Technology-Based-Firms Located off Technology Development Zones: Reasons for Not Being a Part of Technology Development Area in Turkey

Mehmet A. Ozyurt, Basak Cetinguc, Eyup Calik, and Fethi Calisir

***Abstract*—Being prevalent around the world, science and technology parks have been built up and developed under various names in different regions. Turkey has kept pace with this trend, with the seeds of the first science park being sown in the 1980s. In 2001, all techno parks, science parks and techno policies were gathered under the same roof of technology development zones (TDZs) by Turkish law. According to the Scientific and Technological Research Council of Turkey, by 2014, there are more than 3000 firms in 55 TDZs. Firms in TDZs benefit from various government promotions and several tax dispensations granted by law. In spite of these incentives, the number of located-in firms is less than expected. For this reason, this study aims to focus on the reasons for not being a part of technology development areas among technology based firms that are located off science parks. The differing reasons for not being a tenant of a TDZ among several sectors and firm sizes is the main concern of this study. The sample consists of 159 technology-based firms from nine different sectors. Analysis of variance is conducted to test the hypotheses. It is found that some sectors show differences in reference to six of the eight different reasons for not being a part of a TDZ, while there is no difference between firms in terms of size.**

***Index Terms*—Technology development zones, reasons for not being a tenant of TDZs, Turkey.**

I. Introduction

All around the world, most firms, even countries, include technology-focused economic development in their strategic plans. Technology development areas play a key role in gathering universities, industrial organizations and public policy together around the center of technology.

The seeds of the first science park, which is globally famous as Silicon Valley, were sown in the 1950s in Stanford, CA. Afterwards, by the end of the 1960s, Cambridge Science Park in the UK and Sophia Antipolis in France were established [1]. As a new phenomenon, science parks have improved under different names in various regions such as science parks in the USA and UK, technology parks in Germany, and technopolis in France, Italy and Japan [2]-[4].

A recognized institution, The International Association of Science Parks (IASP), defines science parks as "an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated business knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities". Another well-known institution, The United Kingdom Science Park Association (UKSPA) defines a science park as "a business support initiative whose main aim is to encourage and support the start-up and incubation of innovative, high-growth, technology-based businesses through the provision of: infrastructure and support services including collaborative links with economic development agencies; formal and operational links with centers of excellence such as universities, higher education institutes and research establishments; management support actively engaged in the transfer of technology and business skills to small and medium-sized enterprises".

Turkey started to keep pace with the development of science parks around the 1980s. The first science park in Turkey was established in the Middle East Technical University in 2000. Science park, technopolis, and techno-park were the chosen names to refer to technology development areas in Turkey. In 2001, the Law of the Technology Development Zones (No. 4691) was accepted by the Turkish government. All the research centers, science parks, technopolis and techno parks were gathered under the name of Technology Development Zones (TDZs). Technology Development Zones Law No.4691 defines TDZs as "Sites integrating academic, economic, and social structures at or near the campus of certain universities; advanced technology institutes; an R&D centers or institutes; or a Techno park involved in these same areas of work. They are sites where companies using advanced technology or companies with a new technological orientation, produce and develop technology or software by through the facilities provided by the organizations mentioned above. They are involved in activities which transform a technological innovation into a commercial product, method or service and by this means contribute to the development of the region". This law brings academic and industrial sides together to collaborate and develop competitive, value-added technologies, products or services. The Scientific and Technological Research Council of Turkey (TÜBİTAK) announced that, by the end of 2012, there were 49 technology

Manuscript received June 19, 2016; revised August 29, 2016.

Mehmet A. Ozyurt is with Space Science Engineering Department, Istanbul Technical University, Istanbul, Turkey (e-mail: maozyurt@gmail.com).

Basak Cetinguc, Eyup Calik, and Fethi Calisir are with Industrial Engineering Department, University of Yalova, Yalova, Turkey (e-mail: basak.cetinguc@yalova.edu.tr, ecalik@yalova.edu.tr, calisirfet@itu.edu.tr).

doi: 10.18178/joebm.2016.4.8.440

development zones in Turkey. Besides opportunities for collaborations, financial support such as grants for land procurement, infrastructure and construction of management building is provided by the Ministry of Science, Industry and Technology to TDZs.

In the literature, researchers have investigated science parks using different approaches. For instance, [1] studied the reasons for tenants of science parks choosing to be there. [5] took a closer look into research productivity of companies: whether there are any differences between those located in and located off science parks in the United Kingdom. Likewise, [6] examined whether being a tenant of a science park stimulated the innovative output of firms and led to outperforming those outside science parks. Additionally, [7] investigated how science park management works with their tenants and deals with prospective tenants. [8] studied the effects of science park facility managers on tenants of science parks. The study was performed among managers and tenants of 12 Science and Technology Parks in Turkey; tenants were more collaborative when the facility managers showed up more frequently [8]. Although many researchers have studied different aspects of the relationship between firms and science parks, there are no studies that interrogate the reasons for not being a tenant of a TDZ. In this study, the main purpose is to analyze why firms choose not to be a tenant of a science park, and whether there are any differences in terms of the reasons between sectors. These reasons are determined as technical infrastructure, sufficiency of governmental incentive, offered opportunities, bureaucracy procedure, introduction and promotion of TDZs, and culture of collaboration. The management of TDZs should appeal to prospective tenants via promotions. At the same time, they should provide a collaborative culture for tenants. Additionally, facility management of TDZs should investigate firms located off TDZ, and explore those that would benefit from the collaboration offered in TDZs. In this study, we aim to shed light on facility management to identify the reason(s) for not being a tenant of TDZs. The remainder of the paper is organized as follows: Section II discusses data collection; Section III presents analysis and interpretations; in Section IV, the findings will be discussed. Finally, we will conclude the study in Section V and give further research recommendations.

II. Research Design

A. Sample and Data Collection

The population of the study is based on three conditions. Firms located off TDZs should operate in similar sectors to those located in TDZs, performing R&D activities. At the same time, an application for grants regarding R&D activities to TUBİTAK must be made by these firms at least once. Surveys were conducted with 353 randomly selected firms via a face-to-face method. Questionnaires were examined in order to increase validation and confidence. Finally, 159 questionnaires were valid, and were used in making various analyses.

B. Variables and Measures

In order to determine the reasons for not being a tenant of a TDZ, several interviews were performed with specialists from governmental policy institutions, management office of TDZs, and non-governmental organizations related to technology development. After these interviews, the following questions were taken as response variables.

- There is no need for being a tenant of TDZs for R&D activities.
- We do not know sufficient information about governmental incentives and opportunities in TDZs.
- We think that given governmental incentives and offered opportunities are similar to those that we already have.
- We do not have sufficient information about procedures of being a tenant of TDZs.
- We think that infrastructure is not convenient enough in TDZs.
- There is too much bureaucracy in TDZs.
- The collaboration culture is not developed in TDZs.
- There is not a favorable environment to bring tenants together.

The five-point Likert scale, which ranged from "strongly disagree" to "strongly agree," was used to evaluate the questions. Additionally, several descriptive questions were added to the survey with the purpose of giving a general picture to the data. The size and sectors of the firms were remarkable classification areas to see the tendency of firms. A categorical scale was used for these questions. The size of the firms was divided into three groups: small-medium-large; and the sectors of the firms were divided into the following subgroups: Electric & electronics, chemical, mining, machinery, service, automotive, textile, health, and information technologies. The intention of the firms for not being located in TDZs was asked in a dichotomous scale.

C. Hypotheses

Our hypotheses are structured around firm size and sectors. These hypotheses were established in a general form as

H1: There is a difference between sectors

H2: There is a difference between firm sizes.

These general forms should be tested separately for all response variables.

TABLE I: Sector- and Firm Size-based Distributions

		Size of Company			Total	Percent
		Small	Medium	Large		
Sectors	Automotive	3	5	2	10	6.3%
	Chemical	0	6	5	11	6.9%
	Electric & Electronics	8	31	5	44	27.7%
	Health	1	9	1	11	6.9%
	Information Technologies	4	12	2	18	11.3%
	Machinery	5	28	4	37	23.3%
	Mining	1	5	8	14	8.8%
	Service	1	4	1	6	3.8%
	Textile	0	5	3	8	5.0%
	Total	23	105	31	159	
	Percent	14.5%	66.0%	19.5%		%100

III. Analysis

A. Descriptive Analysis and Interpretation

The distributions of 159 firms located off TDZs are shown in Table I with regard to firm size and sectors. The medium size of enterprises forms the majority (66%). Large-sized companies follow with 19.5% and small-sized companies only comprise 14.5%. The largest share of the industrial distribution is determined as belonging to the Electric & Electronics industry. Machinery and Information Technologies have another large share; the lowest proportion is the service industry, with 3.8%.

TABLE II: Response Variables

Code	Questions	Mean	Std. Dev
RV1	There is no need of being a tenant of TDZs for R&D activities.	2.72	1.17
RV2	We do not know enough information about governmental incentives and opportunities in TDZs.	3.54	1.19
RV3	We think that given governmental incentives and offered opportunities are not different than the ones we have.	2.94	1.14
RV4	We do not have enough information about procedures of being a tenant of TDZs.	3.54	1.19
RV5	We think that infrastructure is not convenient enough in TDZs.	3.14	1.09
RV6	There is over bureaucracy in TDZs.	3.30	1.17
RV7	Collaboration culture is not developed.	3.15	1.13
RV8	There is not favorable environment to bring tenants together.	3.30	1.10

Additionally, in accordance with the aim of this study, we want to mention the reasons that mostly affect not being a tenant of a TDZ. According to the results in Table 2, not knowing sufficient information about governmental incentives and opportunities in TDZs, and the procedures of being a tenant of TDZs, are the most essential reasons. This means that governmental institutions and facility management of TDZs should organize arrangements to introduce themselves by presenting more opportunities for being a tenant of a TDZ. Too much bureaucracy and having an unfavorable environment for bringing tenants together are the following main reasons. TDZs should take initiatives to reduce bureaucracy and to increase the collaborative culture. Moreover, the lowest score (2.72) indicates that firms consider being a member of TDZs for R&D activities. The other scores can be seen in Table II.

B. One-Way Analysis of Variance Test

In order to identify differences between sectors and sizes, we conducted a One-Way Analysis of Variance Test (ANOVA). In this statistical technique, under conditions defined by the classification variable, differences between the responses are examined. The classification variables are sectors and firm sizes whose classes have been mentioned previously; the response variables are the reasons mentioned in Table 2. In light of this explanation, we want to show whether the responses of the reasons differ separately in different groups of sectors and firm sizes by conducting ANOVA. For this purpose, Levene statistics were first examined to be able to conduct ANOVA under the assumption of the homogeneity of variances.

In Table III, the analyses for the differences between sectors are shown. The significance of all response variables was greater than p=0.05, indicating that the assumptions of homogeneity of variances for all the response variables were satisfied. Afterwards, the expected significance values of F statistics were less than 0.05, indicating that there is a difference between sectors under certain response variables. Hypothesis 1 is rejected (discussed later). Table III shows that there is no difference between sectors in terms of RV1 and RV8. Post-Hoc tests were employed for the response variables where differences were found between sectors. For RV2, information technology differs from the machinery, textile, chemistry and electric & electronics sectors, while health differs from the machinery and electric & electronics sectors. Moreover, similar kinds of differences were observed in RV3, RV4, and RV6 between information technologies-electrical & electronics, and information technologies-machinery. Furthermore, differences between the machinery and information technology sectors were detected in RV5 and RV7.

TABLE III: Levene and Anova Results for Sectors

Code	Levene Stat.	Sig.	F	Sig.
RV1	.651	.733	1.002	.438
RV2	1.373	.213	5.899	.000
RV3	.398	.919	3.007	.004
RV4	1.942	.058	3.516	.001
RV5	1.328	.239	3.541	.001
RV6	1.134	.348	3.989	.000
RV7	.857	.555	2.289	.026
RV8	1.640	.123	1.883	.071

Similar steps were followed to see whether there are any differences in terms of firm size. The significance values of Levene statistics and F statistics can be seen in Table IV. According to this table, homogeneity of variance was not satisfied, since the significance value of Levene statistics was smaller than 0.05 for RV3. The Tamhane test was employed for this variable only in post-hoc tests apart from remainder of the variables. Table IV shows that all significance values of F statistics are greater than 0.05. This means that Hypothesis 2 is not rejected, and there is no difference between firm sizes for all response variables.

TABLE IV: Levene and Anova Results for Firm Sizes

Code	Levene Stat.	Sig.	F	Sig.
RV1	2.345	0.1	0.065	0.937
RV2	0.196	0.822	0.058	0.943
RV3	4.938	0.009	0.123	0.884
RV4	1.184	0.309	0.037	0.964
RV5	2.189	0.117	0.622	0.539
RV6	1.452	0.239	0.458	0.634
RV7	0.897	0.411	1.078	0.344

RV8	1.929	0.15	0.596	0.553

IV. Discussion

The results will now be discussed. As mentioned above, 159 firms located-off TDZ were examined; we observed that a medium size of enterprises and the electric & electronics industry form the majority.

When considering the reasons that mostly affect not being a tenant of a TDZ, the lack of sufficient information about governmental incentives and opportunities in TDZs affects not being a tenant at the highest level, together with the lack of information about procedures of being a tenant of TDZs. Therefore, governmental institutions and facility management offices should analyze the main problems of transferring information to prospective tenants, in order to increase access channels to firms located outside TDZs. At the same time, suitable channels to reach these firms is the key element to introducing themselves and presenting opportunities of being a tenant of a TDZ. If necessary, governmental regulations should be revised to eliminate information transfer problems. Governmental regulators should also focus on perceived bureaucracy problems, and should develop policy in order to decrease bureaucracy. Although by their nature TDZs should be the center of collaborative works by throwing together universities, firms and the government to perform R&D activities, firms that are located outside consider there is an insufficiently collaborative environment in TDZs. Public authority and governmental regulators should develop policies in order to service expedient to TDZs establishment. Simultaneously, the infrastructure of TDZs was considered insufficient by firms located outside for R&D activities.

In addition, while analyzing differentiation in terms of sector and firm sizes, some interesting results were obtained. First, there is no difference between firm sizes. Small, medium, large firms do not separate each other, because the main reasons for not being a tenant of a TDZ originatein facility management and government policies. On the other hand, this perception became dissimilar in terms of the types of sectors. In terms of lacking sufficient information about governmental incentives and opportunities in TDZs, the information technology and health sectors were differentiated from the other sectors. In particular, firms operating in information technology have a different approach in obtaining information. Similarly, given governmental incentives, offered opportunities and the perception of these opportunities, a lack of information about procedures, and too much bureaucracy were differentiated in the information technology, machinery and electric & electronics sectors. There is a difference between the machinery and information technology sectors in infrastructure insufficiency. This situation can be interpreted by the differing requirements of R&D activities in these sectors. In a similar vein, the collaborative cultures of these sectors differ in project-based approaches to new product development. Surprisingly, the machinery and information technology sectors have divergent attitudes in all hypotheses in terms of sector type. Firms in any sector evaluate that there is no need for being a tenant of TDZs for R&D activities. TDZ management should dispel these perceptions. TDZs should probably focus on changing the perception of not having a favorable environment to bring tenants together. Consequently, information technology firms are the most differentiated; thus TDZ management should take them into consideration when making structural decisions. At the same time, governmental regulators should pay attention to information technology firms when revising policies in order to obtain a favorable environment.

V. Conclusions and Further Research

Rapid change in technology has accelerated the need for collaboration between industry-university-government. Technology Development Zones were established to satisfy this need by bringing together these participants to constitute the desired partnership. The Turkish Government gives incentives and grants to propagate this favorable environment among R&D firms. Studies related to being a tenant and how this reflects performance have been conducted. However, we have yet to come across any study regarding the reasons for not being a tenant of TDZs. This study fills this gap by identifying the reasons and analyzing whether there are any differences between sectors and firm sizes. There are several differences between sectors, e.g. insufficient information about governmental incentives and opportunities in TDZs, perception of governmental incentives and opportunities, lack of information about procedures of being a tenant of TDZs, insufficient infrastructure, too much bureaucracy, an insufficiently collaborative environment, and the perception of governmental incentives and opportunities. On the other hand, no differences were found for the following two categories: no need for being a tenant of a TDZ for R&D activities, and not having a favorable environment between sectors. Furthermore, the responses did not depend on firm size. Besides these valuable contributions, there are several limitations to this study. For instance, non-validated reasons for not being a tenant of TDZs were identified. Additionally, perceptional questions were used; this may cause some biased results that are not leveraged.

For further research, a larger sample size can be analyzed, or specific sectors can be interrogated, to see whether the findings change. Moreover, governmental policy changes can be taken into consideration to identify the reasons. Factor analysis can be employed to classify the reasons into sub-groups by adding considerable reasons from different aspects. This is an initial study and adds reasons for not being a tenant to the literature; its borders and scope could be extended.

References

[1] Y. L. Bakouros, D. C. Mardas, and N. C. Varsakelis, "Science park, a high tech fantasy?: An analysis of the science parks of Greece," *Technovation*, vol. 22, no. 2. pp. 123-128, 2002.

[2] C. Longhi and M. Quéré, "Innovative networks and the technopolis phenomenon: The case of sophia-antipolis," *Environ. Plan. C Gov. Policy*, vol. 11, no. 3, pp. 317-330, 1993.

[3] N. A. Vorobeva, "Cluster policy in regional development of Japan," *Life Sci. J.*, vol. 11, pp. 206-212, 2014.

[4] R. Culp and P. Shapira, "Georgia's advanced technology development center: An assessment," *Technology Incubators: Nuturing Small Firms*, no. 97. pp. 63-75, 1997.
[5] D. S. Siegel, P. Westhead, and M. Wright, "Assessing the impact of university science parks on research productivity: Exploratory firm-level evidence from the United Kingdom," *Int. J. Ind. Organ.*, vol. 21, no. 9, pp. 1357-1369, 2003.
[6] M. Squicciarini, "Science Parks' tenants versus out-of-Park firms: who innovates more? A duration model," *J. Technol. Transf.*, vol. 33, pp. 45-71, 2008.
[7] A. Albahari, M. Klofsten, and S. P. Canto, "Managing a science park: A study of value creation for their tenants," in *Porc. the Triple Helix IX Conference Silicon Valley: Global Model or Unique Anomaly?*, 2011, pp. 1-15.
[8] O. Kocak and O. Can, "Determinants of inter-firm networks among tenants of science technology parks," *Ind. Corp. Chang.*, vol. 23, no. 2, pp. 467-492, 2013.

Mehmet A. Ozyurt was born in 1969 at Istanbul. He is a PhD student in the space science engineering department at Istanbul Technical University (ITU). He graduated with a BS from Yildiz Technical University in 1991, and an MS from ITU in 1994.

His current research interests include science parks and technology management.

Currently, he is working at his own family company as managing director; also he is an executive board member at Teknopark Istanbul.

Basak Cetinguc is a research assistant in the Industrial Engineering Department at the University of Yalova. She obtained her bachelor's degree in industrial engineering from Kocaeli University and her MS in engineering management from The George Washington University in 2012. Currently, she is a PhD student in industrial engineering at Istanbul Technical University. Her research interests are mainly innovation management, R&D, innovation performance and data analysis.

Eyup Calik is a research assistant in the Industrial Engineering Department at Yalova University. He has a BS in industrial engineering and a MS in engineering management from Istanbul Technical University (ITU). He gained his PhD degree in industrial engineering from the same university in 2016. His research interests are innovation management, sustainability, cooperation networks, and performance measurement.

Fethi Calisir is a professor of industrial engineering at ITU. He graduated with a BS from ITU in 1989, an MS from the University of Miami in 1993, and a PhD from Purdue University in industrial engineering in 1996. His current research interests include IT project management, software usability, and human computer interaction. His research papers have appeared in Computers in Human Behavior, Computers & Industrial Engineering, Total Quality Management, Accident Analysis & Prevention, Technovation, Managing Service Quality, International Journal of Information Management, Management Research News, and Internet Research.