THE IMPORTANCE AND DEVELOPMENT OF TECHNOPARKS IN TÜRKİYE

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Abstract

The belief that science parks, the first examples of which were encountered in the 1950s, stimulate economic growth led to the spread of different forms in developed countries, especially in the 1970s and 1980s. Science parks, which have been increasing in number around the world since the 1990s and are expressed in different ways such as technopark, technopol, technology park, technology development zone, innovation park, are very important tools in ensuring cooperation between university-industry-state in the process of transforming innovative information and technologies into innovation. In addition to providing support to newly established companies in commercialization, infrastructure service, meeting with target customers and the market, obtaining patents, it also offers additional incentives and supports beyond the governmental supports. In addition, they have critical importance for the regional and national development of the regions and countries in which they operate. They help revitalize the industry in which they operate; contribute to the solution of social problems such as employment and brain drain. Science parks first emerged in Türkiye in the 2000s as Technology Development Zones, or commonly as "technoparks". Law No. 4691 on Technology Development Zones enacted in 2001 constitutes the legal basis for technoparks. Within the scope of this law, incentive mechanisms are created for technology-based companies and innovative entrepreneurs by providing various supports and exemptions, primarily tax exemptions and infrastructure supports, to the management companies operating in technoparks. Technoparks, which support the creation of an effective entrepreneurship ecosystem and make significant contributions to Türkiye's science and technology policies, are also very important sources of employment for Türkiye. As of February 2022, more than 7,500 companies operate in technoparks all over Türkiye and more than 78,000 personnel are employed in those firms. Technoparks, which strengthen the connections between university, industry and the public with their triple helix understanding, contribute significantly to the execution of science and technology policies within the framework of the National Technology Initiative with the infrastructure and financing opportunities they offer to companies.

Keywords

Technology development zones, Technopark, University-industry interaction, R&D, Innovation, Triple helix

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Introduction

With the rapidly changing market conditions and consumer demands, intensifying competition and technological developments, the transformation of knowledge and ideas into innovation is considered a priority in the economy. In shaping today's world economy on the basis of knowledge, technology, and innovation, it is very important to strengthen the linkages between the fields of science, education, and production and to develop appropriate governance mechanisms. The formation of an innovative and knowledge-intensive economy and the expansion of the production of competitive products will significantly affect a country's export capacity based on high technology.

Innovation is an important motivation for national, regional, and institutional development (Lamperti et al., 2017). Contemporary industries, based on knowledge, have evolved from a production factors and investment approach towards an innovation-oriented structure. Innovative technology businesses tend to develop a shared industrial advantage in order to overcome the traditional constraints of factors of production and achieve "efficient and sustainable development" (GarcíaMorales et al., 2014; Grinstein and Goldman, 2006).

Technology-oriented companies have critical contributions to employment growth, innovation, and economic development. In this context, the number of initiatives in the world has started to increase in order to support the growth and development of technology-based companies and, as a result, to increase economic welfare. The establishment of science and technology parks is among the most prominent steps taken in this regard (Lecluyse et al., 2019). Today, science parks, which are expressed in different ways such as technopark, technopol, technology park, technology development zone, innovation park in different countries, are prominent tools in providing interaction between universities, industries, and government for the transformation of innovative knowledge and technologies into innovation.

Despite general agreement on the efficiency of the science park idea, both industrialized and developing countries have concerned about science park performance rates and how effectively they satisfy expectations. According to the findings, just a minority of these initiatives are successful, particularly in emerging market economies like Türkiye (Radosevic & Myrzakhmet, 2009).

According to the International Association of Science Parks (IASP), a "technology and science park" refers to a general concept encompassing the concepts of "technology park", "technopolis", "research park" and "science park" and it is "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 businesses and knowledge-based institutions". Science parks are crucial in achieving these goals. They strengthen the interaction between academia, R&D institutions, and industry; manage the knowledge and technology flows; and encourage the establishment and development of innovation-based companies. In addition, they provide value-added services to their tenant companies with high-quality infrastructure and physical facilities (IASP, 2022).

According to UNESCO, the term "science and technology park" encompasses all kinds of high technology clusters such as "technocities, science parks, science cities, cyber parks, high-tech (industrial) parks, innovation centers, R&D parks, university research parks, research and technology parks, science and technology parks, science cities, science towns, technology parks, technology incubation centers, technology parks, technoparks, technopols, and incubation centers" (Hobbs et al., 2017). These clusters, which are called

"science and technology parks" in the international literature, were named as "Technology Development Zones" in Türkiye with the "Law No. 4691 on Technology Development Zones" established in 2001. The common name of these regions used in practice is "technopark".

The Technology Development Zones (commonly known as technoparks) in Türkiye, whose number has been increasing since the 2000s, are prominent actors for the vision of Türkiye which is called "National Technology Initiative" envisaging to become "the innovation and technology center of the world", by supporting newly established technology companies for commercializing, addressing target markets and customers, and providing various incentives beyond the government support.

1. The Emergence, Development and Importance of Technology Development Zones

The idea of University-Industry collaboration was first brought up in 1951 by Professor Frederick Terman, the Dean of Faculty of Engineering at Stanford University. Claiming that universities are not just places of learning, Terman's views on the positive effects of universities on industries, assisted the foundation of the first high-tech industrial park (Stanford Research Park), known today as "Silicon Valley", where the interests of profit-seeking, academic and government institutions are united in a synergetic vision. - SRP) (Almaamory & Al Slik, 2021).

Realizing "the significance of knowledge-based industries as a new driver of growth", many countries have engaged in establishing science parks to help "the development of high-tech industries and promotion of technological capacity" (Jongwanicha, Kohpaiboonb, and Yangc, 2014). The belief that technology development zones stimulate economic growth led to developed countries to establish science parks in different forms, especially in the 1970s and 1980s. Countries all around the world have attempted to emulate the cluster model by enacting policies that stimulate the formation of businesses in specific areas. This was followed by the proliferation of technology development zones in emerging economies in the 1990s. Industrialized countries followed a proactive strategy in establishing science parks. Some countries have activated technology development zones to ensure regional development and prosperity, revitalize high-tech industrial zones, and encourage academia-industry cooperation (Henriques et al., 2018). The original rationale for technology development zones is based on the argument that the newly established tenant firms benefit from the physical proximity that the technology development zones provide. Due to the intimate relations with incubation and innovation service providers, tenant firms have advantages in speeding up the start-up phase, solving the problems companies face in the initial phase, providing better infrastructure and financing opportunities, and therefore, stimulating growth. In other words, it was thought that technology development zones would generate added value by improving their tenants' ability to grow and sustain in technology-intensive areas in these prominent ways (Radosevic & Myrzakhmet, 2009).

Technology development zones have multiple objectives for both their effects on firms and the regional industries. The firm objectives are to facilitate university technology transfer, encourage the establishment of new innovation-based technology firms, facilitate the growth of existing high-tech firms, attract firms involved in leading technology areas, and support strategic alliances/networks. Goals for regional effects include economic prosperity, increased employment, and the revitalization of regions experiencing industrial decline (Siegel, 2003).

Technology development zones, which represent a concept that is constantly transforming by being structured on information and communication technologies, are considered "one of the first urban models of the contemporary information society" (Salvador et al., 2019). Technology development zones consist of different companies operating in a specific region, aiming to stimulate science, technology, and innovation and to engage in "formal and informal relationships with research centers, universities, and other higher education institutions". Key features of technology development zones are hosting clustered "high-technology industries and service centers"; a university or technology institute with which tenant companies can maintain some official connections and providing incentives to tenant companies for the transfer of knowledge and technology (Guadix et al., 2016; Steruska et al., 2019).

"Academic science" and "industrial technology" are separated by the assumption that academics and industry are two separate realms that are frequently contradict with one another (Henriques et al., 2018). Technology development zones fill this gap by creating an atmosphere that encourages collaboration between research institutions and businesses. Technology development zones are also tools for promoting and mobilizing "industrial and commercial innovation, reindustrialization, and regional sustainable development." Technology development zones intend to supply the "technical, logistical, and administrative infrastructure" that can help "small businesses develop their products, increase their competitiveness", encourage technology transfer, and create an enabling environment for innovation, with the help of university-industry collaboration (Bakouros et al., 2002; Phillimore, 1999; Kharabsheh, 2009). The goal of technology development zones is to strengthen geographic proximity while also stimulating other sorts of proximity enhancing the interaction between firms and institutions of research and technology. Geographic proximity results in more diversified and long-lasting relationships (V´asquez-Urriago et al., 2016).

The belief that relationships between firms that are close in proximity strengthen their cooperation has been discussed in two ways. First, because physical proximity has a beneficial effect on the frequency of contacts, geographic proximity promotes information flows and, eventually, learning processes (Torre and Gilly, 2000). According to Maskell and Malmberg (1999), knowledge is implicit. Tacit knowledge is fundamental in the innovation process, and frequent and repeated face-to-face interactions are essential for tacit information transfer. Geographic proximity is critical in this context. As a result of the more diversified relationships innovative collaborations among clustered firms produce a higher flow of information. Second, being in physical proximity lowers ambiguity. It also lowers the expense of searching and raises the chances of collaborating with a variety of diverse innovation partners (Feldman, 1999; MacPherson, 1997). It also aids in the development of trust, which lowers transaction costs in collaborative initiatives and leads to more solid and long-term relationships. Longer relationships empower companies to exchange more important information, which leads to better alignment of expectations and outcomes, more trust, and higher collaboration returns (Bennet et al., 2000; Love and Roper, 2001; Vasquez-Urriago et al., 2016). Geographic proximity, on the other hand, is necessary but not sufficient for efficient inter-organizational learning. (Lane and Lubatkin, 1998).

There are two other kinds of proximity that are effective in inter-organizational interaction. These are technological proximity, which is defined as "the level of overlap of the knowledge bases of the two cooperating actors" and organizational proximity, which is defined as "the set of explicit or implicit routines that allow coordination without the need

to define how to do it in advance". This set of routines, which form organizational proximity (Baptista and Swann, 1998; Torre and Gilly, 2000) that affects the frequency and intensity (diversity and duration) of interactions, includes organizational structure, organizational culture, performance measurement systems, language, etc. (Rallet and Torre, 1999). Technology development zones guarantee geographic proximity and facilitate other sorts of proximity that enhance the interactions between firms and research and technology institutes. In this context, positioning in a technology development zone encourages collaboration for innovation among firms. (V´asquez-Urriago et al., 2016).

2. Contributions of Technoparks To Industry, University and Regional Economy

The transition to an innovative economy is impossible without the integration of science, education, and business. The practices of developed countries show that one of the effective forms of such integration is technology parks, where all the innovation stages from the creation of an idea to its commercialization can be carried out in a single region. The basic structure of the technoparks, which ensures the implementation of the innovation process includes universities, research institutions, and industrial organizations. Universities play a key role in the development of the knowledge-based economy and the formation of intellectual capital. They perform all stages of the knowledge management process (creation – storage – distribution – usage). Basic and applied research and development studies are carried out in scientific and research institutions. The third key structural component is the commercial establishments, consisting of large, medium, small, innovative and high-tech companies and start-ups. Commercial enterprises engage in production activities and contribute to the commercialization of the outcomes obtained as a result of research and development activities carried out by universities and research institutions. Transforming the technopark into an "innovation ecosystem" where the entire innovation process will be carried out effectively, will be possible through public-private partnerships, commercialization of research findings, contractual research and development, consultancy services provided by the university scientific community, additional vocational training programs, university spin offs and initiatives, the interaction and knowledge transfer through technology transfer offices and incubation centers (Smirnova et al., 2019).

Technology Development Zones contribute significantly to regional and national development by positively affecting employment, entrepreneurship, innovation and institutional performance (Gonzalez-Masip et al., 2019). The first expected result of the close relationship between universities and companies is that a technology development zone and "its tenants will have access to university resources such as knowledge, talent and equipment", which are supposed to stimulate the growth of the tenant firms and the development of the local economy. Other advantages of positioning in a technology development zone are access to quality infrastructure and enjoying low costs associated with facility management. Technology development zones provide tenant companies with infrastructure facilities such as buildings, high-speed internet connection, administrative support, and the reputation of the technology development zone. Thus, it reduces the risks and problems faced by companies during the establishment phase. It offers linkages to "other businesses, academia or government agencies, and access to research facilities and academics" (Steruska et al. 2019). Technoparks, with various supports and exemptions guaranteed by law, improve companies' R&D capacities by facilitating companies' access to R&D financing; increases their potential to attract qualified workforce (Turkish Republic State Supervisory Board, 2009).

New ventures come with enormous risks and responsibilities. Entrepreneurs face challenges such as lack of resources, lack of capacity, situational conditions, and risk taking. To be successful in a new venture, entrepreneurs must have all the elements, including human capital and skills, culture and values, leadership and organization, processes and tools that operate in a coordinated manner (Xie et al, 2018). Among all options, technology development zones provide a mechanism through incubators to integrate innovative resources, including human resources, knowledge, and many other factors. The incubation center, serving small and medium-sized companies, is a social organization established to promote promising research to entrepreneurs and support them in their entrepreneurial efforts. It provides start-ups with the necessary resources and management expertise. Thus, it is ensured that a start-up turns into a successful enterprise, operates independently, and assumes financial responsibility. Innovation is the foundation of entrepreneurship and a prerequisite for maintaining the creativity and competitiveness of a technology development zone. Market demand and profit are key drivers of innovation for both businesses and universities. As innovation activities accelerate, firms tend to invest more resources in developing innovation to generate better profits; this leads to a higher level of regional economic development. Innovation and technological entrepreneurship further stimulate market demand. Depending on market demand, universities and scientific research institutions can also increase research funding and staffing for higher innovation activities. Also, with technological innovations, new products and new production processes emerge that can reshape an existing industry. On the other hand, an external incentive mechanism is created for the government to complement innovation and entrepreneurship with additional financing and policy support (McAdam & McAdam, 2008; Rios-Ramirez, 2019).

Universities benefit from technology development zones since they facilitate the commercialization of university research. This increases publication and patent outputs by helping universities attract various financial funds and leading academics (McCarthy et al., 2018). In addition, technology development zones provide the opportunity to carry out joint projects and thesis studies by bringing together the academicians and students with the industry. They offer students internship and job opportunities related to their fields; provide the necessary infrastructure and financial support, and prepare the appropriate environment for academicians and students to establish their own enterprises. It creates an environment where academicians can commercialize their ideas and projects (Turkish Republic Presidency State Supervisory Board, 2009).

Finally, technology development zones are regarded a solution to "overcome national and regional problems, reduce unemployment, improve competitiveness and quality of life of enterprises", as well as they are accepted as a factor that "encourages the restructuring of the regions in which they operate" (Khanmirzaee et al., 2018).

3. Technoparks in Türkiye

3.1. The Characteristics of Technoparks in Türkiye

The idea of establishing technology development zones (in practice, technoparks) in Türkiye first emerged in the 1980s. In the 1990s, Technology Centers (TEKMER), the first establishment phase of today's technoparks, were established in cooperation with the Small and Medium Enterprises Development Organization of Türkiye (KOSGEB) and universities. With the increasing importance given to science and technology development in the 2000s, the attempts to establish the first technopark of Türkiye were initiated at the Middle East Technical University. The legal regulation regarding technoparks was made with the Law No. 4691 on Technology Development Zones, which enacted in 2001 (Turkish Republic State Supervisory Board, 2009).

In the Law No. 4691 on Technology Development Zones dated June 16, 2001, Technology Development Zone is defined as "the site where firms with high/advanced technology, or new technology oriented firms, by making use of the facilities of a certain university or high technology institute or R&D center, produce/develop a technology or software; operate to transform a technological invention into a commercial product, method or service and, thus, contribute to the development of the region; the academic, economic, and social structure is integrated in or near the same university, high technology institute or R&D center or a technopark with these features"

According to the data of the Ministry of Industry and Technology, the number of technology development zones in Türkiye reached 92 as of February 2022. Although the number of actively operating regions is 76; 16 regions are under construction. The total number of companies operating in Technology Development Zones in Türkiye is 7,580. 289 of them are foreign companies or companies with foreign partners. The number of incubation companies is 1,899 whereas 1,592 companies are with academician partners. A total of 78,028 personnel are employed in these companies. The total number of national/international patent registrations in these companies is 1,414 and there are a total of 3,076 patent applications in progress. A total of 44,476 projects have been completed within the scope of technology development zones activities. The number of ongoing projects is 12,385. The total sales amount of companies is 149 billion TL while the total export amount is 6.9 billion dollars. Finally, when looking at the distribution of companies by sectors, it is seen that companies carrying out computer programming activities have the highest share among all companies with a rate of 47.17%. Data on the companies operating in the technology development zones in Türkiye are displayed in Tables 1, 2, 3, 4, and 5.

Table 1. *Technology Development Zones operating in Türkiye*

No	Name of the Technology Development Zone	University	Province	Establish-ment Year
1	ODTÜ Technocity Technology Development Zone	Middle East Technical University	Ankara	2001
2	Technopark of TÜBİTAK Marmara Research Center	TUBİTAK-TTGV	Kocaeli	2001
3	Ankara Technology Development Zone	Bilkent University	Ankara	2002
4	İzmir Technology Development Zone	İzmir Institute of Technology	İzmir	2002
5	GOSB Technocity Technology Development Zone	Sabancı University	Kocaeli	2002
6	Hacettepe University Technology Development Zone	Hacettepe University	Ankara	2003
7	İTÜ Arı Technocity Technology Development Zone	İstanbul Technical University	İstanbul	2003
8	Eskişehir Technology Development Zone	Anadolu University	Eskişehir-Bilecik	2003
9	Selçuk University Technology Development Zone	Selçuk University	Konya	2003
10	Kocaeli University Technology Development Zone	Kocaeli University	Kocaeli	2003
11	Yıldız Technical University Technology Development Zone	Yıldız Technical University	İstanbul	2003
12	İstanbul University Technology Development Zone	İstanbul University	İstanbul	2003
13	Batı Akdeniz Technocity Technology Development Zone	Akdeniz University	Antalya	2004
14	Erciyes University Technology Development Zone	Erciyes University	Kayseri	2004
15	Trabzon Technology Development Zone	Karadeniz Technical University	Trabzon	2004
16	Çukurova Technology Development Zone	Çukurova University	Adana	2004
17	Mersin Technology Development Zone	Mersin University	Mersin	2005
18	Göller Bölgesi Technology Development Zone	Süleyman Demirel University	Isparta	2005
19	Ulutek Technology Development Zone	Uludağ University	Bursa	2005
20	Erzurum Ata Teknokent Technology Development Zone	Atatürk University	Erzurum	2005
21	Gaziantep University Technology Development Zone	Gaziantep University	Gaziantep	2006
22	Ankara University Technology Development Zone	Ankara University	Ankara	2006
23	Gazi Technopark Technology Development Zone	Gazi University	Ankara	2007
24	Fırat Technology Development Zone	Fırat University	Elaziğ	2007
25	Pamukkale University Technology Development Zone	Pamukkale University	Denizli	2007
26	Cumhuriyet Technology Development Zone	Cumhuriyet University	Sivas	2007
27	Dicle University Technology Development Zone	Dicle University	Diyarbakir	2007
28	Trakya University Technology Development Zone	Trakya University	Edirne	2008
29	Sakarya University Technology Development Zone	Sakarya University	Sakarya	2008
30	Tokat Technology Development Zone	Gaziosmanpaşa University	Tokat	2008
31	Boğaziçi University Technology Development Zone	Boğaziçi University	İstanbul	2009
32	Bolu Technology Development Zone	Abant İzzet Baysal University	Bolu	2009
33	Malatya Technology Development Zone	İnönü University	Malatya	2009
34	Kütahya Dumlupınar Technology Development Zone	Dumlupınar University	Kütahya	2009
35	İstanbul Technology Development Zone	İstanbul Ticaret University	İstanbul	2009
36	Samsun Technology Development Zone	Ondokuz Mayıs University	Samsun	2009

37	Düzce Technopark Technology Development Zone	Düzce University	Düzce	2010
38	Harran University Technology Development Zone	Harran University	Urfa	2010
39	Kahramanmaraş Technology Development Zone	Sütçü İmam University	K.Maraş	2011
40	Namık Kemal University Technology Development Zone	Namık Kemal University	Tekirdağ	2011
41	Çanakkale Technology Development Zone	Onsekiz Mart University	Çanakkale	2011
42	Izmir Science and Technology Park Technology Development Zone	İzmir Ekonomi University	İzmir	2012
43	Yüzüncü Yıl University Technology Development Zone	Yüzüncü Yıl University	Van	2012
44	Çorum Technology Development Zone	Hitit University	Çorum	2012
45	Dokuz Eylül Technology Development Zone	Dokuz Eylül University	İzmir	2013
46	Bozok Technology Development Zone	Bozok University	Yozgat	2013
47	Kırıkkale University Technology Development Zone	Kırıkkale University	Kirikkale	2013
48	Marmara University Technology Development Zone	Marmara University	İstanbul	2014
49	Ege Teknopark Technology Development Zone	Ege University	İzmir	2014
50	Konya Technology Development Zone	Selçuk- Necmettin Erbakan-Aksaray-Karamanoğlu Mehmet Bey -KTO Karatay Universities	Konya	2015
51	Afyon-Uşak Zafer Technology Development Zone	Afyon Kocatepe - Uşak Universities	Afyonkarah isar-Uşak	2015
52	Niğde University Technology Development Zone	Niğde University	Niğde	2013
53	Celal Bayar University Technology Development Zone	Celal Bayar University	Manisa	2012
54	Ankara TechnoparkTechnology Development Zone	Yıldırım Beyazıt University	Ankara	2014
55	Muallimköy Technology Development Zone	Gebze Technical University	Kocaeli	2011
56	Adnan Menderes Technology Development Zone	Adnan Menderes University	Aydin	2016
57	Kapadokya Technology Development Zone	Nevşehir Hacı Bektaş Veli University	Nevşehir	2018
58	Mehmet Akif Ersoy University MAKÜ-BAKA Technology Development Zone	Mehmet Akif Ersoy University	Burdur	2013
59	Zonguldak Technology Development Zone	Bülent Ecevit University	Zonguldak	2017
60	OSTİM Ekopark Technology Development Zone	Ankara - Hacettepe - Atılım - Çankaya – Başkent-TOBB Exonomics and Technology Universities	Ankara	2014
61	Gaziantep OSB Technology Development Zone	Hasan Kalyoncu University	Gaziantep	2017
62	Hatay Technology Development Zone	Mustafa Kemal University	Hatay	2014
63	Gebze Technical University Technology Development Zone	Gebze Technical University	Kocaeli	2018
64	Sağlık Bilimleri University Technology Development Zone	Sağlık Bilimleri University	İstanbul	2018
65	Dudullu OSB Boğaziçi University Technology Development Zone	Boğaziçi University	İstanbul	2018
66	Balıkesir University Technology Development Zone	Balıkesir University	Balıkesir	2014
67	ASO Technopark Technology Development Zone	TOBB Economics and Technology University	Ankara	2008
68	Karaman Technology Development Zone	Karamanoğlu Mehmet Bey University	Karaman	2015
69	Muğla Technology Development Zone	Sıtkı Koçman University	Muğla	2015
70	Kastamonu Technology Development Zone	Kastamonu University	Kastamonu	2018

71	Karabük University Technology Development Zone	Karabük University	Karabük	2017
72	İstanbul Medeniyet University Technology Development Zone	Medeniyet University	İstanbul	2018
73	Recep Tayyip Erdoğan University and Türk-Alman University Technology Development Zone	Recep Tayyip Erdoğan - Türk-Alman Universities	Rize-İstanbul	2019
74	Osmaniye Technology Development Zone	Osmaniye Korkut Ata University - Adana Science and Technology University	Osmaniye	2017
75	İskenderun Technical University Technology Development Zone	İskenderun Technical University	Hatay	2019
76	İstanbul Sebahattin Zaim İZÜ Technology Development Zone	İstanbul Sebahattin Zaim University	İstanbul	2018

Source: Turkish Republic Ministry of Industry and Technology (February 2022)

Table 2. *Technology Development Zones under Construction*

No	**Name of the Technology Development Zone**	**University**	**Province**	**Establish-ment Year**
1	Batman University Technology Development Zone	Batman University	Batman	2017
2	Antalya OSB Technology Development Zone	Akdeniz University, Antalya Science University	Antalya	2018
3	Mersin Technology Development Zone	Mersin University	Mersin	2018
4	Çankırı Technology Development Zone	Çankırı Karatekin University	Çankırı	2018
5	Kırklareli University Technology Development Zone	Kırklareli University	Kırklareli	2018
6	Teknohab Technology Development Zone	Gazi University	Ankara	2018
7	Giresun Technology Development Zone	Giresun University	Giresun	2019
8	ASBÜ Social Innovation and Entrepreneurship Technology Development Zone	Ankara Social Sciences University	Ankara	2019
9	Abdullah Gül University Technology Development Zone	Abdullah Gül University	Kayseri	2020
10	Yalova University Technology Development Zone	Yalova University	Yalova	2020
11	Bursa Technical University Technology Development Zone	Bursa Technical University	Bursa	2020
12	Esenler Technology Development Zone	YTU, İbn Haldun University, İstanbul University	İstanbul	2021
13	Aksaray University Technology Development Zone	Aksaray University	Aksaray	2021
14	TEKNOGÜ Technology Development Zone	Eskişehir Osmangazi University	Eskişehir	2021
15	Adıyaman University Technology Development Zone ADYÜ teknocity	Adıyaman University	Adıyaman	2021
16	Biruni University Technology Development Zone	Biruni University	İstanbul	2021

Source: Turkish Republic Ministry of Industry and Technology (February 2022)

Table 3. *The Firm, Personnel, Project, and Total Sales and Export Numbers of Technology Development Zones operating in Türkiye*

The number of Firms	7.580
The number of foreign firms/firms with foreign partners	289
The number of incubator Firms	1.899
The number of firms with academic partners	1.592
Total personnel number	78.028
-R&D	64.463
-Design	1.099
-Support	5.253
-Other	7.215
The number of projects (continued)	12.385
The number of projects (completed)	44.476
Total sales (TL)	149 Milyar TL
Total export (USD)	6,9 Milyar $

Source: Turkish Republic Ministry of Industry and Technology (February 2022)

Table 4. *Data on Intellectual and Industrial Property Rights of Firms Operating in Technology Development Zones in Türkiye*

Intellectual and Industrial Property	**SAYI**
Patent Registration Number (National/International)	1.414
Patent Application Number (continued)	3.076
Number of Utility Model Registrations	428
Number of Utility Model Applications (continued)	265
Industrial Design Registration Number	255
Industrial Design Application Number (continued)	132
Software Copyright (obtained)	665

Source: Turkish Republic Ministry of Industry and Technology (February 2022)

Table 5. *Sectoral Distribution of Firms Operating in Technology Development Zones in Türkiye*

Nace Name	**Percentage**
Computer programming activities (system, database, network, web page, etc. software and coding of customer-specific software, etc.)	47.7
Other research and experimental development activities in natural sciences and engineering (including agricultural research)	6.39
Biotechnology-related research and experimental development activities	3.52
Computer consultancy activities (providing expert opinion on hardware related informatics such as hardware requirements, determining computer requirements, planning and designing computer systems, etc.)	3.09
Engineering and consultancy activities for industry and manufacturing projects (rolling mills, farms, transportation vehicles, industrial machinery, etc.)	1.35
Other information technology and computer service activities (installation of personal computers, software installation, etc.)	1.27
Manufacture of embedded electronic boards (loaded printed circuit boards, audio, video, controller, network and modem cards and smart cards etc.)	1.21
Engineering consultancy services (except in relation with a project)	1.19
Manufacture of other special purpose machinery not classified elsewhere	1.08
Cultivation of legumes (beans (fresh and dried), broad beans, chickpeas, lentils, lupines, peas, areca etc.)	1.08
Engineering and consultancy activities for energy projects (services for power plants and energy transmission and distribution lines for those using energy fuels such as coal, oil and gas, nuclear, water, solar, wind and other energies)	1.03
Wholesale trade of computers, computer peripherals and software (including computer equipment, pos devices, ATM devices, etc.)	1
Manufacture of diodes, transistors, diacs, triacs, thyristors, resistors, leds, crystals, relays, micro switches, fixed or adjustable resistors and capacitors and electronic integrated circuits	0.93
Manufacture of devices related to irradiation, electromedical and electrotherapy (electro-cardiograph device, hearing aid, radiology device, X-ray devices, X, Alpha, Beta, Gamma, devices based on the use of ultraviolet and infrared rays, etc.).	0.8
Business and other administrative consultancy activities (an organization's strategic, financial, marketing, production, business processes, project, etc. management services and consultancy on trademark and franchise issues)	0.67
Manufacture of aircraft parts (airframe, wings, doors, control surfaces, main assembly parts such as landing gear, propellers, helicopter rotors, engines, turbo jets, turbo propeller engines, etc. and their parts)	0.55
Other	27.67

Source: Turkish Republic Ministry of Industry and Technology (February 2022)

3.2. Incentives and Supports for Technopark Activities

3.2.1. Incentives and Supports Provided by the Law No. 4691 on Technology Development Zones

Support and exemptions for technopark entrepreneurs (management companies) and R&D personnel employed in technopark initiatives in accordance with the Law No. 4691 on Technology Development Zones are as follows:

1. Managing companies are exempt from fee tax arising from transactions and stamp duty in terms of papers issued with the implementation of the Law No. 4691 on Technology Development Zones. They are also exempt from the real estate tax arising from real estates owned within the borders of the region in which they operate.

2. Waste water fee is not collected from technology development zones operating wastewater treatment plants by the relevant municipalities.

3. Management companies operating in a certain technology development zone are exempt from income and corporate tax until December 31, 2028 for the earnings they derive from their R&D and software activities in the relevant region.

4. Expenses related to infrastructure, buildings, machinery, equipment, and software, and R&D and innovation activities and design activities carried out by management companies in relevant regions may be covered partially. It is limited to the allowance devoted to the Ministry's budget for aid purposes.

5. Provided that permission is obtained from the Ministry, the managing companies can make the necessary investment in the relevant region for the production of the technological product obtained as a result of the R&D or design projects they have initiated and concluded in the region.

6. For the Technology Development Zone companies that employ R&D personnel with at least a bachelor's degree in the program areas to be supported, monthly gross amount of the minimum wage applied for that year is deducted for the monthly gross amount of the wage paid to each of the personnel provided that the portion of the relevant personnel does not exceed the ten percent of the total number of personnel employed in the relevant month. The difference is covered from the allowance devoted the budget of the Ministry of Industry and Technology for a period of two years.

7. In enterprises located in R&D/design centers and Technology Development Zones, provided that it does not exceed 20 percent of the total working time subject to the income tax withholding incentive, times spent by the relevant personnel outside the region are also considered within the scope of the income tax withholding incentive.

8. Within the framework of the conditions determined by the regulation of the Ministry, firms operating in the regions may be supported for the R&D personnel, interns, and doctoral students they employ. This support is limited to the allowance devoted to the Ministry's budget for aid purposes.

9. Income tax calculated after the minimum living allowance is applied over the wages of the R&D personnel and the support personnel up to a maximum of 10 percent of the total number of R&D personnel working in the region will be canceled by being deducted from the tax accrued on the withholding tax return to be submitted until December 31, 2028. Papers issued within this scope are exempt from stamp tax.

3.2.2. Supports Provided by the Program for Supporting Entrepreneurial Capital

In line with Article 2 of Establishment Law No. 278 of the Scientific and Research Council of Türkiye, the objective of the Venture Capital Support Program (Tech-Investr) is to "support legal entities and funds operating for the commercialization of inventions with early development potential" and thus, it aims to create a sustainable venture capital ecosystem. In this context, the capital needed by technology-based companies at their early stages for their activities on incorporation and entrepreneurship, ownership of intellectual property rights and licensing, awareness, promotion, university-industry cooperation are met through venture capital funds. The Ministry of Treasury and Finance, Technology Transfer Offices, Technology Development Zones, qualified Research Infrastructures and other private investors participate in venture capital funds managed by independent fund managers as limited partners (Turkish Republic Ministry of Industry and Technology, 2018).

3.3. The Importance of Technoparks for the National Technology Initiative

With its vision of "seeking the global common interest rather than the interests of only a few global companies and countries", the National Technology Initiative includes policies that will increase Türkiye's global competitiveness, ensure economic and technological independence, and provide advancement in critical technologies. International competition and independence are possible with a young and strong human capital. The goal of "Technology Developing, Technology Producing Türkiye" is achieved by taking steps to reveal the potential of human capital (Turkish Republic Ministry of Industry and Technology, 2019).

The National Technology Initiative has 6 main priorities (Turkish Republic Ministry of Industry and Technology, 2019):

1. *"Inclusive, holistic, and "stakeholder-oriented" approach":* expanding cooperation between industry, entrepreneur, science, R&D, and public institutions
2. *"Data-driven, impact-oriented, and accountable goals":* knowledge-based management approach, disseminating the use of knowledge generated by data-based analysis
3. *"Policies that closely follow the world and direct the pioneering breakthroughs":* creation of holistic industrial and technology policies; close monitoring of global and regional changes
4. *"Agile, change-oriented, and adaptable policies":* adapting long-term planning to changes
5. *"Policies Prioritizing the Development of Human Capital":* to turn the workforce from all segments of society into researchers; develop leadership skills
6. *"Independence and Global Competitiveness":* increased productivity in high-tech fields and increased global competitiveness

Technoparks, which develop university, industry and government cooperation with a triple helix approach, significantly support the science and technology policies carried out within the framework of the National Technology Initiative. Technoparks encourage academicians to benefit from national and international funds from technology transfer offices; they enable the transformation of knowledge obtained as a result of academic studies into the commercial value that the industry needs through protection with intellectual and industrial property rights. With the incubation services they provide to companies, it contributes to both universities and the national economy by transforming design and R&D activities into production activities. Thus, technoparks assist the goal of increasing the technology and innovation-based production capabilities of the National Technology Initiative.

4. Discussion

The development of knowledge-based economies has profoundly affected the global economic environment and activities. Knowledge has become the primary source of development and international competitiveness. The common goal of knowledge-based economic development efforts is to create an "innovative region" (Etzkowitz & Klofsten 2005).

Science parks, whose first examples were encountered in the world in the 1950s, emerged in Türkiye in the 2000s as Technology Development Zones, or commonly technoparks. The activities of technoparks, which were legally grounded by the Law No. 4691 on Technology Development Zones enacted in 2001, have made significant contributions to Türkiye's science and technology policies. Based on this legislation, incentive mechanisms have been created for technology-based companies and innovative entrepreneurs by providing various supports and exemptions (particularly tax exemptions and infrastructure supports) to the management companies operating in technoparks.

As of February 2022, the number of technoparks in Türkiye has reached to 92. Among these, the construction process of 16 technoparks continue. Hosting more than 7,500 companies, most of which are software companies, technoparks make very important contributions to Türkiye's R&D and design activities. Technoparks, where more than 78,000 R&D, design, support, and other personnel are employed, are an important source of employment for Türkiye and it is inevitable that their role in this field will increase with the establishment of new technoparks over the years.

Technoparks have important contributions to industry, academia, regional and national economy. Technoparks contribute to the solution of national and regional problems by increasing employment and reversing migration. It provides the revitalization of declining industrial areas and facilitates the commercialization of university research. It increases companies' R&D capacities and workforce quality and creates an effective entrepreneurial ecosystem. It provides the newly established technology companies with the resources and management consultancy they need to become successful ventures. They pave the way for the creation of new markets and customer demands and the emergence of new products and production processes by accelerating innovation activities. Therefore, they increase the level of regional and national welfare by stimulating the industry in the regions where they operate. Technoparks, which strengthen the links between university, industry and the public with their triple helix approach, contribute significantly to the execution of science and technology policies followed within the framework of the National Technology Initiative with the infrastructure and financing opportunities they offer to firms.

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