, and 1980s in other parts of the world such as Japan and Israel.

2.1.2 The Establishment of Technoparks in Turkey

Scientific developments have been endorsed by the government since the establishment of Turkey Republic in 1923, under different programs.

Initiation of activities for the establishment of technoparks dates back to 1980s (TGBD, 2015). In 1990, within the framework of university-KOSGEB collaboration, technology centers, called TEKMER, were established; TEKMER can be considered as the first step for technoparks (TGBD, 2015).

Through the end of 1980s, the establishment of first technopark of Turkey, METUTECH, located in ODTU University Campus in Ankara, was initiated, and was completed by 2000 (Zuvin & Afacan, 2005). November 2013 statistics show a total of 52 technoparks in all around Turkey, 39 of them being active and the rest in preparation phase. These technoparks are located in 31 cities, a total of about 2.508 firms with around 23.542 R&D personnel working in (Demirli, 2014). 2015 September statistics indicate number of firms pursuing R&D studies as 3587, with 17.489 projects, the number of personnel reaching up to 36.556 (TGBD, 2015). The figure below (Figure-1: Number of Technoparks in Turkey by year) shows the change in the number of technoparks each year, 2013 data showing the total number until November 2013.

1.2 Innovation

The term "innovation", comes from the latin word of "innovatus", meaning the use of new methods in social, cultural and administrative environments (Elci, 2007). Webster's New World Dictionary(1982) defines innovation as "the act or process of innovating; something newly introduced, new method, custom, device, etc; change in the way of doing things; renew, alter."

In the third edition of Oslo Manual, innovation is defined as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (Oslo Manual, 2005:46).

Innovation could be simply explained as the initial presentation or use of an idea, product, service, tool, system, program, or process by an enterprise (Gules and Bulbul, 2004:125). During innovation process, economic and social benefit is derived from knowledge (Elci, 2007:2), as well as from science and technology (TUSIAD, 2003: 23).

Innovation could also be evaluated as a process of management; management of whole activities that take place in idea generation, technology development, the production and marketing process of a new or improved product, manufacturing method or equipment (Trott, 2002:34).

It is important to emphasize on the difference between "new" and "innovative"; by stating that for a new activity to be considered "innovative" it should be different from the alternatives and attract customers; meaning that customers are willing to buy more and pay more for it with respect to alternatives (Kırım, 2006:6).

Innovation process could be examined in three stages, as suggested by Herzog (2008); "Edge stage" is the first stage where generation of new ideas is accompanied by feasibility studies regarding the market and technological assessments. The development and realization of the ideas occur in the second stage. Testing and evaluation of alternatives also take place in the second stage. Finally, the third stage includes the commercialization of the product (Gümüş and Gümüş, 2015).

3. Relationship Between Technology Transfer Collaborations and Organizational Innovation in Technoparks

Technoparks unite technology and innovation based dynamic companies, where they directly develop relationship between each other and with the university. This close contact among parties enhance flow of information and create a learning environment, which are milestones of technology transfer.

Based on literature review presented in prior sections of this study, the following relationship is hypothesized:

H1: Technology transfer collaborations have a positive influence on organizational innovation.

4. Methodology

4.1. Universe and Sample

The universe of the study consists of companies that operate in Information & Communication Technology (ICT) and Software sector found in Yıldız Technical University Technopark (YTU Technopark). As a result of examining the official website of Yıldız Technopark, it is found that there are a total of about 342 technology-based firms, 232 operating in ICT (Information & Communication Technology) and Software sector. Therefore, it was intended to reach owners, managers, and people from other positions that have enough knowledge about and could represent the firm. In order to reach the whole universe, administrative office of YTU Technopark was contacted for permission and support. After the necessary permissions, both paper and online questionnaires were prepared. Online questionnaires were sent through email, and paper questionnaires were applied through face-to-face interviews. Within about two months 35 firms responded online, and 65 responded online. Therefore, a total of 100 responds were collected as sample size that represents %68 of the universe.

4.2. Research Questions

Research questions for this study are stated below.

R.Q.1: Is there a relationship between technology transfer collaborations and organizational innovation?

R.Q.2: Does the volume of technology transfer collaborations differ according to number of employees the firm has?

R.Q.3: Does the volume of organizational innovation differ according to the size of the company.

4.3. Conceptual Model

To address the relationship between technology transfer collaborations and organizational innovation, the following conceptual model was developed. The proposed model is shown in

Figure 1 below.

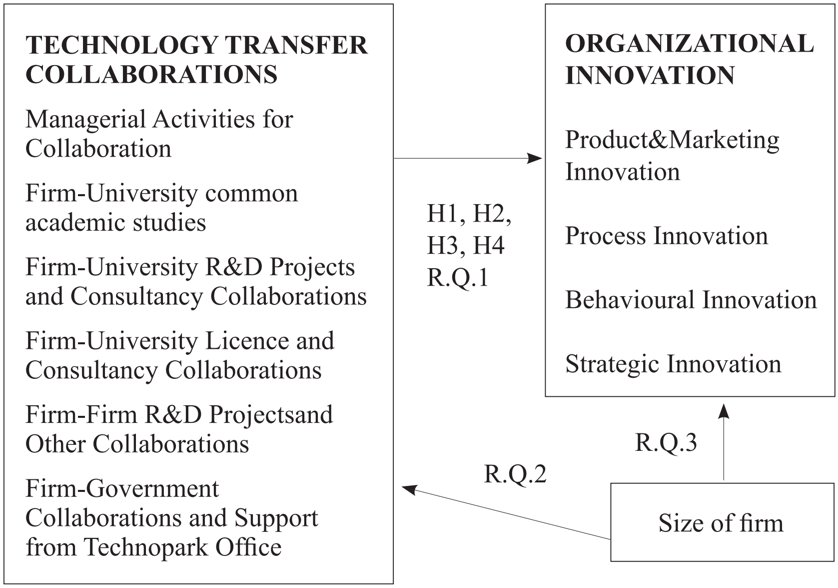

Figure 1: The Proposed Research Model

4.4. Hypotheses

Based on the proposed research model the main hypothesized relationships are as follows:

H1: Technology transfer collaborations positively influence product&market innovation, and explain the variance in it.
H2: Technology transfer collaborations positively influence process innovation, and explain the variance in it.
H3: Technology transfer collaborations positively influence behavioural innovation, and explain the variance in it.
H4: Technology transfer collaborations positively influence strategic innovation, and explain the variance in it.

4.5 Procedure

In order to reach the whole universe, administrative office of Yıldız Technopark was contacted for permission and support. After the necessary permissions, both paper and online questionnaires were prepared. Online questionnaires were sent through email, and paper questionnaires were applied through face-to-face interviews. Within about two months 35 firms responded online, and 65 responded face-to-face. Therefore, a total of 100 responds were collected as sample size that represents 68% of the universe.

4.6. Measures

The questionnaire prepared included 4 independent sections including questions for demographic information and company information, as well as measurement scales designed to assess the constructs of the study. In the first section, purpose of the study and information about the researcher was given, the confidentiality of responses was mentioned. The second section requested information about the individual and the company. The third section included the questionnaire for technology transfer collaborations, and the last section covered the questionnaire measuring organizational innovation.

4.6.1. Demographic Variables and Company Information

The first section covers demographic variables such as gender, age, marital status, position in the company, educational level, and business sector tenure in the organization. Company information such as the size of the company, number of employees, and number of years the firm spent at YTU Technopark were covered as well.

4.6.2. Measurement of Technology Transfer Collaborations

In order to measure technology transfer collaborations, the questionnaire developed by Kılıç (2011) was used., questionnaire consisting of 24 questions, divided in 6 dimensions which are Managerial Activities for Collaboration, Firm-University common academic studies, Firm-University R&D Projects and Consultancy Collaborations, Firm-University Licence and Consultancy Collaborations, Firm-Firm R&D Project and other collaborations, and finally Firm- Technopark Administrative Office Collaborations. Questions were distributed in subscales as 2 questions for Managerial Activities for Collaboration scale, 4 questions for Firm- University common academic studies scale, 3 questions for Firm-University R&D Projects and Consultancy Collaborations scale, 5 questions for Firm-University Licence and Consultancy Collaborations scale, 5 questions for Firm-firm R&D Project and other collaborations, and 5 questions for Firm-Technopark Administrative Office Collaborations. Each subscale measured by 5 items, from “Never” to “Always”.

4.6.3. Measurement of Organizational Innovation

To measure organizational innovation, the questionnaire developed by Ahmed & Wang (2004) was used, questionnaire consisting of five dimensions, and a total of 20 questions with 4 questions in each dimension that are Product Innovation, Market Innovation, Process Innovation, Behavioural Innovation, and Strategic Innovation. As suggested later by Ellonen and his colleagues (2008), Product and Market Innovation was united under one subscale. Each subscale was measured by 5 items, from “Strongly Disagree” to “Strongly Agree”.

5. Research Finding

5.1. Demographic Findings Related to Age

For YTU technopark, demographic structure is shown in Table 5.1 below.

Table 5.1: Demographic Findings Related to Age

Age	Frequency	Percentage	Cumulative Percentage
18-25	5	5	5
26-30	26	26	31
31-35	42	42	73
36-40	19	19	92
>41	8	8	100
Total	100	100	

As seen on the table, 42% of respondents consist of 31-35 years old people, and 26-30 age is 26%. Respondents older than 41 consist only 8%.

Table 5.2: Demographic Findings Related to Educational Level

Educational Level	Frequency	Percentage	Cumulative Percentage
Doctoral Degree	3	3	3
Masters Degree	18	18	21
Bachelor Degree	78	78	99
College degree	1	1	100
Other	0	0	100
Total	100	100	

As seen on the table, 78% of respondents hold bachelor degree, 18% hold masters degree, and 3% hold doctoral degree.

5.2. Descriptive Findings Related to the Size of the Company

YTU Technopark, as well as other technoparks in Turkey is generally small and medium size companies where number of workers could be 10, 15, and less than 50 mostly.

Table 5.3: Demographic Findings Related to The size of the Company

Size of the Company	Frequency	Percentage	Cumulative Percentage
1-9	8	8	8
10-15	15	15	23
16-24	20	20	43
25-49	45	45	88
50-99	5	5	93
>99	7	7	100
Total	100	100	

Statistics for size of the company is shown on Table 5.7 above.

Majority of respondent work in 25-49 size companies where they consist 45%, as seen in Figure-17 above.

5.3. Factor Analysis

In this study, principal component analysis (PCA) was applied to determine the factors. For each PCA, varimax rotation method was performed.

Before factor analysis, two statistical tests were applied to data set in order to assess its suitability for factor analyisis. The first test is KMO (Kaiser-Meyer-Olkin) index; KMO vale being below 0,50 points inadequacy in sample size, therefore a sign of incompability for factor analysis (Kalaycı, 2008). The second test is Barlett test that tests the null hypothesis of correlation matrix being an identity matrix. Significance value being below 0,05 points invalidity of the null hypothesis and acceptance of high correlations between variables and shows suitability of data set for factor analysis.

Factor loadings define the relationship between item and the factor. A factor loading greater than 0,30 and smaller than 0.,60 corresponds to a moderate relationship, whereas factor loading greater than 0,60 points out a strong relationship. Items having loadings on the same factor measure similar properties and therefore belong to the same subconstruct.

Items loading on more than one factor were examined, and the ones having less than 0,1 difference between highest factor loadings were extracted. For items that load on only on a single factor; the ones loading less than 0,40 were removed (Büyüköztürk, 2002).

KMO and Barlett tests, and Rotated Component matrix with varimax rotation performed are explained in the following sections.

5.4. Factor Analysis for Technology Transfer Collaborations Scale

KMO and Barlett Test were performed for collaborations scale, and the result is shown below.

Table 5.4: KMO and Barlett's Test Results for Technology Transfer Collaborations

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,705
Bartlett's Test of Sphericity	
Approx. Chi-Square	1692,269
df	276
Sig.	0,000

KMO result higher than 0.50 and Significance value less than 0,05 for Barlett test shows that the data set is suitable for factor analysis. Therefore, factor analysis was conducted; the results are shown below.

Table 5.5: Final Rotated Matrix for Technology Transfer Collaborations

	Component		
Variable	1	2	3
10	0,819		
11	0,742		
9	0,733		
6	0,729		
4	0,717		
13	0,692		
14	0,670		
7	0,648		
5	0,610		
8	0,569		
15		0,748	
16		0,722	
19		0,719	
17		0,653	
18		0,542	
21			0,817
22			0,693
24			0,686
20			0,681
23			0,639
Extraction Method: Principal Component Analysis Rotation method: Varimax Kaiser Normalization			

It is seen on the final rotated matrix given in Table 5.5 above that technology transfer collaborations scale has three subscales. These 3 factors explain around 57,20% of total variance, as stated in Table 5.6 below. For scales that have various factors, high variance is a measure of how the associated concept is measured appropriately, and the total variance should be more than %50. Factor loadings more than 50% as above confirms the validity of the scales (Hair et al., 1998). Therefore, 57.20% of total variance obtained confirms the validity of the construct.

Questions 3, 12, 1 and 2 were omitted due to low factor loadings (<0,5). 1 and 2 formed the first subscale in the original version of the questionnaire so the corresponding subscale was omitted as well. The remaining items were loaded on 3 factors.

At the end of the factor analysis, 20 items loading on 3 factors were found. These factors are named University-Industry Collaborations, Firm-firm collaborations, and Collaborations with Technopark office. The three original subscales for university-industry collaborations all united under one subscale and therefore the factor is called "University-Industry Collaborations", this factor explains 26.35% of total variance, as stated in Table 5.6 below.

The items loaded on the second factor were all about collaborations between technopark firms, and therefore this factor was called "Firm-Firm Collaborations". This factor explains 15.54% of total variance as mentioned in Table 5.6 below.

Items united under the third factor were all about collaborations with technopark office, and this factor was called "Technopark Office Collaborations". This factor explains 15,31% of total variance as mentioned in Table 5.6 below.

All loadings of the questions are greater than 0,6 as shown in Table 5.5 above; this indicates strong relationship between the item and the factor.

Table 5.6: Total Variance Explained for Technology Transfer Collaborations

Scale	Factors	Number of items	%Variance	Total variance explained(%)
	University-Firm Collaborations	10	26,35%	
TECHNOLOGY TRANSFER COLLABORATIONS	Firm-Firm Collaborations	5	15,54%	%57,20
	Technopark Office Collaborations	5	15,31%	

5.5. Factor Analysis for Organizational Innovation Scale

KMO and Barlett's test results for organizational innovation construct is presented in Table 5.7 below. As KMO value is greater than 0,50 and Barlett test value is smaller than 0,05 the data set is accepted as suitable for factor analysis.

Table 5.7: KMO and Barlett's Test Result for Organizational Innovation Construct

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,829
Bartlett's Test of Sphericity	
Approx. Chi-Square	1958,166
df	190
Sig.	0,000

Factor loadings of each item are shown in the rotated component matrix presented in Table 5.8 below.

Table 5.8: Final Rotated Component Matrix for Organizational Innovation

ITEMS	SUBSCALES			
	1	2	3	4
1	0,889			
5	0,853			
4	0,834			
2	0,765			
3	0,755			
6	0,611		0,537	
8	0,572			
7	0,528			
20		0,882		
18		0,857		
17		0,857		
19		0,789		
14			0,843	
13			0,801	
15			0,744	
16			0,683	

9				0,842
12				0,814
10				0,792
11		0,508		0,656

As suggested by the original version of the questionnaire, 4 subscales were found; Product and Market Innovation, Process Innovation, Strategic Innovation, and Behavioural Innovation. Items 6 and11 were eliminated as they were loaded on more than one factor. Item 11 was also problematic for the purpose of the study as it was questioning manufacturing methods which is found unrelated with ICT (Information & Communication Technology) and software sector in technopark.

The first factor, Product and Market Innovation dimension, consists of 7 items, and explains 24,26% of total variance. The second factor, Process Innovation dimension, consists of 3 items, and explains 20,69% of total variance. The third factor, Strategic Innovation dimension, consists of 4 items, and explains 17,71% of total variance. The fourth factor, Behavioural Innovation dimension, consists of 4 items, and explains 17,03% of total variance.

Total variance explained was found %79,68 as shown in Table 5.9 below. As stated earlier, total variance being greater than 50% confirms the validity of the scales, as high variance is a measure of how the associated concept is measured appropriately (Hair et al., 1998).

Table 5.9: Total Variance Explained for Organizational Innovation

Scale	Factors	Number of items	%Variance	Total variance explained(%)
ORGANIZATIONAL INNOVATION	Product& Marketing Innovation	7	24,26%	%79,68
	Process Innovation	3	20,69%	
	Strategic Innovation	4	17,71%	
	Behavioural Innovation	4	17,03%	

5.6. Reliability Analysis

Kalaycı (2008) evaluates the reliability level of a test instrument as stated in Table 5.10 below.

Table 5.10: Reliability Scale

Cronbach alpa interval	Reliability
0,00-0,40	Not Reliable
0,40-0,60	Weakly Reliable
0,60-0,80	Quite Reliable
0,80-1,00	Highly Reliable

Cronbach alpha values calculated for each questionnaire and their corresponding dimensions are presented below in Table 5.11 and Table 5.12

Table 5.11: Reliability Analysis for Technology Transfer Collaborations Scale

FACTOR	Items	CRONBACH ALPHA
1	4 5 6 7 8 9 10 11 13	0,887
2	15 16 17 18 19	0,863
3	20 21 22 23 24	0,815

Table 5.12: Reliability Analysis for Organizational Innovation Scale

FACTOR	Items	CRONBACH ALPHA
1	1 2 3 4 5 7 8	0,903
2	17 18 19 20	0,974
3	13 14 15 16	0,942
4	9 10 12	0,892

As all coefficients were found to be greater than 0,80, high reliability was obtained for both of the questionnaires and their dimensions. Likewise, for both instruments, no factor gave higher cronbach alpha value when an item was deleted. Therefore, no more item was removed after reliability analysis.

5.7. Testing the Hypothesis of the Study

While testing the main hypotheses, the following hypotheses were also developed.

H1a: University-firm collaborations positively influence Product and Marketing Innovation, and explain the variance in it.

H1b: Firm-firm collaborations positively influence Product and Marketing Innovation, and explain the variance in it.

H1c: Firm-technopark office collaborations positively influence Product and Marketing Innovation, and explain the variance in it.

H2a: University-firm collaborations positively influence Process Innovation, and explain the variance in it.

H2b: Firm-firm collaborations positively influence Process Innovation, and explain the variance in it.

H2c: Firm-technopark office collaborations positively influence Process Innovation, and explain the variance in it.

H3a: University-firm collaborations positively influence Behavioural Innovation, and explain the variance in it.

H3b: Firm-firm collaborations positively influence Behavioural Innovation, and explain the variance in it.

H3c: Firm-technopark office collaborations positively influence Behavioural Innovation, and explain the variance in it.

H4a: University-firm collaborations positively influence Strategic Innovation, and explain the variance in it.

H4b: Firm-firm collaborations positively influence Strategic Innovation, and explain the variance in it.

H4c: Firm-technopark office collaborations positively influence Strategic Innovation, and explain the variance in it.

5.8. Correlation Analysis

With the subscales that are constructed after Factor Analysis, Correlation Matrix calculation was conducted to observe the relationship between constructs.

Table 5.13: Correlation Matrix

		Univ-Industry Collabor Ations	Firm-Firm Collab	Techno Park Collab.	Product &Market Innov	Process Innov	Behav Innov	Strategic Innov
UNIV-INDUSTRY COLLABORATIONS	Pearson Correlation	1	0,280 **	0,358 **	0,047	0,076	0,204*	0,301**
	Sig. (2-tailed)		0,005	0	0,643	0,454	0,042	0,002
FIRM-FIRM COLLABORATIONS	Pearson Correlation	0,280**	1	0,520**	0,328**	0,158	0,081	0,121
	Sig. (2-tailed)	0,005		0	0,001	0,116	0,421	0,229
TECHNOPARK COLLABORATIONS	Pearson Correlation	0,358**	0,520**	1	0,188	0,155	0,174	0,305**
	Sig. (2-tailed)	0	0		0,06	0,123	0,083	0,002
PRODUCT& MARKETING INNOV	Pearson Correlation	0,047	0,328**	0,188	1	0,483**	0,461**	0,436**
	Sig. (2-tailed)	0,643	0,001	0,06		0	0	0
PROCESS INNOV	Pearson Correlation	0,076	0,158	0,155	0,483**	1	0,576**	0,525**
	Sig. (2-tailed)	0,454	0,116	0,123	0		0	0
BEHAV INNOV	Pearson Correlation	0,204*	0,081	0,174	0,461**	0,576**	1	0,738**
	Sig. (2-tailed)	0,042	0,421	0,083	0	0		0
STRATEGIC INNOV	Pearson Correlation	0,301**	0,121	0,305**	0,436**	0,525**	0,738**	1
	Sig. (2-tailed)	0,002	0,229	0,002	0	0	0	

*Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

For researches in the scope of social sciences, correlation is found to be weak for pearson correlation below 0,5; moderate for values between 0,50 and 0,70; and strong for values above 0,70 (Sipahi, 2008:145). Therefore, there is a weak correlation between university-industry relationship and strategic innovation (Pearson r=0,301; p=0,002). Likewise, a weak correlation was found between university-industry collaboration and behavioural innovation (Pearson r=0,204; p=0,042). There is a weak correlation between firm-firm collaboration and Product& Marketing innovation (Pearson r=0,328; p=0,001). Similarly, a weak correlation was found between firm-technopark collaborations and strategic innovation (Pearson r=0,305; p=0,002). As stated, all the collaborations are at weak level; firm-firm collaboration and Product& Marketing innovation being the most powerful among all. The summary of collaborations found is shown in the table below (see Table 5.14).

No multicollinearity was detected between any dimensions, as no significant correlation was found between variables of each group.

Table 5.14: Relationship between Collaborations and Innovation

Relationship	**Pearson value**	**Significance value**	**Strength of the relationship**
University-Firm Collaborations and Strategic Innovation	0,301	0,002	Weak
University-Firm Collaborations and Behavioural Innovation	0,204	0,042	Weak
Firm-Firm Collaborations and Product& Marketing Innovation	0,328	0,001	Weak
Firm-Technopark Office Collaborations and Strategic Innovation	0,305	0,002	Weak

Correlation analysis outlines only existence of a relationship between variables, and the direction of this relationship (positive or negative). After correlation analysis, multiple regression analysis was conducted for each innovation component to see the model of the relationships.

5.9. Regression Analysis

Regression analysis was conducted to test the suggested hypothesis of the study. For regression analysis, normality and linearity were assumed. No multicollinearity was detected in correlation analysis.

5.10. The Relationship between Collaborations and Product & Marketing Innovation

Hypothesis H1a, H1b, and H1c are tested in this section.

H1a: University-firm collaborations positively influence Product and Marketing Innovation, and explain the variance in it.

H1b: Firm-firm collaborations positively influence Product and Marketing Innovation, and explain the variance in it.

H1c: Firm-technopark office collaborations positively influence Product and Marketing

Innovation, and explain the variance in it.

Table 5.15: Regression Analysis of Product & Marketing Innovation, University-Firm Collaborations, Firm-Firm Collaborations, and Firm-Technopark Office Collaborations

Dependent Variable: Product& Marketing Innovation			
Independent Variable:	**β**	**t-value**	**p-value**
(Constant)	3,460	13,566	0,000
University-Firm Collaborations	-0,057	-0,564	0,574
Firm-Firm Collaborations	0,301	2,842	0,005
Firm-Technopark Office Collaborations	0,043	0,720	0,720
R^2 = 0,111 Adjusted R^2 = 0,083 p-value =0,000			

As seen from the table, only firm-firm collaboration relationship is significant (0,005). The model can be summarized as below:

Product& Marketing Innovation=0,301(Firm-Firm Collaborations) + 3,460

Therefore, 1 unit increase in firm-firm collab increases Product& Marketing innovation by 0,301 unit. R^2 shows that 11% of the variance in dependent variable (Product&Marketing innovation) could be explained by the independent variable (collaborations). H1b is accepted, H1a and H1c are rejected.

5.11. The Relationship between Collaborations and Process Innovation

The following hypotheses were tested in this section.

H2a: University-firm collaborations positively influence Process Innovation, and explain the variance in it.

H2b: Firm-firm collaborations positively influence Process Innovation, and explain the variance in it.

H2c: Firm-technopark office collaborations positively influence Process Innovation, and explain the variance in it.

Table 5.16: Regression Analysis of Process Innovation, Firm-Technopark Office Collaborations, University-Firm Collaborations, Firm-Firm Collaborations

Dependent Variable: Process Innovation			
Independent Variable:	**β**	**t-value**	**p-value**
(Constant)	3,807	12,182	,000
University-Firm Collaborations	0,014	0,109	0,914
Firm-Firm Collaborations	0,115	0,885	0,378
Firm-Technopark Office Collaborations	0,115	0,794	0,429
R^2 = 0,032 Adjusted R^2 = 0,002 p-value = 0,000			

As seen on the table, no collaboration significantly effects process innovation. Hence H2a, H2b and H2c were all rejected.

5.12. The Relationship between Collaborations and Behavioural Innovation

Hypothesis H3a, H3b and H3c are tested in this section.

H3a: University-firm collaborations positively influence Behavioural Innovation, and explain the variance in it.

H3b: Firm-firm collaborations positively influence Behavioural Innovation, and explain the variance in it.

H3c: Firm-technopark office collaborations positively influence Behavioural Innovation, and explain the variance in it.

Table 5.17: Regression Analysis of Behavioural Innovation, Firm-Technopark Office Collaborations, University-Firm Collaborations, Firm-Firm Collaborations

Dependent Variable: Behavioural Innovation			
Independent Variable:	**β**	**t-value**	**p-value**
(Constant)	3,518	10,302	,000
University-Firm Collaborations	0,212	1,554	0,023
Firm-Firm Collaborations	-0,041	-0,290	0,772
Firm-Technopark Office Collaborations	0,175	1,098	0,275
R^2 = 0,054 Adjusted R^2 = 0,025 p-value = 0,000			

In the correlation analysis table, university-industry relationship was found to be correlated with behavioural innovation (r=0,233). Likewise, it was found through linear regression that university-industry collaboration affects behavioural innovation (Sig=,023 <,05). Hence, Hypothesis H3a is accepted, Hypothesis H3b and H3c are rejected. The model for H3a is as below:

Behavioural Innovation = 0,212 (University-Firm Collaborations) + 3,518

5.13. The Relationship between Collaborations and Strategic Innovation

The following hypotheses are tested in this section.

H4a: University-firm collaborations positively influence Strategic Innovation, and explain the variance in it.

H4b: Firm-firm collaborations positively influence Strategic Innovation, and explain the variance in it.

H4c: Firm-technopark office collaborations positively influence Strategic Innovation, and explain the variance in it.

Table 5.18: Regression Analysis of Strategic Innovation, Firm-Technopark Office Collaborations, University-Firm Collaborations, Firm-Firm Collaborations

Dependent Variable: Strategic Innovation			
Independent Variable:	**β**	**t-value**	**p-value**
(Constant)	2,549	6,743	,000
University-Firm Collaborations	,338	2,241	,027
Firm-Firm Collaborations	-,113	-,721	,473
Firm-Technopark Office Collaborations	,407	2,310	,023
R^2 = 0,140 Adjusted R^2 = 0,113 p-value = 0,000			

As also found in the correlations table, university-technopark office collaborations significantly affect strategic innovation. R^2 value shows that independent variables explain 14% of the variance. Thus, H4a and H4c are accepted. The model could be summarized as below:

2,549 + 0,338 (University-Firm Collaborations) + 0,407 (Firm-Technopark Collaborations) = Strategic Innovation

Hence, one unit increase in technopark collaboration increase strategic innovation by 0,40 unit; one unit increase in unit collaboration increases strategic innovation by 0,338 unit.

A summary of the hypothesis accepted and rejected is shown in the table below.

Table 5.19: Hypothesis Testing with Regression Analysis

Hypothesis	Relationship	Result
H1a	University-Firm Collaborations and Product&Marketing Innovation	REJECTED
H1b	**Firm-Firm Collaborations and Product&Marketing Innovation**	**Substantiated**
H1c	Firm-Technopark Office Collaborations and Product&Marketing Innovation	REJECTED
H2a	University-Firm Collaborations and Process Innovation	REJECTED
H2b	Firm-Firm Collaborations and Process Innovation	REJECTED
H2c	Firm-Technopark Office Collaborations and Process Innovation	REJECTED
H3a	**University-Firm Collaborations and Behavioural Innovation**	**Substantiated**
H3b	Firm-Firm Collaborations and Behavioural Innovation	REJECTED
H3c	Firm-Technopark Office Collaborations and Behavioural Innovation	REJECTED
H4a	**University-Firm Collaborations and Strategic Innovation**	**Substantiated**
H4b	Firm-Firm Collaborations and Strategic Innovation	REJECTED
H4c	**Firm-Technopark Office Collaborations and Strategic Innovation**	**Substantiated**

As stated in the table 5.19 above, four hypotheses were not rejected. A weak correlation was initially found through correlation analysis among the variables involved in the hypothesis. Regression analysis confirms the results found through correlation analysis.

It could be concluded that the most dominant type of the collaboration affecting innovation was university- industry collaborations where it both positively affected behavioural and strategic innovation. Firm-firm collaboration affected Product and Marketing Innovation, and firm-technopark collaborations affected strategic relationship. Process

Innovation was not affected by any type of collaborations where no related hypothesis was accepted. All types of the three collaborations were found to be affecting different types of innovations. Therefore, all the collaborations were important in terms of developing innovation at technoparks. Strategic innovation was found to be affected by both university-industry and firm-technopark collaborations.

In this research, even though collaborations were found to be positively affecting various sorts of innovations, these relationships were found to be weak. Better and more effective implementation of collaborations is expected to result in improved innovative activities.

5.14. Results

Results regarding the research questions are presented in this section.

5.14.1 Volume of Technology Transfer Collaborations in Technopark

Findings for the volume technology transfer collaborations in YTU Technopark are shown in Table 5.20 below.

Table 5.20: Volume of Technology Transfer Collaborations

		Mean	Standard Deviation
Scale	**Collaborations**	**1,96**	**0,95**
Subscales	University-Firm	2,07	0,94
	Firm-Firm	1,73	0,99
	Firm-Technopark	2,08	0,93

Within the scale of 1-5, type of collaborations, and their respective mean according to respondent replies is presented in Table 5.20 above. As seen on the table, university- firm and firm-technopark collaboration has the mean 2,07 and 2,08 respectively, and firm-firm is observed to be the least used type of collaboration. The mean value being 1.96 it could be considered that collaborations are not very dominantly employed in YTU technopark, and remains at a relatively weak level.

5.14.2 Volume of Innovation in Technopark

Findings for the volume of innovation in YTU Technopark are shown in Table 5.21 below.

Table 5.21: Volume of Innovation

		Mean	Standard Deviation
Scale	**Innovation**	3,86	1,01
Subscale	Product&Marketing Innovation	3,97	0,94
	Process Innovation	2,28	0,96
	Behavioural Innovation	4,3	0,98
	Strategic Innovation	3,92	1,16

Within the scale of 1-5, organizational innovation, and their respective mean according to respondent replies is shown in Table 5.21 above. As seen on the table, product&marketing innovation has the highest mean at 3,97, whereas process innovation points the lowest at 2,28. Mean value of innovation is measured as 3,86, which could be considered moderate-high level.

5.14.3. Size of the Company, and Technology Transfer Collaborations

In order to test if technology transfer collaborations differ according to size of the company at technopark, One-Way ANOVA was conducted. Factors for "size of the company" were 1-9, 10-15, 16-24, 25-49, 50-99; alpha being 0.05.

Hypotheses were set as below:

Ho: There is no statistically significant difference on the volume of technology transfer collaborations according to size of the company.

H1: There is statistically significant difference on the volume of technology transfer collaborations according to size of the company.

The result of the One-Way ANOVA test is shown in Table 5.22 below.

Table 5.22: One-Way ANOVA for Size of the Company

	Sum of Squares(SS)	Degrees of Freedom(df)	Mean Square(MS)	F	P-value
Between Groups	3,08	5,00	0,62	0,46	**0,81**
Within Groups	184,92	138,00	1,34		
Total	188,00	143,00			

As P-value (0,81) is higher than alpha value (0,05), Ho was accepted. Therefore, it was found that collaborations do not differ depending on size of the company.

5.14.4 Size of the Company, and Organizational Innovation

In order to test if technology transfer collaborations differ according to size of the company at technopark, One-Way ANOVA was conducted. For the test, factors for Size of The Company were 1-9, 10-15, 16-24, 25-49, 50-99, alpha being 0,05.

Hypotheses were set as below:

Ho: There is no statistically significant difference on the volume of organizational innovation according to size of the company.

H1: There is statistically significant difference on the volume of organizational innovation according to size of the company.

The result of the One-Way ANOVA test is shown in Table 5.23 below.

Table 5.23: One-Way ANOVA for Size of the Company

	Sum of Squares(SS)	Degrees of Freedom(df)	Mean Square(MS)	F	P-value
Between Groups	4,84	5,00	0,97	1,44	**0,22**
Within Groups	76,75	114,00	0,67		
Total	81,59	119,00			

As P-value (0,22) is higher than alpha value (0,05), Ho was accepted. Therefore, it was found that collaborations do not differ depending on size of the company.

Findings of this study are discussed in the following section.

6. Discussion of Findings

The first part of this study covered broad literature review about technoparks both in Turkey and abroad, as well as innovation. The structure of technoparks, and the reason for their establishment in Turkey were also covered within the literature review section. After presenting demographic findings, the study presented factor analysis for innovation and technology transfer collaboration scales, where at the end of the factor analysis, dimensions were detected in accordance with literature suggestions. Organizational innovation, before and after factor analysis, consisted of the following dimensions: Product and Marketing Innovation, Process Innovation, Behavioural Innovation, and Strategic Innovation.

Technology transfer collaborations initially consisted of the following main dimensions: Managerial Activities for Collaboration, Firm-University Common Academic Studies, Firm-University R&D Projects and Consultancy Collaborations, Firm-University Licence and Consultancy Collaborations, Firm-Firm R&D Project and other collaborations, Firm-Technopark Administrative Office Collaborations. After factor analysis, the model was reduced to 3 dimensions which are Firm-University Collaborations, Firm-Firm Collaborations, Firm-Technopark Administrative Office Collaborations.

Later, regression analysis was conducted to test the effect of collaboration dimensions on innovation dimensions. The analysis was followed by one-way ANOVA analysis examining if size of the company, and number of years at technopark caused any difference on technology transfer collaborations, and organizational innovation. The effect of each technology transfer collaborations subscale on each organizational innovation subscale was tested by regression analysis.

The relationship between firm-firm collaboration and Product&Marketing innovation was observed to be the strongest relationship (Pearson correlation: 0,328 with p=0,001) among other relationships. Other significant relationships found were; university-firm collaboration- behavioural innovation (Pearson r=0,204 with p=0,042), university-firm collaboration-strategic innovation (Pearson r=0,301 with p=0,002), and firm-technopark office collaboration-strategic innovation (Pearson r=0,305 with p=0,002). Nevertheless, all relationships found significant were at weak level (Pearson r<0,5). This could be interpreted as that despite the existing effect of collaborations on innovative abilities in YTU technopark, collaborations do not play a very significant role for innovation improvements.

Organizational innovation and technology transfer collaborations were measured in 1-5 scale. The mean value of perceived innovation is found as 3,86, where the means are 3,97 for Product and Marketing innovation; 3,28 for Process innovation, and 4,30 for Behavioural innovation, and 3,92 for strategic innovation. Therefore, innovation of all kinds could be evaluated as moderately high in YTU technopark, behavioural being the highest. However, mean level of collaborations was found as 1.96 which is quite low with respect to organizational innovation; different types of collaborations being 2.07 for university-firm; 1.73 for firm-firm, and 2.08 for firm-technopark administration collaborations. Firm-firm collaboration was found to be the least used type of collaborations. The findings shows that despite weak level of collaborations, innovation was relatively high in YTU technopark, which shows that innovation has other more important sources than collaborations.

According to the results of the study, university-industry collaborations affect both behavioural and strategic innovation. Many literature finding support this result, one such study (Kaufmann and Tödling, 2001) stating the importance of a successful university engagement with industry resulting in information and technology transfer from university to industry leading innovative product, service, and processes.

Firm-firm collaborations being the least employed type of collaborations, having a mean value of 1,73; still has effect on Product and

Marketing Innovation. It could be concluded that not many firms engage in firm-firm collaborations, and the ones having such collaborations aim to make a specific product or a specific marketing application where technological abilities and various strengths of each firm functions are united.

The next type of collaborations affecting innovation is technopark office collaboration that is observed to be affecting strategic innovation. Technopark offices help strengthening social interaction between companies through organizing various events and services primarily such as trainings, seminars, conference, and fairs.

One- way ANOVA test showed no meaningful difference on the volume of collaborations and organizational innovation depending on size of the company. Indeed, because the companies in technopark are generally of similar sizes (mostly small firms of 30-50 employees), the effect of size was not appropriately measurable in this study. One-way ANOVA test resulted in that there is no meaningful difference on the volume of innovation, depending on number of years spent at technopark. This points that spending more time in technopark does not increase engagement in collaborative activities. Considering that technopark companies already go through selection process, and should fulfill many requirements to be accepted to technopark; they already arrive technopark with a good knowledge about implementation of innovative activities there.

7. Conclusion and Suggestions

As stated in the previous section, innovation was found to be relatively high even though collaborations were at weak level. This may indicate that innovation has more important sources than collaborations in YTU technopark. These sources should be examined and improved. However, collaborations were found to be significantly influencing some types of innovation. This means that volume of collaborations in technopark should be increased in order to strengthen innovative abilities. Accordingly, the ways to improve these collaborations should be examined. At this point, it is important to emphasize that not only the quantity, but also the quality of collaborations should be improved.

In order to increase university-firm collaborations, similar to technopark offices established in technopark, offices could also be established in university campus. Benefits of engaging in university-industry collaborations such as finding training and future employment opportunities, could be told to university students. Similarly, more benefit could be provided to students such as having the chance to get rewards and scholarships for being involved in successful university-firm projects. Firm-firm collaborations could be improved by funding programs (such as TUBITAK (Scientific and Technological Research Council Of Turkey)) encouraging partnerships by ways such as creating programs requiring the involvement of at least two parties to apply for funding.

This study was limited to YTU technopark. In order to deduct general results about overall technoparks in Turkey, a study covering all technoparks in Turkey must be pursued. Such study could contribute to the development of innovation strategies for technoparks.

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