

# The Role of Technology Transfer Offices in Türkiye's Development Policies

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**Abstract:** The development policies and industrialization processes in our country have undergone changes with the increasing technological advancements. Technology management is a concept that focuses on the development of technological capabilities, particularly in conjunction with the development of new products. In this context, the traditional structure of technology management has been centered around research and development (R&D) activities. However, thanks to industrialization and new development policies, it has become evident that technology management can deviate from its traditional structure and contribute to product development, providing a sustainable competitive advantage. For this purpose, the utilization of new technological advancements is necessary. Universities play a crucial role in the development, delivery, and transfer of technologies. Therefore, Technology Transfer Offices, Technology Development Centers (TEKMERS), and Technology Development Centers are of critical importance. Collaboration with the public sector is essential in conducting R&D activities, formulating development policies, and utilizing innovative technologies. The primary objective of this study is to evaluate the roles, practices, and principles of Technology Transfer Offices and Technology Development Centers within the framework of industrialization and development policies established in our country. In achieving the outcomes of R&D activities, universities, Technology Transfer Offices (TTOs), and Technology Development Centers (TDCs) have emerged as prominent entities. Emphasis has been placed on the significance of creating a Technology Roadmap to facilitate the progress of industrialization and highlight the importance of transferring new technologies. Within this context, a literature review and document analysis have been conducted.

**Keywords:** Technology Management, Development Policies, Technology Transfer Office, Technology Development Zones

## 1. Introduction

Technology management has been present in the literature for a long time. Nowadays, the increase in new technologies both in our country and globally, the prominence of

innovative elements, and the growth of R&D activities have added the concept of strategy to technology management. Developments in technology have led to significant changes in both organizational processes and the formulation of development programs. In this field, technology management demonstrates how technological capabilities will develop or be utilized for a company, a corporation, or even states to achieve their strategic and development goals. Managers should facilitate the use of new technologies, determine needs and strategies, and ensure the conditions for international competitiveness.

The initiation of the industrialization process and the formulation of development policies in our country can be considered as the fundamental cornerstone for both economic and technological growth. Information technologies play a crucial role in increasing productivity both in the private sector and within the government. In the context of development policies, technology management is important. In industrialization processes, technology management is one of the forces enabling globalization and playing an effective role in international markets. Developing countries lack the workforce capable of designing, sustaining, and structuring industrial knowledge that gives rise to new technologies.

The impact of Technology Transfer Offices and Technology Development Centers on industrialization processes has become valuable. This is because issues, trends, and strategies of technology management in developed or developing countries have been attempted to be addressed within the framework of TTOs (Technology Transfer Offices) and TDCs (Technology Development Centers). Universities play an effective role in the technology transfer process. TTOs should have main responsibilities such as guiding the formulation of development policies, assisting in accessing effective services for public institutions, and integrating the technology transfer process for the public sector. The continuous change and progress of technology demonstrate that technology management and industrialization processes will be rationalized through well-formulated development policies.

TTOs and TDCs act as significant bridges, facilitating the transfer of know-how to industrialists and investors conducting R&D activities, accelerating innovation processes between the public and universities. Simultaneously, the provision of project guidance services by technology transfer offices directs public plans in innovation and R&D processes, supporting university-industry collaborations. The role of both technology transfer offices and technology development zones is crucial for the success of the technology management process. Establishing a close relationship with

the industry, transferring technology, and conveying university competencies to stakeholders are emphasized. Diversification of incentive mechanisms is essential for providing value-added services and determining effective technology policies for sustaining university-public collaboration.

Informing industry and universities about standards set for enhancing our country's competitiveness, development plans, and long-term strategies through technology transfer offices and technology development zones is crucial. Creating supportive platforms and alternative incentives through support mechanisms should be encouraged, with the government taking a prominent role in these platforms. The state should assume responsibility for formulating long-term goals in technology management, conveying resource and infrastructure strategies to the public, and producing solutions for increasing collaboration potentials and alternative pathways.

## **2. Technology Management**

The concept of technology management can be defined as a discipline where businesses and companies utilize various existing technologies to encourage strategic growth (Ünsal, 2009). In another definition, technology management is described as a set of management disciplines that allows organizations to manage their technological foundations. It involves the planning, design, optimization, control, and evaluation of a technological product, process, or service. Additionally, it encompasses the management of the use of technology for the benefit of humans, including the assessment and prediction of user acceptance and adoption (Akolaş, 2009). Consequently, businesses should invest in new technologies and enhance their existing ones (Ünsal, 2009).

In another definition, technology management is described as a management approach that identifies the existing potentials of technologies and forms various aspects of utilizing this potential for the benefit of the company (Özel, 2018). Technology management is a relatively new field that is heavily dependent on the convergence of both business and technical elements (Alkan, 2014). Technology allows businesses to compete with competitors in almost every market (Pınar, 2014). As businesses grow, there is a need for data storage (Ulutaş, 2021).

If we were to examine the micro and macro approaches of the concept of technology management, the micro approach can be defined as the process of coordinating technology at the firm level to increase the firm's cost-effectiveness, continuity, and

profitability (Akolaş, 2009). In the macro approach, technology management is a concept used to plan both the social and economic development programs of a country appropriately (Değerli & Tolon, 2016). With technology, these processes can become more automatic and faster, leading to increased efficiency and reduced costs (Metem & Özdemir, 2018). Additionally, technology management ensures the storage and security of data.

There is no single way for the technology management process (Türk, 2008). Companies are compelled to integrate into this process due to both internal and external factors. Companies should determine strategies according to their goals, markets, and needs (Yılmaz, 2021). Technology has a significant impact on markets (Zerenler, Türker & Şahin, 2007). To compete in international markets, businesses need to continue the technology management process (Yılmaz, 2021). One of the best examples of how technology has significantly changed human life is the emergence of mobile devices (Kabataş & Akgün, 2019). Companies wishing to stay competitive must develop with advanced technologies and implement the most suitable mobile solutions (Pinar, 2014). Cloud systems play a crucial role in increasing the efficiency of businesses (Çengel & Binark, 2019). They give companies the ability to outsource many of their operations to off-site, third-party resources via the internet (Gemici & Öztürk, 2020). It is evident that technology management requires responsibility, and companies achieve efficiency in terms of cost by improving infrastructure services related to storage. Factors involved in the technology management process must be coordinated with each other (Türk, 2008). We can say that technologies initiate their activities with the need identification process and conclude with the implementation process. In the evaluation process, various elements come together to provide technology management, including analyses and the scanning of resources (Metem & Özdemir, 2018):

- Planning
- Organization
- Monitoring
- Evaluation
- Application and the strategic goals of companies

At the same time, there are main concepts used in technology management (Ünsal, 2009). These can be classified as technology strategy, technology forecasting, technology roadmap, and technology portfolio. Technology strategy is the process of determining the current state of technologies and defining the steps to reach the future technology level, and it is also the most important stage of technology

management (Zerenler, Türker & Şahin, 2007). Although technology management is an important business component on its own, the framework of technology management consists of four fundamental concepts (Gemici & Öztürk, 2020). New businesses should pay attention to these concepts to effectively implement technology management within their structures (Değerli & Tolon, 2016). These are, respectively, Technology Strategy, Prediction of Advanced Technologies, Technology Roadmap, and Creating a Technology Project Portfolio (Üzmez & Büyükbeşe, 2021). Discussing the benefits of technology management; it is listed as Marketing, Cloud Computing, Global Access, Security, and Mobile Management (Alkan, 2014). Looking at the tasks of technology managers, one of the key functions of a technology manager is to manage an organization's technology, take steps to ensure its reliable operation, and eliminate potential problems (Baykul, Oruç & Dulupçu, 2016). This may involve monitoring the maintenance of hardware and networks, overseeing IT security, and predicting future hardware and software needs (Akkoyun & Demirkaya, 2022). Technology managers are expected to keep a pulse on technological innovations that can somehow improve their organizations or operations (Gemici & Öztürk, 2020). However, this is more than just awareness: Technology management is also about convincing organizations that new technology is worth adopting and then implementing these technological innovations (Akolaş, 2009). Information technology management, among other things, may involve overseeing a budget that includes approving purchases, tracking expenditures, reviewing contracts, and requesting budget changes when necessary (Çengel & Binark, 2019). This task requires technology managers to lead new technology initiatives within an organization, create a timeline for achieving goals, and report progress to executives (Özel, 2018). When we examine different perspectives on Technology Management, we can define it as the integrated planning, design, optimization, operation, and control of technological products, processes, and services (Çengel & Binark, 2019). In a different definition, it would be the management of the use of technology for the benefit of humans (Özel, 2018). The role of the technology management function in an organization is to understand the value of specific technologies for the organization and ensure the organization's competitive advantage through the application / generation of the best innovative solutions at the right time (Alkan, 2014). Technology management is a set of management disciplines that enable organizations to manage their technological foundations to create a competitive advantage (Pinar, 2014). In summary, these definitions assume that technology is a resource, regardless of whether the company is a manufacturing or service company (Akolaş, 2009). Consequently, the technology foundation is at the heart of this framework (Metemir & Özdemir, 2018). This process is necessary for product and service development (Alkan, 2014). Not only that, but it also utilizes technological capabilities

developed by Technology Management. Sometimes government and corporate technology policies, including finance, regulations, constraints, guidance, collaboration, and R&D, are significant factors. Developing, managing, and implementing technology in organizations can influence the public sector, businesses, and academic institutions (Ünsal, 2009). Therefore, government and business policy towards technology management can be good sources for observing different public and private sector technology policies and their decision-making processes (Pınar, 2014).

To formulate the company's technology strategy and alignment, technological aspects are directly relevant to the company's overall competitive strategy (Değerli & Tolon, 2016). Technology transfer and procurement policies are important tools for obtaining various inputs necessary for information and production both within the company and between the company and external organizations (Pınar, 2014). This also includes intellectual property strategies adopted by the company. Operations and production management, which includes all activities from obtaining and distributing inputs to transforming them into the final product, are crucial. Quality management ensures the final product's specifications and features by evaluating and implementing the necessary methods and systems. Technology management focuses on the design, development, operation, and use of technological products (Ulutaş, 2021). It aims to offer various services to companies and organizations to increase market value and efficiency (Üzmez & Büyükbeşe, 2021). In particular, technology managers help organizations navigate the evolving technological world by identifying technological needs, developing creative solutions, and providing advanced technical support. The responsibilities of individuals in this position include establishing technological infrastructure, ensuring the effectiveness of hardware, software, network, and communication systems. In other words, technology managers advise on the use and application of technological innovations to improve and upgrade business processes. The technology management process has also played an absolute role in competitive processes in technological innovation; this is because the importance of communication and information technologies has increased significantly in all sectors (Üzmez & Büyükbeşe, 2021). Businesses have gained a competitive advantage with the technology management process. This management process is a structure that not only provides financial gain but also maintains continuity (Baykul, Oruç & Dulupçu, 2016). Recognition and competitive environment are expanding (Gemici & Öztürk, 2020). It is possible to establish structures summarizing the technology management process as efficiency and quality (Akkoyun & Demirkaya, 2022). Processing technology, which we call the technology used in the production of products and used in national

and international competitive markets, has become important for companies in terms of helping the development of brand image, reducing product costs, eliminating marketing processes from traditional structures, and developing business development techniques (Ünsal, 2009). Businesses and companies emphasize technology management to ensure continuity in quality and to conduct low-cost business (Kabataş & Akgün, 2019). Companies that implement the technology management process require technical knowledge to perform R&D activities, and the licensing process for technologies can be carried out through technology transfer (Türk, 2008).

### **3. Türkiye Industrialization Process and Development Policies**

We can say that the industrialization process in the Republic of Türkiye began with the 1923 Economic Congress. Turning points in Turkish industry occurred with the military interventions in 1960 and 1980, as well as the economic crisis in 2001 (Arslan, 2013). The industrial and development policies, which began with the import substitution process, evolved into a technological and competitive structure over the years (Boratav, 2015). Significant investments in the industrial sector started with the Industrial Encouragement Law enacted in 1927 (Bulut, 2003). The main purpose of this law was to promote domestic production and attract foreign investments. However, the economic crisis that started worldwide in 1929 affected Türkiye, leading to delayed investments (Boratav, 2015). In the 1930s, state intervention policies were implemented, leading to the establishment of facilities in line with basic consumption needs throughout the country (Ulutaş, 2021). In this period, the First Five-Year Industrial Plan was introduced in 1934 for the industrialization to be created by the state (Kabataş & Akgün, 2019). Foreign experts were brought in for this plan, and projects to revitalize the economy were attempted to be developed (Çağlar & Acar, 2013). The role of the state was crucial in leading the country's industry, with significant support from Sümerbank and İş Bankası within this plan (Öcal, 2015). In 1938, there were developments in the industrial and agricultural sectors, but the outbreak of World War II in 1939 damaged the Turkish economy (Uzunkaya, 2020). Although Türkiye did not participate in the war, it felt the effects considerably (Göcen, 2017). State investments were postponed, controlled production started, and the impact of state intervention in the economy was strongly felt (Bulut, 2003). In 1950, a liberal era began in Türkiye (Öcal, 2015). The revival of the economy was ensured with the effect of Marshall Aid (Kaynak, 2014). Agriculture-based industry faced problems in rural areas due to the war's impact, leading to a rapid migration towards industrial cities (Özçelik & Tuncer, 2007). Due to the inability to fully implement the liberal system in the country and the emergence of political problems, an instability process

began. In 1958, a mixed economic system was adopted, and a stability program was implemented (Doğan, 2013). In 1960, with the military intervention, the authority of civilian government was shaken, affecting the economic system (Göcen, 2017). Also, the State Planning Organization, established in 1960, made decisions for development policies; effective use of the country's resources, acceleration of development, and the formulation of long-term plans were emphasized (Bulut, 2003). Between 1963 and 1967, the First Five-Year Development Plan was implemented, aiming to increase investments in both agriculture and industry. With the establishment of TÜBİTAK in 1963, the plan aimed to address the knowledge gap in industrialization (First Five-Year Development Plan, 1963). In the following period, the Second Five-Year Development Plan, implemented between 1968 and 1972, aimed to increase investments in machinery, glass, and heavy industrial products, and support the production of agricultural products to support rural areas (Kaynak, 2014). The plan emphasized support for small industrialists, making the industry the driving sector, and establishing heavy industry facilities. Between 1973 and 1978, the Third Five-Year Development Plan, implemented, continued the objectives of the previous plan (Özçelik & Tuncer, 2007). The simultaneous development of agriculture and industry was targeted (Sarica, 2001). Increasing investments related to industry were highlighted, and it was decided that new technologies should be used in the production sector to compete in the international market (Arslan, 2013). When we look at the 4th Five-Year Development Plan, an advanced and competitive industrial structure will be established, relying on domestic resources (Boratav, 2015). Within the framework of this development plan, production of intermediate and capital goods will continue rapidly. Efforts to combat unemployment will begin, and measures will be taken to ensure a safer trend in population growth and decline (Fourth Five-Year Development Plan, 1979). During this plan period, the share of manufacturing industry production in total industrial production was 94.9% in 1972 and decreased to 94.0% in 1977, leading to an increase in the share of consumer goods in manufacturing industry production. As we move into the 1980s, the decisions of January 24, 1980, were made (Sarica, 2001). According to this program, a transition to a free-market economy will occur, foreign trade will be liberalized, and measures to reduce the state's share in the economy will be emphasized (Sarica, 2001).

As for the 5th Five-Year Development Plan, inflation will be controlled, and growth will be gradually pursued (Boratav, 2015). During this plan period, the sector where developments will predominantly occur is the manufacturing industry (Sarica, 2001). Priority is given to investments in the research and development (R&D) areas of important institutions such as Roketsan, Havelsan, and Aselsan. Improving the



technological level of existing industries and increasing capacity utilization will be a top priority. Encouraging economic-scale new industrial investments aimed at utilizing our economic and geographical advantages and increasing exports will be a focus (Pinar, 2014). The government will prioritize infrastructure and service investments for the widespread distribution of industry across the country. More emphasis will be given to the private sector in manufacturing industry, especially targeting rapid development of private sector investments in the food, textile, clothing, and forestry sectors (Boratav, 2015).

In the 6th Five-Year Development Plan, production will be carried out efficiently and rationally, and employment opportunities will be developed. Adequate resource increases will continue for the agricultural sector of the industrial industry (Sarica, 2001). Improving credit opportunities for small industrialists and craftsmen is among the important items. Manufacturing industry will be one of the elements achieving growth during this period, and the role of the private sector in the country's industrialization will be increased (Sarica, 2001). Competitiveness will be established within and internationally for industrial sectors. The most important development in this plan period will be industrialization becoming the fundamental element of development, encouraging the improvement of technology levels, increasing efficiency, and integrating small and medium-sized industries with large industries.

In the 7th Five-Year Development Plan, technological developments are followed to ensure industrial competitiveness, and markets are reorganized. After 1980, significant increases are achieved in GDP growth, manufacturing industry capacity utilization, export volume, the share of manufacturing industry in exports, and the ratio of foreign trade volume to GDP. Industrialization is accelerated to reduce inflation. Infrastructure efforts are emphasized for services to be provided in the industrial sector. Legal procedures for software-related services in the industrial sector will be fulfilled. Increasing the country's prosperity depends on shifting human resources from low value-added activities to high value-added activities requiring advanced technology. In this context, developing education, science, and technology infrastructure and giving new momentum to industrialization are important.

In the 8th Five-Year Development Plan, looking at industrialization and development policies, technology and R&D policies will be integral to the industrialization process (Uzunkaya, 2020). The ability of our industry to compete in international markets, manage national resources, follow technological developments, use modern production techniques, and achieve continuous progress using information will be

crucial. Within the plan framework, a map of the country's industry will be created, and local projects will be supported (Uzunkaya, 2020). Achieving the welfare levels of developed countries is contingent on increasing the capacity for science and technology (Yılmaz, 2021). To elevate the capacity for science and technology, it is important to increase resources allocated for R&D, train enough researchers, and support these activities in harmony with education, training, and industrial policies (Göcen, 2017).

In the 9th Five-Year Development Plan, a high value-added production structure will be established in the industrialization process, and both the banking sector and companies will be restructured to make the industry competitive. Encouragement will be given for foreign investors to enter the country (Ninth Development Plan, Official Gazette 2006). Within the framework of this development plan, new technologies will be introduced domestically to gain competence in the automotive sector. Research and development (R&D) activities will be supported (Öcal, 2015). During this period, the industrial sector has made the most significant contribution to growth. While the annual average growth rate of the agricultural sector was 1.1% in the 2001–2005 period, the industrial and services sectors grew by 5.1% and 4.3%, respectively. Under the Türkiye Research Area Program implemented by TÜBİTAK in 2005, programs such as "Academic and Applied R&D Support," "Public R&D Support," "Industrial R&D Support," "Defense and Space R&D Support," "Increasing Awareness of Science and Technology," and "Training and Developing Scientists" were initiated. The goal is to achieve efficient production in the industrial sector by effectively utilizing raw materials. Additionally, infrastructure investments will be increased during this period to enhance university–industry collaboration and accelerate R&D processes (Sarica, 2001).

In the 10th Five-Year Development Plan, the share of the industry in GDP was 19.3%, with a decrease in agriculture and an increase in the service sector. Evaluating the 11th Development Plan, the strengthening of the digitization process to collect data on industrial production and increase production has been targeted (Source, 2014). The entrepreneurial university model will be adopted, and R&D activities will continue intensively. Within the plan framework, the industry sector, based on exports, is adopted to increase efficiency and competitiveness (Uzunkaya, 2020). Special emphasis will be placed on stimulating private sector investments in allocating public investments for technological transformation in priority sectors determined for the plan period. The goal is to achieve value-added growth, ensuring a more efficient and competitive economic structure (Uzunkaya, 2020). It is aimed to continue international

investments through the industrial sector and increase the share of new investments (Eleventh Development Plan, 2013). The service and agricultural sectors will support the industrial sector, and a holistic and international approach will be adopted to achieve productivity gains (Göcen, 2017). A transition from an industrial society to an information society is observed today. There is a clear shortage of qualified, technical personnel in the industry. Therefore, education has become the engine of the development process. The National Technology Move and the 2023 vision of our country are also crucial for all these development plans. The reason is to enhance our country's technological competence, create national and original projects, reduce external dependency, become competitive in global markets, revive sustainable economy, and produce value-added technologies (Industry and Technology Strategy, 2019). In the 9th Five-Year Development Plan, a high value-added production structure will be established in the industrialization process, and both the banking sector and companies will be restructured to make the industry competitive. Encouragement will be given for foreign investors to enter the country (Ninth Development Plan, Official Gazette 2006). Within the framework of this development plan, new technologies will be introduced domestically to gain competence in the automotive sector. Research and development (R&D) activities will be supported (Öcal, 2015). During this period, the industrial sector has made the most significant contribution to growth. While the annual average growth rate of the agricultural sector was 1.1% in the 2001–2005 period, the industrial and services sectors grew by 5.1% and 4.3%, respectively. Under the Türkiye Research Area Program implemented by TÜBİTAK in 2005, programs such as "Academic and Applied R&D Support," "Public R&D Support," "Industrial R&D Support," "Defense and Space R&D Support," "Increasing Awareness of Science and Technology," and "Training and Developing Scientists" were initiated. The goal is to achieve efficient production in the industrial sector by effectively utilizing raw materials. Additionally, infrastructure investments will be increased during this period to enhance university–industry collaboration and accelerate R&D processes (Sarica, 2001).

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The 12th Development Plan will provide opportunities for increasing human resources capacity for R&D and will support researchers engaged in scientific and technological studies with special programs. One of the important aspects mentioned in the development plan is the increase in financial support for R&D projects, entrepreneurship projects, and innovation-focused projects. Coordination support will be provided within the scope of university-industry collaboration. Activities related to technology transfer offices (TTO) will involve analyzing TTO structures, and performance-based measures will be taken to develop human resources. Performance-based support will continue for Technology Development Zones. In line with this, the Industrial Innovation Network Mechanism program for high-tech R&D and Product Development activities, especially in priority sectors, will be expanded (Twelfth Development Plan, 2023).

#### **4. Technology Management and Technology Transfer Offices, Technology Development Zones**

Technology Development Zones (TDZs) began to be established with the Technology Development Zones Law numbered 4691 in 2001. As of November 2023, a total of 101 TDZs are actively operating, while in 2020, there were 85 TDZs. In 2020, there were 5,638 companies within the 85 TDZs, and by 2023, this number increased to 9,951 companies. The export figure also saw substantial growth, reaching 10 billion USD in 2023 from 4.6 billion USD in 2020. The number of patents granted in 2020 was 1,132, with 319 software copyrights recorded. In 2023, the patent application count increased

to 1,835, and the number of software copyrights granted rose to 1,169. The policies implemented during this period likely contributed to the observed increase in these numbers. Thanks to the support provided in the field of qualified human resources, the number of people employed in TDZs increased from 57,713 in 2020 to 105,323 in 2023.

**Table 1. Comparisons of Companies by Year**

Description	2020	2023
Total Number of Companies	5.638	9.951
Number of Foreign/Foreign Partnership Companies (Current)	318	457
Number of Companies with Academician Partners	1.187	2.695
Total Number of Personnel 57,713	57.713	1.946
– R&D	46.882	105.323
– Design	788	89.061
– Support	3.618	7.329
– Out of scope	6.425	7618
Number of Ongoing Projects	9.903	15.047
Number of Completed Projects	34.988	55.215
Total Sales (TL)	89,1 Milyar TL	353,2 Milyar TL
Total Exports (USD)	4,6 Milyar USD	10 Milyar USD

**Source:** Türkiye Katılım Bankaları Birliği, 2016: 26. / Participation Banks Association of Türkiye, 2016: 26.

Technology Transfer Offices are structures that carry out activities to commercialize scientific outputs quickly and efficiently. They support the dissemination of R&D activities in the technology management process, provide support for innovation and knowledge production processes, and assist in directing research (Arslan, 2013). They are among the significant mechanisms facilitating the transfer of scientific research outputs from universities to the industry (Ünsal, 2009). Strategies covering scientific outputs and the technology management process aim to foster collaboration between industry, public, and university, as well as supporting innovation and R&D processes. Collaboration between academics in universities and companies in technology development zones on Technology Management is crucial for enhancing innovation capabilities. The establishment of long-term strategies and the development of projects with stakeholders in the industry are essential for technology management. Technology management is important for encouraging technological innovations in our country and determining priority R&D topics (Doğan, 2003). The utilization of infrastructures, provision of financial support, and utilization of human resources in technology development zones are advantageous for setting strategic objectives. Tax advantages, grant programs, financial support, innovation and R&D processes, and

university–industry collaboration have numerous positive aspects. From this perspective, technology development zones, by creating an ecosystem in technology management, enable the interaction of companies, SMEs, researchers, and entrepreneurs, and also formulate strategic plans for commercialization. Technology management is not only about planning, implementing, and managing processes within the ecosystem (Göcen, 2017). It also involves setting strategic goals, participating in innovation processes, and incorporating elements of technology transfer. The goals to be integrated within the framework of development policies should be related to management and innovation (Kaynak, 2014). Monitoring and planning applications in risk and project management processes are crucial. Therefore, technology management is a key factor for the success of small, medium, and large-scale firms (Özel, 2018). When looked at, this management organization will provide both national and international competitive advantages for firms and help them achieve sustainable growth. Paying attention to the following elements is crucial for firms located in Technology Development Zones.

- Companies determining their strategic goals and new technology needs,
- Conducting innovation management and planning R&D activities,
- To identify new technologies suitable for the company structure and to conduct studies on key research topics,
- Developing projects in cooperation with universities,
- Determining the company's risk planning and setting targets according to all conditions,
- Creating qualified human resources within the company and planning trainings suitable for new technologies,
- To analyze well the monitoring and evaluation processes within its own in-house structure.

According to the Technology Development Zones Implementation Regulation, it states that it will carry out studies on the development plans and industrial potential of the selected location. Incubation programs carried out by the managing company to support R&D and innovation activities, Technology Transfer Office services and industry–university–industry collaborations are the leading elements of these regions in technology management. Technology management in Technology Development Zones consists of processes using methods such as developing a commercialization strategy, carrying out infrastructure studies, evaluating R&D and innovation processes, projecting innovation with spin-off organizations, license sales and patent transfers. It is prepared on sensitive and interactive activities on innovation, R&D and Entrepreneurship. Educational activities aimed at increasing the technological

infrastructure of the region come to the fore. Providing support for the establishment of innovation ecosystems in Technology Development Zones will be possible through collaborations on the public–university–industry axis. Technology Transfer Offices continue their commercialization activities as a result of contract–based R&D work by identifying the industrial enterprise's technology needs in specific areas and highlighting the technological infrastructure and management of this situation (Yılmaz, 2023). The R&D project process with the industry constitutes an interface function for contractual and confidential studies. The development of the technology management module in Technology Transfer Offices enables the coordination of all innovation activities.

Technology Management is a comprehensive process that involves planning, controlling, and coordinating the development of technological competencies to achieve the strategic goals of Technology Transfer Offices (TTO) and Technology Development Centers (TGB) (Akolaş, 2009). In our country, the most crucial factor for sustaining development goals in the field of technology is the correct utilization of resources. It ensures the creation of a competitive and robust structure by bringing together both management structure and scientific outputs through interdisciplinary approaches (Alkan, 2014). TTOs and TGBs are considered fundamental areas of technology management for tracking global technological developments and anticipating future project activities. The knowledge accumulated through these activities enables companies to transform technological innovation into new products and gain advantages internationally (Gemici & Öztürk, 2020). The creation of a technology roadmap, management of product portfolios, monitoring of activities and business plans, and the compilation of technology inventories are all management stages for both TTOs and TGBs. In the management of TTOs and TGBs, the Technology Roadmap should be developed as the main implementation plan that forms the basis of the activity plans of all strategic business units and supports the activity plans of all collaborative business units.

## 5. Conclusion

The impact of Technology Transfer Offices (TTOs) and Technology Development Zones (TGBs) on our country's development policies and industrialization processes, as well as their influence on the innovation value chain, will play a decisive role. The advancement of technology and the determination of innovation and R&D policies will have a significant effect on industrialization and development policies, directly contributing to our country's innovation processes.

Collaborations, consortia, and the management of intellectual and industrial property rights conducted by technology transfer offices in the industrial and public sectors will be crucial in determining development policies. In the present day, technology transfer offices play a bridging role in relationships with SMEs, industrial organizations, and public institutions, as well as in accessing funding sources. The competencies of technology transfer offices, which play a significant role in transferring academic knowledge to the industry, are highlighted in industrial policies.

Technology transfer offices strategically conduct their industry relationships through the context of R&D processes. The inclusion of collaborations with industry in public policies will enhance the role of technology transfer offices and universities. It is crucial to share the research laboratories of universities with the industrial sector and SMEs. The maturation of research projects and the increased impact on the development policies of target sectors will make the process functional and dynamic.

For the effective development of industrial policies within an ecosystem, the sharing of databases by the public sector, the establishment of patent sharing platforms, support for mentor networks, and the development of sponsorship structures will make the role of technology transfer offices and technology development centers decisive. Programs introduced by institutions like TÜBİTAK and KOSGEB have strengthened the connection between universities and industry, providing opportunities for collaboration.

The determination of legal statuses that increase transparency and efficiency in the activities of the public, industry, and public sectors will also affect development policies. Within the framework of regulations in Technology Development Zones, plans for development, especially those targeting entrepreneurs and investment partnerships, need to enhance their effectiveness. Publicly determined strategic goals should support multiple R&D and innovation collaborations, prioritizing projects in critical technology areas.

Organizations like TÜBİTAK and KOSGEB should support research centers in the public sector through university and industry collaborations and assist companies in the ecosystem in developing new technologies and products. Publicly created development plans should designate the state as the main provider of financial support for technology transfer offices, prioritizing information and technology transfer activities.



The activities developed through industry collaboration by Technology Development Zones and Technology Transfer Offices require the development of regulations and alternative solutions for business plans. Support models need to be developed for the section that spans from preliminary research on platforms developed for collaboration between Technology Transfer Offices and industry to the prototyping process. The research infrastructures of companies in Technology Development Zones and Technology Transfer Offices within universities need to establish support mechanisms to increase information and technology transfer and enhance the institutional capacities of interface structures.

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