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Study of the Technology Transfer Ecosystem of TÜRKİYE

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Comprehensive Study of the Technology Transfer Ecosystem

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List of Abbreviations

1004 Programme: TÜBİTAK High Technology Platforms Support Program
A.Ş: Joint Stock Company
and Technological Research Council of Türkiye
BU: Boğaziçi University
CGF: Credit Guarantee Fund
DA: Development Agency
DP: Development Plans
EU: European Union
IP: Intellectual Property
IPR: Intellectual Property Right
ITD: International Trade Documents
ITU: Istanbul Technical University
ITUNOVA: Istanbul Technical University Technology Transfer Office
KOSGEB: The Small and Medium Enterprises Development Organization
KTU TTC: Karadeniz Technical University Technology Transfer Application and Research Center
KTU: Karadeniz Technical University
MAM: Marmara Research Center
MEMS: Micro-Electro-Mechanical Systems
METU: Middle East Technical University
MSN: Materials Science and Nanotechnology Institute
OECD: Organisation for Economic Co-operation and Development
OIZ: Organized Industrial Zone
R&D: Research and Development
SME: Small and Medium Enterprise
SSI: Social Security Institution
SU: Sabancı University
SUATT: Sabancı University Research Development and Technology Transfer Office
SUNUM: Sabancı University Nanotechnology Research and Application Center
TDZ: Technology Development Zone
TEKMER: Technology Development Center
TOBB: The Union of Chambers and Commodity Exchanges of Türkiye
TRL: Technology Readiness Level
TRM: Technology Roadmap
TT: Technology Transfer
TTO: Technology Transfer Office
TÜBİTAK: The Scientific
TÜRKPATENT: Türkiye Patent and Trademark
UIC: University-Industry Collaboration
UNAM: Bilkent University National Nanotechnology Research Center
ÜSİMP: University-Industry Collaboration Centers Platform
VC: Venture Capital
YÖK: Council of Higher Education

1 Introduction

This report presents a comprehensive analysis of the technology transfer (TT) ecosystems in Greece, Bulgaria, Türkiye, and Romania, conducted by four leading institutions specializing in innovation and technology commercialization. These institutions include the Centre for Research and Technology Hellas (CERTH) in Greece, the Bulgarian Association for Transfer of Technology and Innovation (BATTI) in Bulgaria, Karadeniz Technical University Technology Transfer Application and Research Center (KTU TTC) in Türkiye, and the "Dunărea de Jos" University of Galați (UDJG) in Romania.

The study is part of the broader "Technology Transfer and Innovation Network for the Black Sea Basin" (T3N-BSB) project (https://t3nbsb.net/), which is funded under the Black Sea Basin Cross-Border Cooperation Program for the 2021-2027 period. T3N-BSB aims to develop sustainable transnational networks and platforms to facilitate the exchange of best practices and knowledge on leveraging innovative technological advancements. With a budget of €498,120.00, the project fosters stronger collaboration among academia, industry, and policymakers, ensuring technology transfer processes are more effective across borders. By enhancing institutional capacities and interconnectivity, T3N-BSB seeks to create a robust ecosystem that supports economic growth through innovation and research commercialization in the Black Sea region.

1.1 Importance of the Study

Technology transfer (TT) is of great importance in terms of commercialization of innovations and their transformation into economic value. However, inefficiencies encountered in TT processes, lack of standardization and difficulties in scaling innovations require an in-depth examination of studies in this field. This study aims to comprehensively address Türkiye's TT ecosystem, to develop stakeholders' competencies in this field and to contribute to the strengthening of the ecosystem. In addition, this study aims to contribute to Türkiye's efforts to increase its global competitiveness and to ensure that innovations and technological developments are integrated into the economy more effectively. In this context, evaluating not only the economic but also the social and cultural impacts of TT allows the ecosystem to be addressed from a broader perspective.

TT is a vital tool for the integration of innovation into the economy, and effective management of this process can directly affect the competitiveness of countries. The interaction and cooperation levels of the actors in Türkiye's TT ecosystem play a critical role in the success of this process. Therefore, the importance of this study lies in the in-depth examination of TT processes. The study has created the opportunity to compare the TT ecosystems of Türkiye and the countries where the project partners are located. Identifying the differences in these countries has contributed to the advancement and development of TT.

1.2 Existing Challenges

There are various challenges in the TT ecosystem. These challenges include inefficiencies in the commercialization of innovations, complexity of TT processes, and lack of cooperation between different stakeholders. In addition, lack of standardization complicates the effective implementation of TT and prevents widespread adoption of innovations. Overcoming these challenges is critical to increasing the effectiveness of the TT ecosystem and maximizing the contribution of innovations to the economy.

In addition, lack of coordination among stakeholders in the existing ecosystem, inadequate information sharing, and limited financial support for TT and its concentration in certain areas may hinder the development of innovative initiatives in other areas. In addition, cultural and structural barriers encountered in TT processes also reduce the effectiveness of this process.

1.3 Methodology

The methodology of this study includes a literature review, review of TT and Research and Development (R&D) reports published in Türkiye, and one-on-one interviews. The judgmental sampling method, also known as purposive sampling, was used in the interview process. This approach involves the researcher selecting a sample from a smaller subgroup of the population based on their knowledge, expertise, and relevance to the larger population (Bernard, 2000; Robson, 2002). It is assumed that the selected group is compatible with the purpose of the study and will help achieve its goals (Churchill, 1996). When the population is homogeneously distributed and the researcher knows the population well, the selected samples are likely to yield effective results (Arıkan, 1995). The fact that the research team consisted of TT experts significantly influenced the choice of this method. Since these experts are actively involved in the TT ecosystem, it was easy to select participants for one-on-one interviews. The individuals contacted showed great interest in the project activities and participated willingly. In addition, some of the industry experts and institutions interviewed had previously provided letters of support during the planning phase of the project, which had a positive impact on the discussions.

1.4 Coverage

The coverage of the study focuses on the TT processes among the parties in Türkiye's TT ecosystem (academia, industry, technology transfer office (TTO), government, etc.). All stakeholders in Türkiye's TT ecosystem are included in the scope of this study. It also covers TT activities that are geographically spread across Türkiye. However, the study is limited to a specific period, and this should

be taken into account if the results need to be extrapolated over a wider period of time.

The coverage of the study aims to comprehensively address the different stages of TT and the roles of the actors involved in these stages. In addition to collaborations between academic institutions, industrial organizations and public institutions, other interface structures that contribute to TT are also included in the scope of this study. In this context, in-depth analyses were conducted on the factors that affect TT processes and what can be done to make these processes more effective. The geographical scope of the study covers all regions of Türkiye.

1.5 Limitations

Among the limitations of this study, the difficulties experienced in reaching the desired depth of data, the restrictions encountered during the data collection process (the absence of a central/official data source on TT), affected the generalizability and depth of the study. Being aware of these limitations, it should be taken into account that the information obtained is evaluated within the scope of data obtained within a certain date range. The limitations of the study may not reflect the full multifaceted structure of TT processes.

1.6 Practical Implications

The results of this study provide important information for policy makers, TT managers, interfaces and other stakeholders to help them make informed decisions. By developing policy recommendations and strategic approaches to strengthen the TT ecosystem in particular, this study will contribute to stakeholders to increase their innovation capacity and create economic value.

The findings of the study provide recommendations for improving TT processes and help to manage these processes more effectively. For policy makers, it is of great importance to overcome the barriers to TT and make the necessary arrangements to make this process more efficient. In addition, for technology managers and other stakeholders, this study provides valuable information on creating awareness of the difficulties encountered in TT processes and how these processes can be made more effective. This study is expected to contribute to increasing the innovation capacities of all actors involved in TT processes. In this way, it is aimed to strengthen Türkiye's TT ecosystem and increase its competitiveness in the international arena.

2 Historical Context & Current State

TT in Türkiye has been shaped by strategies and dynamics that changed in different periods in parallel with the country's economic development goals. This process, which started as industrialization-oriented steps in the early years of the Republic, has evolved into a more comprehensive structure by placing R&D activities at its center with the impact of the transition to a knowledge economy. In this development process, collaborations between universities, research institutions and industry have been strengthened; various policies and structural arrangements have been implemented to transform scientific knowledge into economic value.

In this process, the legislation enacted to increase the country's global competitiveness, the public support provided, and the international cooperation opportunities have continuously nourished the TT ecosystem. With the inclusion of venture capitalis (VC)s and multinational companies in the ecosystem, TT has gained a wider scope and has prepared the ground for cooperation at both local and international levels. While TT in Türkiye is now taking shape as a system that supports innovative entrepreneurship, contributes to the industry, and adds value to the national economy; this transformation is considered a strategic necessity for the country to achieve its development goals.

2.1 Overview

2.1.1 Initial Efforts in Technology Transfer

Türkiye's historical development in TT began with efforts to develop the economy and industry since the beginning of the establishment of the Republic of Türkiye.

With the establishment of the Republic in 1923, Türkiye adopted the goal of transitioning to a new economic structure and began efforts to accelerate the industrialization process. These efforts were shaped in line with the industrialization policies and goals determined at the 1923 Izmir Economic Congress. In line with the decisions taken at the congress, important steps were taken such as developing industrial branches whose raw materials are found in Türkiye, encouraging private entrepreneurship, and establishing banks to support industrial investments.

In the 1930s, Türkiye began to follow an economic policy that supported industry through the state and strengthened its industrial infrastructure with state-supported institutions such as Sümerbank. TT practices were largely carried out through the public sector, and attempts were made to increase technological capacity by importing machines used in sectors such as textiles, mining and agriculture.

In 1949, the Ministry of Industry of the Republic of Türkiye was established, and the processes progressed in a much stronger way. The relevant ministry aims to develop and implement industrial policies, promote technological development and innovation, support R&D and innovation activities, ensure regional development, ensure the safety and supervision of industrial products, develop international cooperation, regulate investment incentives and increase the competitiveness of the IT sector. The name of the ministry, which has undergone various changes since its establishment, is currently the Ministry of Industry and Technology of the Republic of Türkiye.

In the 1950s, Türkiye followed a policy more open to international cooperation and established economic partnerships with developed countries. In addition, external resources were used for infrastructure investments such as energy and railways.

In the 1960s, more systematic steps were taken towards TT in Türkiye. During this period, the Scientific and Technological Research Council of Türkiye (TÜBİTAK) was established under the Ministry of Industry and Technology of the Republic of Türkiye, and it was aimed to increase R&D activities. The establishment of TÜBİTAK was an important step to increase Türkiye's scientific capacity in the field of TT and paved the way for scientific research that would meet the technological needs of the industry. At the same time, in the 1960s, Türkiye determined its industrial strategies within the framework of its development plans (DP) and made the TT process more systematic. Since then, almost all DP have directly and indirectly targeted the development of University-Industry Collaboration (UIC) in Türkiye, and various programs and structures have been established for this purpose and are still being established (SBB, 2019, 2023).

In the 1980s, Türkiye transitioned from an import-substitution industrialization model to an export-based growth model. During this period, Türkiye facilitated the entry of foreign capital into the country and accelerated the TT by making regulations that encouraged Foreign Direct Investment (FDI). Foreign capital investments increased especially in sectors such as automotive, electronics and chemicals, and thanks to these investments, new technologies were brought to Türkiye. In order to increase Türkiye's global competitiveness, the Free Zones Law No. 3218[1] was enacted in 1985, and thus the establishment of technology-intensive production facilities was supported.

In the 1990s, important steps were taken for the institutionalization of TT in Türkiye. During this period, incentives such as the establishment of Technology Development Zones (TDZ), also known as technoparks or technopolises, increasing UIC and providing R&D support were implemented. The foundations of the Small and Medium Enterprises Development Organization (KOSGEB) were laid with the projects " Small Industry Development Organization General Directorate" (KÜSGET) and "Industrial Training and Development Center" (SEGEM).

The Small Industry Development Center (KÜSGEM), established in Gaziantep in 1973, provided technical support to small industrial enterprises, while SEGEM met the training needs of Small and Medium Enterprises (SMEs). However, these projects could not meet all the needs because they were of limited duration. For this reason, KOSGEB was established in 1990 with Law No. 3624[2]. Initially providing services only to the manufacturing industry, KOSGEB was expanded to include the trade and service sectors in 2009. It has continued to support SMEs focused on technology and domestic production since 2017 (KOSGEB, n.d). With the establishment of the first Organized Industrial Zones (OIZ) in 1991, efforts to use modern technologies in industry increased and the TT process gained momentum. Integration into the Customs Union in 1995 contributed to Türkiye increasing its technological collaborations with Europe and accelerated the TT. Türkiye's becoming a party to the World Trade Organization and the European Union (EU) Customs Union agreements in 1995 made it mandatory to protect industrial property rights at international standards. In this context, the Turkish Patent Institute was established with the Decree Law No. 544[3] on 24 June 1994 (TÜRKPATENT, n.d). The Institute aims to contribute to Türkiye's technological advancement and to protect industrial property rights by registering them.

In the 2000s, Türkiye's science and technology policies experienced a major transformation. The Vision 2023 Project, launched in 2003, set out Türkiye’s goal of becoming a global actor in science and technology. Within this scope, technology foresight projects were developed, various incentives were provided to increase R&D expenditures, and the aim was to accelerate the TT process (TÜBİTAK, 2004). Since the 2000s, the establishment of TTOs in TDZs, the opening of TTOs within universities, the provision of support to TTOs and R&D projects by TÜBİTAK, and the establishment of the TTO regulation in 2017 have become important tools in Türkiye’s production and transfer of technological knowledge. In addition, technology development projects and innovative initiative support programs launched by TÜBİTAK have played an important role in this process.

Finally, it can be seen that Türkiye started to adopt a more strategic approach in TT in the 2010s. TTOs established in universities with the support provided by TÜBİTAK have strengthened Türkiye’s innovation ecosystem by supporting the commercialization process of knowledge and technology. In line with the 2023 goals, targets such as increasing the ratio of Türkiye’s R&D expenditures to gross domestic product and introducing domestic technologies to the industry have been determined. During this period, Türkiye has accelerated TT and original production projects for the production of high-tech products, especially in the defense industry.

Türkiye’s historical development in TT has gone through various stages from the early years of the Republic to the present day. Türkiye, which has adopted TT as an important tool in line with its economic development and industrialization

goals, continues to support the industrialization process with the knowledge and technological accumulation it has gained in this process in order to achieve a competitive structure in the global technology market today.

2.1.2 Creation of First Technology Transfer Offices

The first technology commercialization and seed funding company in Türkiye was İnovent Incorporated Company (INC.) (İnovent, n.d) established in 2006 within Sabancı University (SU). In addition, the first TTO in Türkiye was established in 2007 as METU-TTO within the Middle East Technical University (METU) Technopark. Then, in 2008, Hacettepe Technopolis Technology Transfer Center, which operates within Hacettepe Technopolis, started its activities (Güler & Kırbaşlar, 2020).

In line with the decision of the Turkish Science and Technology Supreme Council dated 2011, it was aimed for TTOs to actively participate in academic entrepreneurship and economic value creation processes. In this context, TTOs have enabled the transformation of academic studies into economic value by both transferring the research results of universities to industry and providing services in licensing, intellectual property rights (IPR) management and commercialization (T.C. Sanayi ve Teknoloji Bakanlığı, 2020).

In 2012, with the launch of the TÜBİTAK Technology Transfer Offices Support Programme under code 1513, there was a rapid increase in the number of TTOs throughout Türkiye. This program was designed to encourage UIC, increase academic entrepreneurship and support the commercialization of innovation-based technologies. In line with these goals, the Entrepreneurship and Innovation University Index was developed to increase the technology transfer capacity of universities in Türkiye. The relevant index is shared regularly every year, encouraging competition between universities (Arinkom TTO, 2023).

2.1.3 Expansion of Technology Transfer Offices and Related Organizations

TT interfaces have been established in Türkiye since the 2000s. During this process, interfaces such as TTOs, technoparks and incubation centers have served as a bridge in technology and information sharing for both universities and industry.

When the development of **TTOs** is examined, only nine TTOs started operating in Türkiye between 2000 and 2011 (T.C. Sanayi ve Teknoloji Bakanlığı, 2021). Starting from 2012, with the launch of the TÜBİTAK 1513 Technology Transfer Offices Support Program and 1601 Support Programs for Capacity Increase in Innovation and Entrepreneurship Fields, TTO establishments have accelerated even more. With the publication of the Regulation on Technology Transfer Office of Higher

Education Institutions[4] in 2017, which allows universities to establish TTOs with the status of a scientific research project or a revolving fund-based capital company, the processes such as the establishment of TTOs, the way they do business, etc. have become easier and more systematic. With these developments, the number of TTOs in Türkiye has reached over 80 (T.C. Sanayi ve Teknoloji Bakanlığı, 2020).

Technoparks also play an important role in the expansion of TT interfaces. The establishment of technoparks in Türkiye was supported by the Technology Development Zones Law No. 4691[5], enacted in 2001, and within this scope, 37 technoparks were put into operation by 2011. As of 2024, the number of technoparks reached 105, and many TTOs within these technoparks support cooperation between universities and industry (T.C. Sanayi ve Teknoloji Bakanlığı, 2021, n.d).

Technology Development Centers (TEKMER), which serve as a crucial interface in Türkiye's technology development process, were first established by KOSGEB in the 1990s and continue to be established and operate today. The aim of these centers is to act as a bridge between universities and industry to encourage the commercialization of innovative ideas and entrepreneurship. The first TEKMERs served as incubators to support the development of technology-based businesses and provided services such as mentoring, business development and financial support to entrepreneurs. As of 2017, 41 TEKMERs were operating across the country. However, these centers were closed in the same year and entered a restructuring process. As of 2020, KOSGEB has begun efforts to revive TEKMERs and TEKMERs have been reorganized with the aim of strengthening the regional innovation ecosystem by collaborating with local universities, chambers of industry and development agencies (DA). This transformation aims to ensure that TEKMERs make more sustainable contributions to the entrepreneurship and innovation ecosystem (T.C. DAP Bölge Kalkınma İdaresi Başkanlığı, 2017). As of 2024, 28 TEKMERs continue their activities actively (KOSGEB, n.d).

R&D centers are important interfaces established in Türkiye to increase the R&D capacity of industry and support technology development activities. The establishment of R&D centers was supported with the Law No. 5746[6] on Supporting Research and Development Activities enacted in 2008, thus providing tax deductions, Social Security Institution (SSI) premium supports and income tax incentives for companies' R&D projects. Following this legal regulation, there has been a significant increase in the number of R&D centers, and as of 2024, 1326 R&D centers are operating throughout Türkiye (T.C. Sanayi ve Teknoloji Bakanlığı, n.d). While these centers strengthen the UIC, they accelerate the access of the industry to the technology it needs and encourage innovative product development processes. In addition, joint projects carried out between R&D centers and universities facilitate the transfer of knowledge and technologies

developed at universities to the industry. Thus, Türkiye's technology development infrastructure is strengthened and the R&D ecosystem across the country is expanding (T.C. Sanayi ve Teknoloji Bakanlığı, 2021).

2.1.4 Key Milestones

- **Establishment of Technology Transfer Offices as Companies**

The Regulation on Technology Transfer Office of Higher Education Institutions[4] regulates the establishment, operation and supervision of TTOs in order to protect the knowledge and inventions produced through R&D activities at universities within the scope of IPR and to transform them into commercial products or services. This regulation has enabled TTOs to be established by higher education institutions under the legal entity of a joint-stock company, thus enabling these offices to operate in a more flexible structure. Before the regulation, there were institutions that carried out TT activities as a joint-stock company, and with this regulation, the processes were regulated by legislation for higher education institutions. With this regulation, TTOs can directly transfer resources from the research budgets or revolving fund budgets of universities. In addition, TTOs were exempted from state procurement laws and were given a structure that would enable them to make fast and effective decisions. This change was an important step in terms of TTOs being able to compete more effectively with the private sector and increasing UIC.

- **Universities Can Become Partners in Technoparks**

The Technology Development Zones Law No. 4691[5], enacted in 2001, allowed universities to participate in technoparks as founding partners, enabling the direct transfer of academic knowledge to industry. The active role of universities in technoparks has strengthened the UIC and paved the way for the commercialization of academic research. In this way, universities have created a sustainable TT cycle by transferring a portion of the income they earn in technoparks to R&D projects.

- **Technology Development Zones Implementation Regulation**

The Technology Development Zones Implementation Regulation[7], which entered into force in 2016, required companies located in TDZs to establish TTOs within their own organizations or provide these services through another legal entity. This regulation aimed to provide TTO support to companies in technoparks and to bring developed technologies into the economy. This regulation has been an important step in accelerating the commercialization of R&D projects and TT processes, especially in technoparks.

- **R&D Law and Innovative Supports**

The Law No. 5746[6] on Support for Research, Development and Design Activities, published in 2008, encouraged the spread of R&D centers in Türkiye and the private sector to invest in R&D activities. Within the scope of this law, incentives such as tax deductions and SSI premium support are provided for R&D expenditures. This regulation facilitated the development of innovative technologies and TT by companies by supporting the institutionalization of R&D and design activities.

- **IPR Management**

Protection and management of IPR in TT processes has become one of the primary duties of TTOs. TTOs provide support to researchers at universities regarding patent processes and IPR management, facilitating the protection and commercialization of these rights. This practice accelerates the integration of research outputs into industry and contributes to the innovation ecosystem.

In Türkiye, until 2017, inventions made by academics at universities were considered free inventions. Due to this gap in the law, there have been problems in universities commercializing inventions made at universities. In order to solve this problem, the Industrial Property Law No. 6769[8] entered into force on January 10, 2017. With this law, the law regarding inventions made with the knowledge of universities includes the following statement: "The sharing of the income obtained from the invention between the higher education institution and the inventor shall be determined in such a way that at least one-third of the income shall be given to the inventor." In addition, in applications made by academics at universities, the applicant is the university, and the inventor is the academic who made the invention. This law has closed the gap in IPR in TT activities.

2.1.5 Notable Cases and Examples

In Türkiye, many successful examples have been realized in the field of TT in recent years. The collaborations of various actors involved in the TT process have contributed to the strengthening of Türkiye's technology ecosystem and the increase of its global competitiveness. Below are examples of successful TTs that have had a significant impact on the ecosystem.

- **Ege University and Dermalix**

As a result of studies conducted by four female academics at the Ege University Pharmaceutical Technologies Laboratory in 2012, a biocompatible skin patch was developed that will accelerate the healing process of open wounds. This product is designed for the treatment of chronic wounds and significantly accelerates the treatment process of patients. In 2015, the technology was protected with a patent application and commercialized with the support of Ege University EBİLTEM TTO.

In this process, a spin-off company called Dermalix was established and then a collaboration was established with Abdi İbrahim. Within the scope of the signed agreement, Dermalix was responsible for R&D operations, while Abdi İbrahim took on the task of commercializing and launching the product. This transfer is a successful example of UIC and has enabled domestic innovation to be supported by large pharmaceutical companies and launched into the market (ASELSAN, 2024).

- **Aerovide Wind Turbine**

ASELSAN carried out the project of transferring wind turbine technology from Germany-based Aerovide. This process aimed to bring various technical information and equipment such as know-how, patents and designs owned by Aerovide to Türkiye. ASELSAN evaluated this cooperation as a strategic step for the localization and development of wind turbine technology in Türkiye's energy sector. In this context, technical and financial evaluations were made, and turbines that meet the required performance criteria were adapted to Türkiye. ASELSAN is aimed to complete the integration of the turbines by making its own developments after this TT and to become a significant player in the local market in this field. It is predicted that the size of Türkiye's wind energy market will reach 40 billion dollars in the coming years, and this transfer will make ASELSAN a significant player in this market (ASELSAN, 2024).

- **Konya Weapon Systems and Remote Controlled Weapon Systems**

ASELSAN transferred technology to Aselsan Konya Silah Sistemleri Anonim Şirketi (AKSS) in order to realize the production of remote-controlled weapon systems with local capacity. In this process, ASELSAN has transferred its technical knowledge and experience to AKSS and ensured the development of a local production infrastructure in this field. This transfer is of great importance in terms of reducing Türkiye's external dependency in the defense industry and developing strategic weapon systems with local resources. The installation and qualification of the production lines required for remote controlled weapon systems production is ongoing, and this process is compatible with Türkiye's goal of developing its own defense systems independently (ASELSAN, 2024).

- **Development of TeraHz Integrated Receiver Array**

ASELSAN, in cooperation with TÜBİTAK Marmara Research Center (MAM), has realized TT within the scope of Terahertz Real-Time Passenger Imaging Product Family Project. This project covers the development of an innovative imaging system for the detection of explosives, weapons and other contraband items hidden in the human body. The technology developed by TÜBİTAK MAM has been integrated into ASELSAN's relevant system, providing innovative solutions in the field of security and contributing to the development of the local technology

infrastructure. This technology enables security forces to detect threats on the human body quickly and accurately (ASELSAN, 2024).

- **Highway Traffic Radar and MELSIS Cooperation**

ASELSAN signed a TT agreement with Mikro Elektronik Sistemler Ltd. Şti. (MELSİS) in order to commercialize its know-how in radar technologies in the civilian sector. ASELSAN's technical know-how in radar technologies was licensed to MELSİS to develop highway traffic radars in the civilian sector. In this process, the licensing and production processes required for the commercial use and development of the technology transferred to MELSİS were carried out, and ASELSAN was provided with royalty income upon the launch of the products. This cooperation provides a broader commercial benefit by ensuring that technologies developed in the defense industry are used in civilian sectors (ASELSAN, 2024).

- **CinnaGen Pharmaceuticals and D-8 TT Award**

CinnaGen Pharmaceuticals was awarded the "Technology Transfer Award" by the D8-Technology Transfer and Exchange Network/D-8 TTEN, which operates under the Developing 8/D-8 and aims to improve technological cooperation among member countries. This is a prestigious award given to the best TT in any field of technology among member countries. The award was presented to Dr. Ferhat Farşi, CEO of CinnaGen Pharmaceuticals, by Mr. Dato' Ku Jaafar Ku Shaari, Ambassador of Malaysia, Secretary General of the D-8 Economic Cooperation Organization. Dr. Ferhat Farşi, CEO of CinnaGen Pharmaceuticals. CinnaGen Pharmaceuticals received this award as a result of the successful transfer of a biotechnological product containing a monoclonal antibody that selectively binds to the antigen called human epidermal growth factor 2 (HER2) to its factory in Çerkezköy OIZ. This TT is of great importance for the local production of high-tech biotechnological products (Winally, 2021).

2.1.6 Institutionalization of Technology Transfer

In Türkiye, TT processes have been institutionalized through formal structures and procedures, and various regulations and support have been provided for the development of this field. The establishment, professionalization and certification of TTOs according to international standards represent important steps in this institutionalization process.

- **Regulation on Higher Education Institutions Technology Transfer Office**

The procedures and principles regarding the establishment, management, operation, monitoring and evaluation processes of TTOs in universities are regulated and institutionalized by the TTO regulation[4]. Within the scope of this regulation, TTOs are structured as capital companies established with the

permission of the board of directors of higher education institutions and within the framework of the Turkish Commercial Code No. 6102[9] for the purpose of commercializing the knowledge and inventions produced in universities. TTOs undertake tasks such as developing the UIC, providing support for R&D projects, protecting the IP and encouraging entrepreneurship within the university. In addition, the annual activities of TTOs are examined by the TTO Monitoring and Evaluation Commission established by the Council of Higher Education (YÖK) and their activity permits can be canceled if necessary. The regulation defines the income of TTOs as the income obtained from the services they provide, partnerships and donations. It also allows them to operate in a flexible structure by being exempted from the State Tender Law No. 2886[10].

- **Professionalization of Technology Transfer Offices and Determination of Professional Standards**

In Türkiye, TTOs have been established within universities and research institutions, and have undertaken an important task as structures that strengthen the UIC and support knowledge transfer. The definition of the title of "TT Specialist" by the Vocational Qualifications Authority in 2018 and ensuring that TTO professionals receive RTTP (Registered Technology Transfer Professional) certification in accordance with international standards has been a critical step in professionalization in this field. The training programs conducted by the University-Industry Collaboration Centers Platform (ÜSİMP) increase the competence of TTO specialists and provide specialization in TT processes (ÜSİMP, 2019).

- **Institutionalization of the Activity Structure of Technology Transfer Offices**

It has been decided that TTOs operating in line with the goals of transforming research outputs conducted at universities into economic value, providing UIC, universities benefiting from national and international support mechanisms, developing academic entrepreneurship based on knowledge produced at universities, and commercializing IPR at universities will be supported by being included in the TÜBİTAK support mechanism within the framework of the decision numbered 2011/104 of the Supreme Council of Science and Technology. TÜBİTAK has defined TTO activities with five modules (TEYDEB, 2017). The modules created by TÜBİTAK within the scope of TTO activities are as follows:

- Module 1- Awareness, Promotion, Information and Education Services
- Module 2- Services for Benefiting from Support Programs
- Module 3- Project Development/Management Services (UIC Activities)
- Module 4- IPR Management and Licensing Services
- Module 5- Incorporation and Entrepreneurship Services

With the creation of module structures by TÜBİTAK, TTOs have been enabled to cooperate in TT processes.

- **The Effect of Laws on Institutionalization in Technology Transfer Processes**

The institutionalization of Türkiye's TT ecosystem is supported by various legal frameworks and regulations. One of the prominent regulations, Law No. 5746[6] on Support for Research, Development and Design Activities, provides tax incentives and insurance premium support for R&D centers, while allowing academics from universities to be assigned to facilitate the transfer of knowledge to industry.

In addition, the Higher Education Law No. 2547[11] provides academics with the opportunity to work in TDZs and receive a greater portion of their income from R&D activities exempt from taxes. This law facilitates the commercialization of academic knowledge by encouraging UICs.

The Technology Development Zones Law No. 4691[5] offers conveniences such as conducting research activities in technoparks and authorizing universities to establish companies by collaborating in these zones. Companies located in these zones are supported with incentives such as tax deductions for R&D studies, thus aiming to accelerate TT.

In addition, the Industrial Property Law No. 6769[8], which entered into force in 2017, significantly improved the TTO. This law defined higher education institutions as strong actors of the patent ecosystem, increased university-based patent applications and encouraged UICs. In addition, by clarifying the licensing and income distribution issues related to service inventions, it encouraged academics to patent and commercialize their inventions and also increased the effectiveness of TTOs.

These regulations have made TT processes more transparent and efficient, and as a result, have increased Türkiye's international competitiveness in the fields of innovation and R&D. In addition, while contributing to the institutionalization of TT processes in Türkiye, they have strengthened innovation capacity by increasing the integration of academic knowledge into industry.

2.1.7 Impact of Global Trends

On a global scale, TT is of great importance as the key to industrial progress, productivity growth and economic growth. The key trends driving TT worldwide and their impacts in Türkiye are given below.

- **Digitalization and Digital Transformation**

Digitalization accelerates TT, facilitates knowledge and skill sharing, and encourages inter-institutional collaboration. Digital tools provide a more effective

and efficient transfer process by expanding data sharing and communication channels (Adomako & Nguyen, 2024; Nikitin & Nochvai, 2023).

Digitalization in Türkiye plays an important role in the business processes of SMEs in particular. Thanks to digitalization, companies optimize their business processes and perform a faster and more effective TT process. In particular, cooperation between industry and universities is strengthened through digital platforms and information sharing is becoming faster. This accelerates innovation processes. At the same time, digitalization radically affects the way of doing business and provides both efficiency and speed increase.

- **Open Innovation Models**

Instead of using only their own resources in their innovation processes, businesses benefit from internal and external resources. This model makes it easier for businesses to innovate faster and adopt technology (Nikitin & Nochvai, 2023).

The adoption of open innovation models in Türkiye enables technological innovations to spread to a wider ecosystem. In particular, joint projects are being developed with local and foreign companies through R&D centers, technoparks and incubation centers, enabling wider sharing of know-how. In Türkiye, companies such as Turkcell, Türk Telekom, Vestel, Arçelik, Aselsan, Kordsa, Kayalar Kimya, Dizayn Group, Atlas Halı, Borusan, Fujifilm, Tüpraş, Türk Telekom, Şişecam, Bayer, Çimsa, Tat Gıda and Türk Ekonomi Bankası have analyzed their needs and taken quick action with the open innovation model and made their products ready for the market (Dağlı & Ezanoğlu, 2020).

- **International Cooperation and Academic Contribution**

The role of scientific research and academic institutions in TT is increasing. Academic institutions are accelerating TT processes by strengthening their collaborations with industry. This trend is of great importance especially in high-tech sectors (IP Law Mastery, 2024). In particular, public and private sector collaborations with academia are increasing, and information and technology sharing between universities and industry is encouraged, and international partnerships are established in the creation of these partnerships, and the outputs are evaluated in the international arena.

Türkiye is developing strategies to increase the contribution of academic institutions and research centers in the TT process. These strategies include international project partnerships and collaborations. In this context; network participation tools (EEN, COST, etc.), international programs that researchers can fund their scientific studies (Erasmus+, Horizon Europe, etc.) and TÜBİTAK international collaboration programs are frequently used. Such collaborations increase the country's innovation capacity and support TT.

- **Providing a Safe Transfer Environment with IPR**

IPR supports TT by ensuring the protection of innovations. Legal mechanisms such as patents, copyrights and trade secrets add confidence to transfer processes by protecting companies' competitive advantage (Adomako & Nguyen, 2024; IP Law Mastery, 2024).

IPR increases the security of TT processes in Türkiye and attracts more interest from investors. Türkiye has strengthened its legislation on patents and copyrights, which allows for a more secure transfer of technology.

- **Green Technology and Sustainability**

Türkiye also follows global trends in green technologies. Interest in renewable energy and environmentally friendly technologies is increasing, which supports green TT. Investments made especially in the energy sector accelerate sustainability-focused TT and ensure that Türkiye is more integrated with environmentally friendly innovations. Türkiye follows developments in this field, participates in relevant programs specifically, and creates funding sources. TÜBİTAK's "Green Growth Technology Roadmap" determines technological transformation strategies for industrial sectors in order for Türkiye to reach its 2053 net zero emission target. While environmentally friendly solutions are targeted in the steel, aluminum, cement, chemicals, plastics, and fertilizer sectors, sustainability-focused innovations are emphasized throughout the entire cycle from production processes to waste management. The roadmap was created in collaboration with academics, the public, and industry, and includes steps towards the 2026, 2030, and 2035 targets (TÜBİTAK, 2023).

These trends make the TT ecosystem in Türkiye more dynamic, competitive and innovative. Strengthening international collaborations and adapting to global trends such as digitalization increases Türkiye’s TT capacity and enables it to achieve a more competitive position in international markets.

2.1.8 Emergence of New Stakeholders

The emergence of new stakeholders in the TT ecosystem in Türkiye has accelerated since the 2000s. Among these stakeholders, universities, private sector organizations, public institutions and international investments have played important roles.

- **Universities and Research Centers**

Universities and research centers are one of the most important components of the TT ecosystem. Universities contribute to the development of new technologies and the transfer of these technologies to industry by collaborating with industry through technoparks and TTO’s etc. Universities, especially in big cities such as Istanbul and Ankara, have taken on leading roles in entrepreneurship and

innovation. Universities support the emergence of technology-based initiatives by establishing entrepreneurship centers and incubation centers (Aka & Özdemirci, 2022). Universities ensure the emergence of new technologies and the commercialization of these technologies through their collaborations with industry and technology development activities. The infrastructure and support provided by universities and research centers play an important role in TT processes.

- **Technology Development Zones**

TDZs were established with the Technology Development Zones Law No. 4691[5], enacted in 2001. TDZs contribute to the commercialization of R&D and innovation activities by strengthening the UIC. Start-ups and SMEs located in TDZs contribute to TT processes by developing innovative solutions. The increase in the number of enterprises located in these zones in particular has contributed to the development of Türkiye's technology capacity and innovation level (Sağdıç et al, 2020).

TDZs have accelerated TT by contributing to the commercialization of R&D studies and the growth of technology-based enterprises. Firms in these zones contribute to the transfer of new technologies to industry and their commercialization.

- **Development Agencies**

Development agencies (DAs) in Türkiye began their activities with the publication of Law No. 5449[12] on the "Establishment, Coordination and Duties of Development Agencies" in 2006 (Arslan, 2016). DAs were established to reduce regional development disparities in Türkiye and support local innovation ecosystems. At the local level, DAs contribute to the entrepreneurship ecosystem by supporting different R&D and innovation activities within the scope of their strategies. These DAs have contributed to the adoption and dissemination of technology at the regional level and accelerated TT by encouraging cooperation between universities and the private sector (Bektaş & Bahtiyar, 2023).

DAs contribute to reducing regional disparities, enabling a more balanced spread of TT across the country. The support they provide at the local level accelerates TT processes.

- **Venture Capitalists**

Investors are important components that provide funding to the entrepreneurial ecosystem in Türkiye. These are; VC companies, individual investors (angel investors) and angel investment networks (İpekten, 2006). These investors provide financing in the early stages of technology-based initiatives, supporting the growth of these initiatives and the development of their technologies. The increase in angel investors in Türkiye draws attention with their contributions to TT. Of the 1098 licenses granted since 2013, 603 are still active. In 2024, a total of TL

11,170,883 worth of capital was transferred for 18 different investments, and 47% of these investments were made to businesses with fewer than 5 employees. Istanbul is the province where angel investors are concentrated and has hosted a total of 69 investments (T.C. Hazine ve Maliye Bakanlığı, 2024). The financial support provided by VCs allows technology-based enterprises to focus more on R&D and innovation activities (Sağdıç et al, 2020). The growth and development of technology-based enterprises is ensured through angel investors and VCs (T.C. Hazine ve Maliye Bakanlığı, 2024). This situation has provided a new and dynamic contribution to TT processes in Türkiye and has enabled the development of innovative solutions.

The emergence of new stakeholders in Türkiye has contributed to the expansion and strengthening of the TT ecosystem. These stakeholders, by assuming different roles in the TT processes, enable Türkiye to develop its innovation infrastructure and become an important player in global competition.

2.1.9 Graphical Representation

Year	Main Event	Description
1963	State Planning Organization (SPO) and Publication of the 1st Development Plan (DPT, 1963)	Türkiye's first five-year DP was published. Science, technology and R&D targets were included in these plans for the first time.
1963	Establishment of TÜBİTAK	TÜBİTAK was established to support Türkiye's scientific research and technology development activities.
1990	Establishment of KOSGEB	KOSGEB was established to support SMEs and began to make significant contributions to R&D activities.
2001	Adoption of the Technology Development Zones Law No. 4691[5]	Legal regulations were provided for the establishment and operation of technoparks in Türkiye.
2004	Publication of Vision 2023 Strategy Document (TÜBİTAK, 2004)	A long-term strategy was determined to develop Türkiye's R&D and innovation ecosystem.
2006	Adoption of Law No. 5449[12] on the Establishment, Coordination and Duties of Development Agencies	In order to support regional development, DAs were established throughout Türkiye and projects were initiated to encourage TT and R&D activities.
2008	Adoption of Law No. 5746[6] on Supporting Research and Development Activities	Incentives were introduced for R&D and innovation activities, tax reductions and personnel support were provided.

2014	TÜBİTAK 1601 Program and TTOs Support Program (TÜBİTAK, 2014).	A support program was launched to increase the capacity of TTOs established at universities.
2017	Adoption of Industrial Property Law[7] No. 6769[8]	Regulations were made for the commercialization of inventions made at universities and the protection of patent rights.
2017	Entry into Force of the Regulation on Technology Transfer Office of Higher Education Institutions[4]	The regulation regulating the structures and operations of TTOs established at universities was published, and TT processes were accelerated.

Table 1: Main Events Affecting Türkiye's Technology Transfer

2.2 Existing Studies

2.2.1 Institutions and Organizations Supporting the Technology Transfer Ecosystem in Türkiye

Rapidly developing technology creates significant effects on every stage of society. Türkiye is increasing its R&D investments every day in order to produce and develop these technologies. In addition, the issue of transferring the technologies produced has also been prioritized. Policies and legal regulations have been implemented for this purpose. At the same time, cooperation on TT is being developed between institutions.

TT in Türkiye generally works as follows; the importance of transferring the knowledge that exists in universities and research institutions to the business world within the historical development of Türkiye has been understood. Interfaces have been created to support TT in order to meet the problems experienced in transferring this knowledge to the business world and to expect effectiveness. The transfer of the existing knowledge accumulation to the parties in need of technology/solution is carried out with the support of the relevant interfaces. Usually, the information required by industrial companies is transferred from the parties that produce information by this method to the practitioners of this information. In this way, the commercialization of the existing academic knowledge is ensured. This transfer generally takes place through the **transfer or licensing of patented technology, entrepreneurship and contracts**. The institutions and organizations within this ecosystem are as follows; **Universities, R&D centers, TTOs, TDZs, and the business world**. Institutions that play an active role in this ecosystem are located. The leading relevant institutions and organizations in Türkiye are given below.

- **TÜBİTAK:** TÜBİTAK, which is affiliated with the Ministry of Industry and Technology of the Republic of Türkiye, is a public institution established to

support Türkiye's development in the fields of science and technology. It provides significant contributions in the fields of R&D, innovation and TT by providing funds for national and international projects. TÜBİTAK contributes to increasing the scientific and technological capacity of Türkiye with the supports it provides to scientists, industrialists and entrepreneurs.

- **KOSGEB:** KOSGEB, which is affiliated with the Ministry of Industry and Technology of the Republic of Türkiye, was established in 1990 to increase the competitiveness of SMEs. It supports the commercialization of projects by providing financial support to SMEs in R&D, innovation and TT processes. KOSGEB contributes to the development of technology-based entrepreneurship, especially through the incentives it offers to SMEs located in TDZs
- **Turkish Patent and Trademark Office:** Turkish Patent and Trademark Office (TÜRKPATENT), which is affiliated with the Ministry of Industry and Technology of the Republic of Türkiye, was established in 1994 to protect and develop IP in Türkiye. It encourages innovation and increases Türkiye's international competitive power by regulating the patent, utility model, trademark, design and geographical indication registration processes. TÜRKPATENT accelerates TT by providing consultancy and technical support for the commercialization of patents.
- **Technology Development Zones (TDZs):** They are important centers for supporting TT and innovation. They provide a suitable ecosystem for companies to conduct R&D studies and develop new technologies. Technology-focused enterprises can establish their companies in technoparks after receiving approval. In addition to tax reductions and exemptions, companies located in TDZs accelerate knowledge and TT by collaborating with universities and other research institutions. In this context, they play an active role in the development and commercialization of new products and processes, thus contributing to the increase in the technological capacity of the country.
- **Organized Industrial Zones (OIZs):** Although they were not established for the purpose of TT in Türkiye, there are OIZs for the purpose of supporting the growth of industry and the development of technology. TT interfaces conduct active activities in OIZs and realize academic studies in OIZs. Thus, the problems of the companies located in OIZs are solved quickly through TT. For these reasons, TTOs and TDZs in Türkiye work in close relationship with OIZs. OIZs are one of the important dynamics of the Turkish economy and contribute to the country's economy with their production activities, employment creation and export potential.
- **R&D Centers:** As units established within companies or organizations and conducting R&D activities, they play a critical role in the innovation process. R&D centers provide competitive advantage by conducting strategic studies for the development of new products, technologies and processes.

By turning scientific and technological knowledge into practical applications, these centers encourage the emergence of innovative solutions and projects and thus directly contribute to economic growth and sustainable development.

- **Development Agencies (DAs):** DAs, which are affiliated with the Ministry of Industry and Technology of the Republic of Türkiye, are public institutions established in 2006 to support regional development and mobilize local potential. They support regional R&D and innovation processes by providing financing and consultancy services to local businesses. DAs contribute to the development of the TT ecosystem at the regional level by cooperating with universities and technoparks.

These organisations, the number of which can be increased, have a very important place in the TT ecosystem in Türkiye. The total value provided by these organizations in TT processes is increasing. These organizations, established to support the science and technology ecosystem in Türkiye, play important roles in R&D, innovation and TT processes.

In addition to the above-mentioned institutions and organizations, TT mechanisms are also widely used in the private sector. **Angel investment and VC funds, pre-incubation, incubation and accelerator programs, technology competitions (Teknofest etc.), crowdfunding platforms, innovation and entrepreneurship programs run by private companies, contract-based TT agreements** are also among the instruments frequently used in Türkiye. In addition to these, **company mergers and acquisitions of enterprises** are also among the tools used in TT.

2.2.2 Mechanisms Supporting Technology Transfer Processes

Interfaces play a very important role in successfully completing TT and accelerating the process. Various mechanisms have been established in Türkiye to support these interfaces. The prominent mechanisms in Türkiye are listed below.

- **TÜBİTAK Technology Transfer Offices Support Programs**

TÜBİTAK makes calls under certain programs to support TT. These calls are; 1601- TÜBİTAK Capacity Building for Innovation and Entrepreneurship Grant Program, TTOs Preparation Call and TT Professional Call and TÜBİTAK 1513- TTOs Support Program. With the relevant supports, TT interfaces can meet their expenses in terms of qualified human resources, events and equipment. In 1601- TT Professional Calls, only TT professional employment support is provided.

Under the TÜBİTAK 1601- Capacity Building for Innovation and Entrepreneurship Grant Program, relevant interface structures have been guided to operate within five modules. In this context, universities in particular have implemented their own special structures in accordance with the mentioned modules of TTOs

according to their institutional strategies. Accordingly, there are examples of active activities in each module, as well as interface structures in which some module services are weighted, or some modules do not operate at all. The remaining areas can also be undertaken by different units/structures.

The service units (modules) defined by TÜBİTAK are defined as follows.

- **Module 1: Awareness, Promotion, Information and Training Services**
  - Directing researchers according to private sector needs and introducing their competencies.
  - Informing and training researchers and the private sector on research, technology, innovation and IP.
- **Module 2: Services for Benefiting from Support Programs**
  - Ensuring that national and international support programs are utilized by providing project preparation, application and monitoring services.
  - Facilitating access to funds by providing information on R&D and innovation financing.
- **Module 3: UIC Activities**
  - Providing consultancy and guidance services on information, technology and collaboration opportunities.
  - Introducing project results and coordinating team formation in multi-partner projects.
  - Acting as an intermediary for contract research.
- **Module 4: IPR Management and Licensing Services**
  - Providing consultancy in determining IP assets and legal protection procedures.
  - Managing the commercialization processes of IPR through licensing.
  - Collaborating with other TTOs and relevant institutions in commercialization processes.
- **Module 5: Incorporation and Entrepreneurship Services**
  - Providing incubation center services and accelerator programs for the commercialization of knowledge.
  - Providing business guidance and mentoring services to entrepreneurs.
  - Finding resources for prototype development and making them available to entrepreneurs.

- **TÜBİTAK 1702- Patent Based Technology Transfer Support Program**

This program aims to transfer patented technologies developed in universities, research institutions and TDZs to industry and commercialize them. Within the scope of the program, the transfer of patents to the industry through licensing or transfer is supported. The upper limit of the project budget is 4 million TL as of 2024 and the support rate is 75% for SMEs.

- **TEKNOFEST - Aerospace and Technology Festival**

Taken under the leadership of Türkiye Technology Team Foundation and Ministry of Industry and Technology, TEKNOFEST is the first and only aviation, space and technology festival of the country, organized with the partnership of many organizations that play a critical role in the development of national technology in Türkiye. The festival, which has been organized since 2018, aims to increase the interest in technology in society and to transform Türkiye into a society that produces and develops technology with events such as technology competitions, air shows, concerts and talks. Competition categories and the number of participants has increased rapidly over the years; In 2023, more than 333,000 teams and more than 1,000,000 competitors from 81 provinces and 96 countries applied to the technology competitions organized in 41 different categories. Various awards are given in different categories in the competition.

2.2.3 Importance of Technology Transfer in Development Plans

The organizations and support mechanisms mentioned above are determined and maintained in line with Türkiye's development goals. The "DP" which includes policies aimed at advancement and development in areas such as economy, health, education, transportation, social security, justice, etc., and outlines the public policies to be implemented, is prepared by the Strategy and Budget Office of the Presidency of the Republic of Türkiye. Throughout Türkiye's DP, common goals for science and technology policies have been constantly emphasized. Summary information on Türkiye's DP published to date, focusing on TT, is provided below.

- **In the First and Second Five-Year DP,** increasing R&D expenditures and training qualified human resources were among the priority targets (DPT, 1963, 1968).
- **The Third and Fourth DP,** stated that domestic technology production should be supported, and the industry should be provided with a structure that produces its own technology (DPT, 1973, 1979).
- **In the Fifth and Sixth DP,** it was emphasized to strengthen the UIC, to provide a dynamic structure to R&D activities and to focus on priority technology areas (DPT, 1985, 1990).

- **The Seventh and Eighth DP,** determined strategies for the transition to an information society and the dissemination of information and communication technologies, and suggested the establishment of technoparks (DPT, 1996, 2001).
- **In the Ninth and Tenth DP,** targets such as increasing R&D investments, developing global competitiveness through innovation, and supporting domestic technology in public procurement came to the fore (DPT, 2007, 2014).

In general, the common themes observed in all plans are increasing Türkiye's science and technology capacity, attaching more importance to R&D, and seeing knowledge-based production as the cornerstone of economic growth.

The last two DP published in Türkiye, the Eleventh and Twelfth DP, are of critical importance in increasing Türkiye's global competitiveness. These plans aim to strengthen the R&D and innovation ecosystem, commercialize research outputs, and transfer them to industry. By increasing the effectiveness of TTOs and developing domestic competencies in strategic areas, Türkiye aims to reach a stronger and more sustainable position in the international arena. The Eleventh and Twelfth DP mentioned below are shared separately:

- **Eleventh Development Plan (2019-2023):** This plan aims to strengthen Türkiye's R&D and innovation ecosystem. The R&D support system is planned to cover all processes and be tailored to the needs of the sectors. Emphasis is placed on UIC by increasing the number and quality of researchers in the private sector and promoting the employment of PhD researchers in industry. It is planned to increase the effectiveness of TTOs, provide financial support to innovative projects and ensure integration with the EU Research and Innovation Framework Programs. In the field of space, it is planned to implement the National Space Program and increase the capacity of the Turkish Space Agency (SBB, 2019).
- **Twelfth Development Plan (2024-2028):** This plan aims to increase Türkiye's international competitiveness in science, industry and technology. R&D and innovation activities will focus on priority sectors and critical technology areas, and performance-based supports will be expanded. National initiatives will be launched for green transformation and domestic technology development; UIC will be strengthened and support models will be developed from basic research to final product. Competent academics abroad will be attracted to Türkiye and pioneering R&D infrastructures will be supported. R&D capabilities will be increased in strategic areas such as space technologies, health technologies, chip production and polar research; infrastructures for advanced technologies such as artificial intelligence, cyber security and biotechnology will be established within the scope of the "National Technology Initiative". These

goals will serve Türkiye to achieve its 2053 net zero emission target and strengthen its international strategic position (TÜBİTAK, 2023; SBB, 2023).

Türkiye's future DP/strategies/policies are made by giving importance to improving TT processes and aiming to increase high value-added outputs.

2.2.4 Investments in Türkiye

When examined in terms of TT investment in Türkiye; between 2010-2020, an annual average of 104 investment activities attracted an investment of 74 million dollars in early-stage investments, while between 2021-2023, an annual average of 338 investment activities attracted an investment of 1.33 billion dollars. Between 2020-2023, the number of ventures that reached the unicorn (ventures with a value exceeding 1 billion dollars) level was five and the number of ventures that reached the decacorn (ventures with a value exceeding 10 billion dollars) level was two (T.C. Cumhurbaşkanlığı Yatırım Ofisi, 2024).

2.2.5 Methods and Tools Used in the Technology Transfer Process in Türkiye

The methods and tools frequently used by interfaces supporting the TT process in Türkiye are given below. Although not all interfaces use all of these tools, they are frequently preferred by actively operating interfaces.

- **Methods and Tools Supporting the Entrepreneurship Process**
  - **Pre-Incubation Programs:** These programs provide support for projects in the idea stage; entrepreneurs test their ideas and try to validate their ideas by receiving mentoring and training.
  - **Accelerator Programs:** These programs aim to rapidly grow advanced-stage ventures. Intensive programs ensure that ventures develop their products and receive investment.
  - **Incubation Centers:** These centers provide long-term support to ventures in their early years; they aim for sustainable growth with office space, mentoring and networking opportunities.
  - **Demo Days:** Startups present their products and business models to investors at these events, gaining opportunities to secure investment and establish strategic partnerships.
  - **Entrepreneurship Competitions:** These are organizations where innovative ideas are rewarded; entrepreneurs present their projects and receive awards and investment opportunities.
  - **Experience Sharing Days:** Successful entrepreneurs share their experiences at these events and provide networking opportunities by providing inspiration and insight to new entrepreneurs.

- **Co-working Spaces:** These spaces offer a flexible and collaborative working environment for freelancers and small teams, providing networking and training opportunities.
- **Entrepreneurship Ecosystem Platforms:** These are online tools that bring together entrepreneurs, investors, and mentors; they offer resources, training, mentorship, and investor databases, and facilitate the establishment of global connections (bigg.tubitak.gov.tr).

- **Methods and Tools Supporting the IP Process**
  - **Patent License Agreements:** The patent owner can grant the right to use his invention for a certain fee. In Türkiye, these licenses can be realized through tender or direct sale.
  - **Trademark, Design and License Agreements:** These are agreements in which the brand or design owner grants the right to use their brand or design for a certain fee. The process is carried out with TTO support, similar to patent license agreements.
  - **Geographical Indication License Agreements:** The geographical indication owner grants the right to use their sign for a certain fee. They are usually made by municipalities and chambers of commerce and protect the originality of local products.
  - **Transfer of IPR:** IPR are transferred through acquisition, merger or sales agreements. These transactions contribute to the commercialization of patented technology.
  - **Attorney Company Service:** Industrial property applications are made individually or through authorized attorneys. The use of attorneys speeds up and facilitates the processes.
  - **Confidentiality Agreements:** These are documents in which the parties undertake not to share the shared confidential information with third parties. They ensure the protection of technological information.
  - **Publications on IPR:** Patent portfolio booklets, patent introduction cards and invention summaries are prepared to support the commercialization of inventions. They are published on web pages and exhibited at fairs.

- **Methods and Tools Supporting UIC**
  - **UIC Process Management:** In Türkiye, TTOs manage UIC activities with workflows to accelerate TT; field visits and business development activities are conducted for the needs of the industry and product and process development projects are determined. Collaborations are formed by receiving project proposals suitable for the fields of the companies from academicians. These collaborations take place in the form of R&D partnerships, supported projects or assignments, and there are defined workflows for each model.

- **UIC Service Procurement Agreements:** In Türkiye, TTOs support the process by preparing contract drafts for the services to be provided by researchers; this standardized process prevents disputes, reduces the workload of researchers and encourages collaboration professionally.
- **Creating an Academician Pool:** In Türkiye, TTOs collect the information of academicians who want to work for industrial needs and create a pool; this pool includes areas of expertise and collaboration experiences. By providing industrialists with open or special catalogues, TT is encouraged, targeted collaborations are ensured, and the finding of suitable experts is facilitated, thus accelerating innovative projects.

- **Methods and Tools Supporting Scientific Studies**
  - **Call Information Form:** The Call Information Form is an information form that summarizes current project, and grant calls and presents them to researchers and increases their awareness.
  - **Training Activities:** Researchers, students and entrepreneurs are provided with training on project writing, patent research, contract preparation and company establishment, and their knowledge and skills are developed.
  - **Guidance Support:** Idea owners are informed about R&D and innovation financing and directed to funds; their ideas are directed to suitable projects, company establishment and industry collaborations by evaluating their industrial suitability and commercialization potential.
  - **Participation in International Networks:** Activities are carried out to improve access to international cooperation and funding programs in order to increase the effectiveness of researchers, entrepreneurs and companies in the international arena.
  - **Project Preparation, Budgeting, Evaluation and Application Support (Administrative and Technical Support):** TTOs in Türkiye provide comprehensive support to academics, students and industrialists in project development, writing, application and implementation processes. They accelerate TT by reducing bureaucratic obstacles with administrative support and contribute to the faster delivery of innovative solutions to the market.

3 PESTEL Analysis of the Technology Transfer Ecosystem

The TT ecosystem refers to the process of transitioning innovative ideas from laboratories to commercialization. This process involves many stakeholders and is directly affected by political, economic, social, technological, environmental and legal factors. Below, the PESTEL analysis of the TT ecosystem and the aspects that are missing or need to be developed between the public, academia and industry will be discussed.

Political	Economic	Social	Technological	Environmental	Legal
Public incentives	R&D incentives	Information and Technology education	Digital technologies	Sustainable technologies	Laws
Public grants	Economic growth	Young population	Local technologies	Clean energy technologies	Patent applications and processes
Incentive and support laws	Investment funds	Social innovation awareness	Infrastructure deficiencies	Compliance with carbon emissions	Licensing agreements
Tax advantages	VC	Regional differences in education	Adapting to new technologies	Climate change risk	
	SME supports	Public awareness of technology		Environmental regulations	

Table 2: TT ecosystem PESTEL Analysis findings

3.1 Political Factors

The Organisation for Economic Co-operation and Development (OECD)'s 2018 report emphasizes that state support for R&D investments, innovation incentives, and regulations that increase UIC are critical components of the TT ecosystem (Andrenelli et al, 2019). Grants and R&D funds for new ventures help researchers and entrepreneurs accelerate their innovation processes. When the strengths of the TT ecosystem in Türkiye are examined, it is seen that the state's support for technology and R&D is a major driving force. Ministries in Türkiye, TÜBİTAK, Health Institutes of Türkiye, KOSGEB, TÜRKPATENT, TÜRKİYE Standards Institue, Türkiye Academy of Science, regional DAs, universities, institutes affiliated with ministries, etc. carry out programs that support TT processes. With the programs carried out, organizations are encouraged to carry out, protect, and commercialize R&D activities. Programs are shaped in line with needs and are constantly revised according to today's conditions. The incentives offered, the creation of TDZs and

the support provided to R&D activities at universities contribute significantly to the growth of the TT ecosystem.

In Türkiye, the biggest obstacle to the UIC and TT processes in the past periods was not the lack of institutional structures for these activities, but the problems encountered in their implementation. Various legal regulations have been developed to solve these problems. The Additional Article 32 of the Higher Education Law No. 254711 dated 2017, which facilitates the establishment of TTOs within universities, represents a significant change in Türkiye's approach to TT and aims to facilitate the processes that previously hindered innovation and commercialization efforts (Ministry of Industry and Technology of the Republic of Turkey, 2020).

With Law No. 5746[6], companies have gained the opportunity to deduct all of their annual R&D expenses from corporate tax. It includes tax exemptions and discounts provided under the Income Tax Law (No. 193[13]), Corporate Tax Law (No. 5520[14]), Technology Development Zones Law (No. 4691[5]) and Supporting Research and Development Activities Law (No. 5746[6]). The increase in the number of TDZs in Türkiye creates opportunities for strengthening university-industry collaborations. These legal regulations encourage entrepreneurs to engage in more activities in technoparks. The diversity of incentives encourages collaboration between academia and industry, enabling faster commercialization of innovative projects. Combining special financing instruments such as angel investors and VC with incentives creates opportunities that can accelerate technological progress. With Law No. 6769[8] on Industrial Property, universities can share in the income generated from inventions and academics are recognized as inventors, creating a great opportunity for TT and commercialization of inventions. This law has been an important step in building bridges between universities and industry, while increasing the motivation of academics to innovate.

There are differences in economic and infrastructural development between different regions of Türkiye. This situation causes regional imbalances in the rate of benefiting from the incentives provided to technoparks and R&D centers established under the Technology Development Zones Law No. 4691[5]. While universities and technoparks in developed regions can benefit more from these supports, institutions in underdeveloped regions have difficulty accessing these opportunities. This shows that public incentives cannot be distributed homogeneously throughout the country and the TT ecosystem is not developed equally throughout the country (Tekin & Doğan, 2022).

Regulatory processes have an important place in TT processes. Our country is developing rapid compliance policies with grant programs in Europe and around

the world. While participation in grant programs and the development of national application guidelines create financial value for grant beneficiaries, the speed of participation in the processes does not carry the agility of the private sector. Application processes to benefit from incentives within the scope of regulations such as Law No. 57466 on Support for Research and Development Activities and Law No. 46915 on Technology Development Zones can be complex and time-consuming. In particular, the wide time interval for SMEs and universities to participate in incentive processes also affects the speed of R&D activities. The slow progress experienced in universities' commercialization activities and cooperation processes with industry reveals that regulatory processes need to be accelerated. There are many incentive and support mechanisms in Türkiye for TT processes. There is a partial lack of financial information flow in the implementation phase of the incentives provided by TÜBİTAK and the Ministry of Industry and Technology. Although the guides and application principles published by the grant authority institutions are sufficiently defined, they can be limited to the information provided by service provider organizations to companies/entrepreneurs. The technologies and production processes developed by companies and entrepreneurs can hinder financial literacy management and affect the benefits they can gain from incentive mechanisms.

3.2 Economic Factors

In Türkiye, R&D incentives provided by the state contribute to the economic acceleration of TT processes. Regulations such as the Supporting Research and Development Activities Law No. 5746[6] and the Technology Development Zones Law No. 4691[5] offer direct tax deductions, incentives and various financial advantages for R&D activities. Thanks to these laws, the private sector increases R&D investments and allocates more resources to TT processes. Various grant and support programs provided by institutions such as TÜBİTAK and KOSGEB also encourage the participation of SMEs in TT processes (Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2020). Researchers and technology entrepreneurs in Türkiye have the opportunity to obtain funding from international organizations such as the EU as well as national funds. This situation increases Türkiye's potential to integrate into global markets and creates new business opportunities.

However, access to financing sources for SMEs and early-stage technology companies affects TT processes in Türkiye. The private sector may be reluctant to invest in TT projects, which may slow down the commercialization process of innovative ideas. Limited financing opportunities from venture capitalists and

angel investors affect the development cycle of innovative technologies. Efforts to manage application processes in terms of time and budget may affect the effective use of government incentives for R&D and TT. Access to incentives provided under the Law No. 57466 on Support for Research and Development Activities and the Law No. 46915 on Technology Development Zones may involve complex procedures, especially for small-scale companies. Although this situation weakens the competitive advantage in TT processes, it creates an advantageous result thanks to the project support services of TT Centers located in the regions. The existence of TT Centers in Türkiye transforms international competition in private se

Türkiye, which has to compete with strong technology ecosystems, especially in developed countries, must make major technology investments to survive in global markets. However, the limited financial resources required for countries' competitiveness and actions to comply with international standards require additional financial budgets for countries.

If public incentives are cut or reduced, TT processes may face serious financing problems. In addition, financing provided by universities and research centers' own resources may also be insufficient. In TT processes, inadequate investment in developing technologies such as artificial intelligence, biotechnology, and quantum computing poses the risk of Türkiye falling behind in the global technology race. Although TTOs are critical for the commercialization of knowledge produced at universities, the lack of sufficient expertise and financing in these offices may slow down TT processes. In addition, the problems experienced by TTOs in accessing qualified human resources weaken these structures and reduce the effectiveness of the processes (ÜSİMP, 2022).

The inadequacy of the service quality of TTOs in Türkiye poses a threat to the commercialization of ideas and projects, technological developments, knowledge and TT, and the integration of projects into the industry. TT can be improved and accelerated by increasing the quality of TTOs (TÜBİTAK, 2024).

3.3 Social Factors

Türkiye's young population offers a great opportunity for the TT ecosystem. Young people are rapidly adopting both the entrepreneurship ecosystem and the use of technology thanks to their interest in new technologies and their learning abilities. Young people, who play a more active role especially in digital technologies and innovative ideas, contribute to the increase in technology-based initiatives. Increasing technology-focused curricula with science, technology, engineering, etc. courses taken in universities and secondary schools can ensure the early

development of TT awareness. In addition, with Deneyap Technology Workshops established all over Türkiye, it is possible to ensure that young individuals adopt TT processes and the young population can be included in the R&D process at an early age. The need for trained personnel for R&D can start at an early age and be integrated into the labor market by developing them here. The open attitude of Turkish society towards innovative solutions helps TT processes to be accepted more quickly, which accelerates the process.

Although Türkiye has a young population, regional imbalances in education are one of the important threats affecting the process. Limited opportunities in less developed regions reduce the integration of these regions into education and development processes. The young population has the capacity to adapt to innovative thinking and digital technologies. However, access to qualified labor force and differences in quality in education limit this advantage. In particular, inequalities in education and opportunities between rural and urban centers make it difficult to spread TT processes. Despite the existence of incentive mechanisms for R&D studies in Türkiye, the fact that scientists and experienced and talented engineers go abroad threatens the healthy progress of TT processes. This situation can negatively affect the implementation of innovative projects, ideas and commercialization processes. In addition, the lack of social research projects for the social-societal effects of technological transformation makes it difficult for the society to adopt technological transformation.

The sustainability of TT processes in Türkiye is at great risk due to the limited availability of qualified human resources. Brain drain creates a talent gap and has a negative impact on Türkiye's TT ecosystem by inhibiting innovation and productivity. Talented professionals often seek opportunities abroad, leading to a loss of expertise that could contribute to technological developments and economic growth in Türkiye.

Although there is an increase in the number of young people studying in STEM fields, the lack of a sufficient level of qualified workforce working in these fields may cause TT processes to slow down (ÜSİMP, 2022). Although courses such as information, technology and engineering are included in the curriculum, the fact that these trainings are not applied to all segments of society, especially disadvantaged groups, may cause inequality of opportunity and cause social problems in the long term.

3.4 Technological Factors

Technology is believed to be one of the most important forces supporting economic growth; therefore, an effective TT system will ensure efficient use of resources (Reisman et al, 2004).

For OECD countries, including Türkiye, the fact that the share of high-technology products in exports remains lower than the exports of medium-low-technology, medium-high-technology and low-technology products poses a threat to Türkiye's technological competitiveness (Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2020).

Digital platforms and technological collaboration tools in Türkiye have the potential to accelerate TT. Digitalization can make collaboration processes between universities and industry more efficient. In particular, technologies such as artificial intelligence, big data and the internet of things create new opportunities in TT processes.

Supporting regions and TDZs in Türkiye increases Türkiye’s technological competitiveness. Thanks to incentives and supports such as the promotion of domestic technology production by Republic of Türkiye Ministry of Industry and Technology and TÜBİTAK, and incentives provided to OIZs, domestic and national innovations are increasing. However, the inadequacy of technological device, hardware and information technology infrastructure in some regions of Türkiye may cause slowdowns in TT processes. According to research conducted within the scope of an EU Project conducted by the Technology Development Foundation of Türkiye, the SWOT analysis conducted for TTOs in Türkiye has identified significant deficiencies. These include weaknesses such as the inadequacy of well-trained and experienced TTO personnel, lack of knowledge in IP management and commercialization processes, and the absence of a database and matching portal. These deficiencies, especially when combined with limited R&D infrastructure and access to technology outside of developed regions of Türkiye, make it significantly difficult to commercialize innovative technologies. In addition, adapting to developing technologies and bringing these technologies to the market can often take a long time. The difficulties of TTOs in Türkiye in accelerating these processes negatively affect TT and innovation processes due to the lack of qualified personnel. This situation stands out as one of the critical factors threatening Türkiye's technological progress (Türkiye Kalkınma ve Yatırım Bankası, 2021).

3.5 Environmental Factors

The lack of sustainability and environmental awareness in Türkiye creates a great demand for green technologies and environmentally friendly innovations. In this context, project calls are made at both national and international levels. National organizations such as TÜBİTAK and DAs, as well as international organizations such as United Nations and EU, support and encourage R&D projects on clean energy, green innovation and sustainable technologies. Within the scope of the UN's Sustainable Development Goals and through programs such as Horizon Europe, participants from Türkiye provide funds for such projects. These calls contribute to the development of green technologies and Türkiye's achievement of environmental sustainability goals. In TT processes, this demand can create opportunities, especially in areas such as renewable energy and sustainable agriculture.

Türkiye has very favorable conditions for renewable energy sources such as solar and wind, which offers great opportunities in terms of environmental sustainability. If Türkiye's renewable energy sources are used effectively, a large portion of its electricity needs can be met from these sources. In this context, TT and innovative solutions are of critical importance for a sustainable energy future by both supporting economic growth and minimizing environmental impacts (İncitaş, n.d.). Türkiye's renewable energy capacity, especially in the fields of solar and wind energy, can help the country achieve its environmental sustainability goals. Research conducted by the World Bank and other international organizations shows that Türkiye's investments in renewable energy sources support efforts to reduce carbon emissions and diversify the energy sector. Türkiye's very favorable conditions for renewable energy sources such as solar and wind enable the development of clean energy technologies. TTs in this area can offer great opportunities in terms of environmental sustainability (World Bank, 2022). While the abundance of agricultural lands in Türkiye offers a significant advantage in terms of environmental sustainability, the occupation of these lands by industrial sectors threatens this potential. The transfer of agricultural lands to industry negatively affects not only food security but also biodiversity and ecosystem balance. Regulations such as the EU's Border Carbon Adjustment Mechanism encourage Türkiye's efforts to reduce carbon emissions in order to increase its competitiveness in international trade. In this context, the protection of agricultural lands and the sustainable management of industrial activities play an important role in achieving environmental goals.

Although environmental awareness is increasing, there is a lack of awareness of environmentally friendly technologies in some segments of society. This can lead to social resistance in TT processes that aim for environmental sustainability.

Climate change can directly affect TT processes in Türkiye. Although Türkiye has abundant natural resources such as water resources and agriculture, the decrease in these resources increases the demand for sustainable technologies, but the failure to develop innovations to meet this demand can create economic and environmental risks in the long term.

3.6 Legal Factors

The TT ecosystem in Türkiye plays an important role in the process of transforming innovative ideas and technologies into economic value. The effective operation of this ecosystem is supported by various legal regulations and policies. Legal factors such as the protection of IPR, the regulation of license agreements, R&D incentives and foreign investments directly affect the success of TT. Legislations such as the Industrial Property Law No. 6769[8], the Law on Supporting Research and Development Activities No. 5746[6] and the Law on Direct Foreign Investments No. 4875[15] in Türkiye create the legal framework of this process and increase the sustainability and effectiveness of TT.

With The Industrial Property Law No. 6769[8], the commercialization of inventions made in universities has been facilitated and the rights of inventors have been secured. This regulation encourages universities to participate more in TT. The Technology Development Zones Law No. 4691[5] also provides tax advantages and incentives for companies located in TDZs and has the potential to accelerate TT processes. Law No. 5746[6] on Supporting Research and Development Activities, tax incentives and personnel support provided for R&D projects, offers opportunities to increase academic and industrial collaborations in TT processes. These laws particularly offer opportunities for increasing collaboration between universities and industry.

Entrepreneurs and investors are not sufficiently involved in the necessary steps to receive incentives due to their nature of focusing on developing production and service processes. As a result of the extra information capabilities of service recipients, an open space is created for small-scale companies, investors and entrepreneurs, and the duration of administrative processes is shortened.

As is the case worldwide, patent application processes can take a long time in Türkiye. The extension of patent registration processes due to legal deadlines also affects the protection and commercialization processes of innovative inventions.

Technology license agreements are still in the development phase in Türkiye. Contracts that define clear lines in license agreements help resolve disputes and strengthen cooperation between parties.

4 Main Actors of the Technology Transfer Ecosystem in TÜRKİYE

4.1 Profile of Major Institutions

4.1.1 Prominent Research Centers

Universities are rare institutions that include the entirety of science, technology, added value production, reaching the level of contemporary civilization and development, as well as the social, political and economic aspects of society. In order to encourage the innovation and entrepreneurship activities of universities in Türkiye and to measure their performance in this area, the Entrepreneurial and Innovative University Index was first prepared by TÜBİTAK in 2012 (TÜBİTAK, n.d). The Entrepreneurial and Innovative University Index is an important indicator that measures the entrepreneurship and innovation performance of universities in Türkiye. This index, prepared by TÜBİTAK, evaluates the success of universities in criteria such as technology development, creation of an entrepreneurial ecosystem, research capacity, project production, IPR and collaboration with industry. The index analyzes the ability of universities to commercialize innovative projects and the extent to which they have adopted an entrepreneurial culture and ranks the most successful universities in Türkiye that contribute to the innovation ecosystem.

Research universities are universities that conduct high-level academic and scientific research, contribute to knowledge production, train researchers and contribute to the country's knowledge infrastructure. The increasing importance of the concept of research universities has also affected higher education policies in Türkiye and has manifested itself in the Research University Initiative, which aims fto increase research productivity and quality (Gülbak, 2020). In Türkiye, institutions granted research university status by the YÖK are considered to have the potential to conduct academic studies that can compete both nationally and internationally. These universities are also important as centers that encourage TT by collaborating with industry. Research universities in Türkiye contribute to the country's knowledge base with their research infrastructure, technological facilities and qualified human resources and provide support to industry with R&D projects.

When examined in this context, it is seen that the main areas of activity of TTOs directly contribute to the Entrepreneurial and Innovative University Index and Research University indicators. Considering these headings, some of the leading research universities and the TTOs of these universities are listed below.

4.1.1.1 Middle East Technical University

Founded on November 15, 1956 under the name "Middle East Institute of Technology", METU is a university that aims to train experts in the fields of science and social sciences. METU is one of the leading universities in Türkiye with its scientific level, cultural and intellectual activities. METU has 5 faculties offering a total of 41 undergraduate programs, 107 graduate and 69 doctoral programs.

The university became the first university in Türkiye to establish a central computer system in 1966, opened an archaeological museum displaying excavation findings on campus in 1968, and implemented many innovations such as initiating the technopark initiative in Türkiye in 1987 and establishing Türkiye's first Internet connection in 1993 (Vikipedi, n.d).

Technology Transfer Office: METU TTO

METU TTO was established in 2007 within METU Technopolis to support academics for the university's patent processes and to raise awareness about IPR. It is the first TTO established in Türkiye. It received support from the TÜBİTAK 1513-TTOs Support Program in 2013. It currently has 12 active employees.

Operations

- **Core Services**
  - Industrial Property Rights and Contracts Services
  - Commercialization Services
  - UIC Services
- **Funding Mechanisms**
  - Income from UIC projects
  - Resources provided through national (TÜBİTAK, KOSGEB, support provided by ministries, etc.) and international funds
- **Policies/Strategies Related to TT**

As a result of the strategies followed by METU TTO to make TT processes more effective, the following programs have been developed (ODTÜ, n.d):

- **METU TTO Pre-Seed Fund Program:** It was launched in 2022 to increase the Technology Readiness Levels (TRL) of early-stage academic inventions in the METU TTO portfolio. The program, which was launched to increase the commercialization potential of the METU TTO

patent portfolio, has the distinction of being the first program in Türkiye carried out with TTO's own resources for the development of academic inventions. Within the scope of the program, budget support is provided to Inventor academics for 12-month project activities.

- **LabsOut Program:** Launched in 2018 with the aim of accelerating the commercialization of technologies produced at METU and increasing the number of academic initiatives based on IPR, the LabsOut program was designed for METU academics, doctoral and graduate students in cooperation with METU TTO, Growth Circuit and Berkeley University. In 2018 and 2019, 11 academics gained experience in presenting their commercial ideas to international investors in the program held in San Francisco after attending two-stage training modules in Türkiye.
- **Co-Tech Program:** With the "First Develop, Then Commercialize" strategy, research results obtained at the university are matched with start-ups in the relevant sector to establish mutually beneficial collaborations. The Co-Tech program, which was launched in the first half of 2016 to solve the problem of university inventions generally being early-stage technologies and investors not showing interest in these areas due to "high risk", is one of the most effective tools of METU TTO. Thanks to this program, the technology development process of inventions before commercialization is initiated and early-stage inventions are turned into products with the support provided by national and international funds.
- **Proboost Program:** The ProBoost acceleration program, implemented within the framework of UIC, brings academics and companies together and provides the necessary support to benefit from various grant programs for the projects they will develop. Within the scope of the program, academics are matched with the demands from industry and industrial project partners suitable for their areas of expertise are determined.
- **Patent Acceleration Support Program:** It was developed to support companies in METU TEKNOKENT to gain competitive advantage in the market and was launched in 2018. This program provides support for issues such as preparation of preliminary research and application documents for inventions and designs developed by companies, making patent or design applications, monitoring research report processes and payment of attorney fees.

- **Internal Processes & Practices**

The applications offered to the ecosystem by METU TTO are presented below:

- Creative processes and rapid patenting methods to commercialize R&D projects

- Evaluating academic inventions according to their commercializability potential and matching them with suitable companies
- Providing direct contact with industry using digital channels and fairs for technology promotion
- Providing consultancy to academics and industry in areas such as project development, patent application, and finding funds
- Supporting collaborations by establishing strategic partnerships with national and international companies

Key Achievements

METU TTO's invention portfolio has a strong diversity in different technology areas. In the field of medical technologies, medical devices and biomedical innovations stand out and contribute to the health sector. In the field of materials and chemistry, it supports the industry with new material development and advanced chemistry applications. In the field of defense and security, critical defense technologies and security solutions are developed. In energy and environment, it focuses on sustainable energy systems and environmentally friendly technologies. In the field of machinery and manufacturing, it offers innovative solutions for industrial production processes, while in the field of information and communication technologies, it has a strong presence with digital transformation and software-based innovations.

Metrics and Impact

- Patent support for over 250 inventions, 750 patent/design applications, 420 patent/design registrations.
- 60 licensed technologies
- 17 startups/spin-offs
- 500+ UIC projects.

4.1.1.2 Istanbul Technical University

Istanbul Technical University (ITU), founded in 1773, is the first technical university in Türkiye and is known for its engineering and architecture education (İTÜ, n.d). It provides master's and doctoral education in 13 faculties, 1 conservatory, 67 undergraduate programs and 7 institutes on 5 separate campuses located in the central points of Istanbul. It is one of the most established and respected technical universities in Türkiye. It has been a pioneer in the fields of science, technology and engineering for over 250 years.

Many firsts in the field of engineering in Türkiye were realized by ITU, such as the first television broadcasting in Türkiye, the establishment of the first university radio, the first use of computers at a university, the first time a Turkish university sent a satellite into space; the first domestic communication satellite, the first

domestic helicopter and the first domestic unmanned automobile were built (Vikipedi, n.d).

Technology Transfer Office: ITUNOVA TTO

ITUNOVA Technology Inc., established in 2013, started operating as ITUNOVA TTO in January 2014 with the support of TÜBİTAK's 1513 Call. Working with a team of 16 people, ITUNOVA Technology Inc. is positioned as a company with the shareholding of ITU, ITU Foundation, and ITU ARI Teknokent.

As the TTO of ITU, ITUNOVA TTO serves the purposes of commercializing research and innovation activities within the university, establishing collaborations with industry, and encouraging entrepreneurship. In this process, it is in close cooperation with ITU ARI Teknokent and ITU Çekirdek. This structure ensures that academic knowledge and experience at the university are transferred to the economy and industry by operating ITU's research, technology development, and entrepreneurship ecosystem in an integrative manner.

Operations

- **Core Services**
  - National and International Funds Services
  - UIC Services
  - IPR Services
  - Incubation and Acceleration Services
- **Funding Mechanisms**
  - Income from UIC projects
  - Resources provided through national (TÜBİTAK, KOSGEB, support provided by ministries, etc.) and international funds.
- **Policies/ Strategies about TT**

Strategies developed by ITUNOVA TTO to make TT processes more effective are listed below (İTÜNOVA TTO, n.d).

- **ITU ARI Teknokent:** It is a TDZ operating within ITU and is one of the largest technokents in Türkiye. Founded in 2003, ITU ARI Teknokent operates with the aim of providing support to entrepreneurs and companies that carry out projects focused on research, development and innovation. Teknokent provides an important platform for the implementation of innovative projects and the development of UIC.
- **ITU Çekirdek:** It is one of the leading incubation centers in Türkiye operating within ITU. Founded in 2011, ITU Çekirdek aims to help technology and innovation-focused entrepreneurs develop, grow and commercialize their projects. Providing support for both early-stage

entrepreneurs and projects in the idea stage, the center is considered one of the most important parts of the entrepreneurship ecosystem.

- **Big Bang:** It is a start-up competition organized by ITU Çekirdek since 2012 and offers entrepreneurs the opportunity to introduce their business ideas. This event is open to both Turkish and international entrepreneurs and enables entrepreneurs to meet with investors, expand their business networks and introduce their projects.

- **Internal Processes & Practices**

The applications offered to the ecosystem by ITUNOVA TTO are presented below:

- Innovative approaches, technology marketing strategies and industrial collaborations
- Evaluation and monitoring of TT projects, internationalization activities
- Protection of inventions and support for the integration of business ideas into commercial life
- Provision of pre-incubation, accelerator, financial service mechanism (Big Bang) and incubation services to entrepreneurs who want to implement their technology-based ideas with the ITU Çekirdek Early Stage Incubation Center.

Key Achievements

ITUNOVA TTO aims to commercialize ideas by protecting inventions with patents, marketing promising technologies to the industry, and executing license agreements with interested parties. In this context, ITUNOVA TTO has achieved many commercialization successes. For example, the cellulose technology included in the "A Bulk Delignification" patent registered in America, Russia, and Türkiye, supported by ITUNOVA TTO, was licensed to a company operating in the cosmetics sector.

Metrics and Impact

- 269 national, 145 international patent applications
- 40 patent registrations in 2022
- 1600 number of corporate ventures, 4700 number of supported ventures
- 1185 UIC projects

4.1.1.3 Boğaziçi University

It was founded in 1863 by Dr. Cyrus Hamlin and Christopher Rheinlander Robert as Robert College in Istanbul. Robert College, the first American college within the borders of Türkiye, was transferred to the Turkish government in 1971 and was named Boğaziçi University (BU) (BÜ, n.d). The University: It has become an educational institution recognized in the national and international arena by conducting a wide range of research and teaching activities with 33

undergraduate, 67 graduate and 33 doctoral programs in 7 faculties, 1 college, and 7 institutes.

Technology Transfer Office: BU TTO

BU TTO was established in 2012 and acts as an interface that coordinates the university's relations with industry and funding sources. The organizational structure includes UIC, IP management, and national and international grant programs units. TTO employs 9 people who are experts in technology management, IP, and entrepreneurship.

Operations

- **Core Services**
  - UIC Services
  - IPR Services
  - National and International Grant Services
  - Entrepreneurship and Investment Services
- **Funding Mechanisms**
  - Income from uIC projects
  - Resources provided through national (TÜBİTAK, KOSGEB, supports provided by ministries, etc.) and international funds
  - Intra-university research funds
- **Policies/ Strategies about TT**

The process presented below has been included by BU TTO in order to make TT processes more effective.

- **Dream BİGG:** BU TTO has applied to the TÜBİTAK 1812 – Investment-Based Entrepreneurship Support Program, also known as the BİGG Investment Program, and has received the title of Implementing Organization. With this program, it supports the activities of entrepreneurs from the idea stage to the market, so that they can transform their technology and innovation-focused business ideas into enterprises with high added value and qualified employment potential.

- **Internal Processes & Practices**

The applications offered to the ecosystem by BU TTO are presented below:

- Protection of IPR and licensing to industrial partners
- Promotion of technologies developed within the university in national and international markets
- Development of cooperation projects between the university and industry

- Conducting international TT projects and discovering new markets

Major Achievements

The first TTO joint stock company with a special status belonging to a university, which will ensure the commercialization of technologies developed at universities in Türkiye, was established at BU. Within the scope of the Regulation on TTOs for Higher Education Institutions, which allows universities to establish TT companies, the TTO within BU has become a company for the first time in Türkiye and gained the status of a capital company (Joint Stock Company).

Metrics and Impact

- 108 patent applications
- 15 number of licensed technologies
- 35 startups/spin-offs
- 45-50 UIC projects per year

4.1.1.4 Sabancı University

SU was established in 1994 under the leadership of the Sabancı Foundation and started education in 1999. It has an interdisciplinary research and education approach and is the first Turkish university to become a member of the European Foundation for Quality Management (Sabancı Üniversitesi, n.d). The university is recognized as an innovative model in Türkiye and internationally with its philosophy of "creating and developing together". It started education as the first higher education institution in Türkiye to provide liberal sciences style education. In 2020, it was ranked 2nd in the Times Higher Education magazine ranking of the top 10 Turkish universities.

Technology Transfer Office: Sabancı University Research Development and Technology Transfer Office

SU Research Development and Technology Transfer Office (SUATT) was established in 2001 at SU. The office ensures the management of research and innovation activities within the institutional framework and supports sustainable R&D processes throughout the university. It is among the first TTOs established in Türkiye. SUATT employs a total of 33 people.

Operations

- **Core Services**
  - Arts and Social Sciences and Management Sciences Project Services
  - Engineering and Natural Sciences Project Services
  - Research Project Management Services
  - External Stakeholder Access Services
  - IPR Management and Licensing Services

- **Funding Mechanisms**

As of June 2024, SU's external active research fund size has reached 1.38 billion TL with 273 projects, and the distribution of this fund according to financing sources is given below (Sabancı Üniversitesi, n.d).

  - EU: 48%
  - TÜBİTAK: 24%
  - Private sector: 11%
  - NGO-University-Other: 17%

- **Policies/ Strategies about TT**

Strategies developed by SUATT to make TT processes more effective are listed below.

  - **Inovent A.Ş:** Türkiye's first technology commercialization and seed funding company, founded by SU in 2006. It provides services and carries out projects in the field of technology commercialization, from entrepreneurial candidates at the idea stage to fast-growing startups, from academics developing commercial technologies to medium-sized enterprises seeking funding.
  - **Pre-Incubation and Accelerator Services Center:** Since 2013, SU has been providing training, business development mentoring, funding support and strategic consultancy services to early-stage entrepreneurs who create added value, meet a real need based on technology-R&D and provide them with training, business development mentoring, funding support and strategic consultancy services to achieve international success.

- **Internal Processes & Practices**

The applications offered to the ecosystem by SUATT are presented below:

  - Expanding and commercializing the patent portfolio
  - Transforming innovative ideas born within the university into spin-off companies
  - Facilitating technology licensing processes and supporting the university with the goal of creating economic benefits
  - Bringing together SU research with industry, transforming projects into economic and social benefits
  - Developing international partnerships for the global applicability of research projects

Key Achievements

The project titled "Demonstration of a sustainable circular-by-design manufacturing system based on additive manufacturing" with the acronym

DIAMETER, conducted by SU Faculty Members, was supported within the scope of the Horizon Europe Program. The total budget of the project, consisting of 18 partners from Europe, Asia, America and Australia, is 6 Million Euros. Thanks to the DIAMETER project, outputs with significant environmental and economic impacts will be obtained within the scope of Compliance with the European Green Deal, which is also among Türkiye's strategic development goals.

Metrics and Impact

- 364 patent applications
- 1.38 billion TL budget externally funded active research fund as of 2024
- 15 number of startups/spin-offs as of 2024

4.1.1.5 Karadeniz Technical University

Karadeniz Technical University (KTU) was established on May 20, 1955 by a law passed by the Turkish Grand National Assembly. Being the first university outside of Istanbul and Ankara, KTU started education in 1963 and moved to its current central campus in 1966. The university has a wide academic spectrum with its faculties of engineering, basic sciences, forestry, earth sciences and medicine. Within the scope of 12 faculties, 1 college, 8 vocational schools, KTU has 78 undergraduate and 34 associate degree programs; 80 graduate and 57 doctoral programs in 6 institutes (Karadeniz Teknik Üniversitesi, n.d). KTU is the fourth oldest university in the Republic of Türkiye. It is the first university established outside of the provinces of Istanbul and Ankara and also the second technical university established.

Technology Transfer Office: KTU Technology Transfer Application and Research Center

KTU Technology Transfer Application and Research Center (KTU TTC) was established in 2012 with the decision of the university senate as an official unit affiliated to the rectorate under the name of TTO in order to ensure that the infrastructure and academic pool within KTU are used to meet local, regional, national and international needs, to contribute to the development of the target audience in R&D and innovation focuses and to act as a bridge in UIC and to operate with an interface identity in cooperation and harmony with the relevant internal and external support units. It continued its activities in this status until 2018. As of 2018, it continues its activities as an Application and Research Center. TTC has 20 full-time employees. 4 of the employees are funded by TÜBİTAK 1513 and 1 by the Black Sea Basin Cross-Border Cooperation support programs (İskender Balaban, 2024).

KTU TTC stands out as a leading TTO that strengthens the ecosystem in the Black Sea Region. It guides companies in the region in their R&D and innovation

processes, brings together the knowledge and expertise of academics with industry, and makes significant contributions to regional development.

Operations

- **Core Services**
  - Awareness, Promotion, Information and Education Services
  - Project Support Services
  - UIC Services
  - IPR Management and Licensing Services
  - Entrepreneurship and Incorporation Services
- **Funding Mechanisms**
  - Resources provided through national (TÜBİTAK, KOSGEB, supports provided by ministries, etc.) and international funds
  - Income obtained from UIC projects
  - Intra-university research funds
- **Policies/Strategies about TT**

The applications developed by KTU TTC to conduct TT processes more effectively and expand the ecosystem are listed below:

- **Gaining Project Implementation Experience:** Finding programs with suitable ideas for international programs, filling out the application form, searching for partners and making the application. In addition, by supporting the applied projects, both the application phase and the project implementation phase are carried out one-on-one, and experience is gained in project application and implementation phases. With the experience gained in the application and implementation processes, all stages can be conveyed in the best way to those who will apply for the project.
- **R&D and Design Center Establishment Support:** In order to make R&D sustainable and encourage R&D, support services are provided during the preparation and implementation phases so that companies can obtain the title of R&D and Design Center through the Ministry of Industry. With this application, an organic connection is established between R&D and Design Centers and Universities. Since companies with R&D Centers have adopted the R&D culture and are open to continuous improvement and development, they are seen as priority institutions for producing UIC projects.
- **Academician R&D Catalogue:** Prepared for industrialists, the Academician R&D Catalogue is an important tool that aims to make UIC more efficient and effective. This catalogue allows industrial representatives to easily access the areas of expertise and current

research projects at universities. This catalogue, which introduces academicians' scientific competencies, the projects they carry out and the inventions they obtain, makes it easier for industrial organizations to find academic partners that suit their needs and to quickly implement potential collaborations. In addition, this catalogue accelerates the conversion of R&D activities into commercial value by paving the way for new collaborations and contributes to the national economy. Thus, it strengthens the flow of information between industry and academia, develops innovative solutions and creates sustainable growth opportunities for both parties.

- **Internal Processes & Practices:**

The applications offered to the ecosystem by KTU TTC are presented below.

- Organizing information, promotion and training activities
- Utilizing national and international funds, performing pre-evaluation of projects before application and providing support during application stages
- Patent applications, protection and management of inventions
- Commercialization of technologies and realization of license agreements
- Encouraging UIC and developing joint projects
- Supporting the establishment of new ventures and spin-off companies

Key Achievements

KTU TTC has been supported by TÜBİTAK with the 'Eastern Black Sea Entrepreneurship Movement' project in order to spread the entrepreneurship movement in the region and to ensure the sustainability of the initiatives and has gained the title of Implementing Organisation. The partnership structure of the project includes seven universities from the Eastern Black Sea Region and VAKIFBANK, and it is evaluated that this structure will contribute to the development of the entrepreneurship ecosystem in the region and offer significant benefits to national development. Since 2020, KTÜ TTC, which has been carrying out Implementing Organisation activities since 2020, has supported more than 500 entrepreneurs and the incorporation processes of more than 20 initiatives with TÜBİTAK funding.

Metrics and Impact

- 250 patent applications, 77 patent registrations
- 46 number of startups/spin-offs in the last 5 years
- 250 UIC projects

4.1.2 Prominent Research Centers

There are many research centers in Türkiye that provide services in different scientific fields. Although these centers make significant contributions to the scientific and technological development of the country, they face common challenges in terms of management, financing and collaborations. In order to find solutions to these problems, the Law No. 6550[16] on Support for Research Infrastructures, enacted by the Ministry of Development of the Republic of Türkiye, has enabled these centers to work more effectively and strengthen their collaboration with the private sector.

Among the important research centers that received their first qualification certificate within the scope of the law in 2017 and achieved the title of "National Research Infrastructure" are SU Nanotechnology Research and Application Center (SUNUM), Bilkent University National Nanotechnology Research Center (UNAM) and METU Micro-Electro-Mechanical Systems (MEMS) Center. In addition, these three research infrastructures are the infrastructures established within the universities that are in the top 10 in the 2023-2024 URAP Türkiye ranking (URAP, 2023). These three institutions are among the leading research centers in Türkiye, considering the projects they have carried out to date, their achievements and their competencies. The activities of these centers, their scientific achievements and their contributions to the country will be examined in detail below.

4.1.2.1 Sabancı University Nanotechnology Research and Application Center

SUNUM is one of the leading nanotechnology research centers in Türkiye. Founded in 2010, SUNUM draws attention with its innovative studies in fields such as advanced materials, nano-biotechnology, nano-electronics (Sabancı Üniversitesi, n.d). After a very competitive screening process by the Ministry of Development, SUNUM was selected as one of the four National Research Infrastructures in 2017.

Technology Transfer Office: SUNUM TTO

SUNUM TTO was launched simultaneously with the establishment of the center and acts as a bridge between the center's research outputs and industry. TTO is managed by an experienced team of engineers, scientists, lawyers and business experts.

Operations

- **Core Services**

The basic services of SUNUM as stated in its 2023 activity report are as follows (Sabancı Üniversitesi, 2023):

- Developing pioneering projects that are suitable for country and industry needs through interdisciplinary research
- Providing services such as consultancy, design and prototype production to stakeholders with nanotechnology infrastructure
- Transforming research results into socioeconomic value by establishing strategic industry collaborations
- Contributing to the maintenance of long-term collaborations between academia and industry and TT
- Providing information sharing and international collaboration opportunities to train future researchers
- Supporting new products and initiatives that contribute to economic development with nanotechnology solutions

- **Funding Mechanisms**

According to Law No. 6550[16], the income of research infrastructures consists of the income obtained from the services provided and projects carried out, donations received from domestic and foreign countries, project supports, income from IPR, income provided by the higher education institution, resources transferred from the central government budget and other incomes (T.C. Strateji ve Bütçe Başkanlığı, 2016).

- **Policies/ Strategies about TT**

SUNUM offers an ecosystem that aims to transform academic research into commercial value through its projects and programmes in the field of nanotechnology and advanced materials. In this context, it organises various programmes and calls that accelerate the commercialisation processes of researchers and entrepreneurs and support product development stages. The details of the applications mentioned in SUNUM's Annual Report published in 2023 are as follows (Sabancı Üniversitesi, 2023);

- **SUNUM e-Store:** It is a virtual platform where prototypes, products and services obtained from the outputs of SUNUM-supported research meet with users. It supports the transition of nanotechnology solutions, products and services to commercial processes.
- **ArTS Programme:** The Research Commercialisation Strategies (ArTS) Workshop identifies the commercial potential of SUNUM research and supports the creation of a technology roadmap and business plan.
- **Strategic Product/Prototype Portfolio (SPPP):** The commercial potential of new technologies emerging from SUNUM projects is evaluated, and those deemed appropriate are developed with internal funds and directed to the commercialisation process.
- **seed.SUNUM Programme:** It is an acceleration programme that provides support for rapid product development and prototyping

according to market demands and supports research outputs with high productisation potential.

- **spnSUNUM Programme:** Early-stage start-ups in the field of nanotechnology and advanced materials can benefit from SUNUM's infrastructure and benefit from rapid product development processes.
- **NORMDEA Call:** It is a call opened to support innovative commercial ideas in the fields of biology, chemistry and engineering at universities. Some of the evaluated projects continue negotiations in the fields of pharmaceuticals, functional food and cosmetics.

The main strategy of SUNUM is to transform the accumulated knowledge obtained from research results carried out in global and national priority areas into high value-added information products and services for society.
In 2023, SUNUM carried out various collaborations with 19 different industrial and public institutions at the international level. In this context, different agreements were made including international industrial collaborations, partnership triggering projects and academic collaborations. In addition, in 2023, cooperation agreements were signed with 18 international academic institutions within the scope of joint project applications (Sabancı Üniversitesi, 2023).

- **Internal Processes & Practices**

SUNUM has designed its goals for 2024 and beyond in line with the national policy that supports the strengthening of export-oriented companies that can produce domestic and national solutions, reduce foreign dependency and support export-oriented companies. In this context, SUNUM operates in line with the following objectives (Sabancı Üniversitesi, 2023):

- **Growth through Platforms:** SUNUM aims to expand its research and development activities by developing collaborations with technology and innovation platforms and receiving international funding support.
- **Contributions in Nanotechnology:** To carry out diversification studies in order to utilise the know-how in the field of nanotechnology more widely in the national value chain in the short and medium term.
- **Licensing of Intellectual Property and Corporatisation:** To support the establishment and growth of knowledge-based and agile companies by licensing innovative ideas.
- **Commercialisation of Research Results:** Aiming to transform research outputs into commercial products with the right value in local and international markets.

With these objectives, SUNUM aims to contribute to reducing Türkiye's external dependency, increasing its export capacity and supporting high-tech production.

Key Achievements

The international and national projects highlighted in SUNUM's 2023 annual report are as follows (Sabancı Üniversitesi, 2023):

- **Nanobiotechnology Project (NANOBIO4CAN):** The project, carried out within the scope of Horizon Europe MSCA COFUND, works on nano-biotechnologies with the aim of developing innovative therapeutic approaches for cancer. Izmir Biomedicine and Genome Center (IBG), Koç University Translational Medicine Center and TÜBİTAK MAM participate in the project, which is coordinated by SUNUM.
- **Team.NANO Project:** Evaluated by the EU Commission on micro-nanofabrication and flexible electronics within the scope of the HORIZON-WIDERA-2023 call and qualified to proceed to the second stage.
- **NATO DIANA Program:** SUNUM applied to participate as a test center in NATO DIANA, an international start-up support program.
- **European Digital Innovation Centers - ADİM:** The "Sensor Platform" application of the consortium formed under the coordination of SUNUM has been accepted for this project carried out by the Presidency Digital Transformation Office and the Ministry of Industry and Technology.
- **NANOSIS:** The Technology Acquisition Roadmap titled “NANOSIS” carried out by SUNUM is supported within the scope of the TÜBİTAK High Technology Platforms Support Program (1004). This project, which aims to develop fast, economical and original nanotechnological components, products and systems for monitoring and diagnosis in the field of health, is carried out jointly with universities such as Sabancı, Koç, Yeditepe, Marmara, Ankara and ITU and companies such as Arçelik, Eczacıbaşı Monrol and Ford Otosan.
- **LignoNANO:** A project that aims to produce high value-added advanced nanotechnological materials from woody materials, carried out under the leadership of SUNUM within the scope of the TÜBİTAK 1004, in partnership with companies such as Vestel, Renault and institutions such as İTÜ and SÜ EFSUN. The project focuses on the development of green and environmentally friendly materials to contribute to a sustainable circular economy.

Metrics and Impact

- 129 patent applications, 63 patent registrations (Sabancı Üniversitesi, 2023).
- 438 research projects (Sabancı Üniversitesi, 2023).
- Collaborated with 245 national and 72 international institutions and organizations (Sabancı Üniversitesi, n.d).

4.1.2.2 Bilkent University National Nanotechnology Research Center

UNAM was established in 2007 as a "National Laboratory" at Bilkent University and conducts interdisciplinary R&D activities in nanotechnology, materials science, biotechnology, nanobiotechnology and related fields (Bilkent Üniversitesi, n.d). It became one of the first four National Research Centers of Türkiye by gaining qualification in 2017 within the scope of the Law on Support for Research Infrastructures No. 6550[16]. UNAM contributes to both academia and industry with its high-tech and innovation-focused R&D projects and continues its work in a wide range from scientific research to technology commercialization.

Technology Transfer Office: UNAM TTO

UNAM TTO was established to commercialize UNAM's R&D activities and protect IPR, Its organizational structure includes a team of experienced patent experts, licensing consultants and TT experts. TTO provides services with personnel specialized in many fields in parallel with UNAM's interdisciplinary structure.

Operations

- **Core Services**

UNAM's basic services are as follows (Bilkent Üniversitesi, n.d).

  - Patent and commercialization support: Contributing to the commercialization of high-tech products
  - Academic and industrial collaboration: Enabling knowledge production and new technology development by encouraging UIC
  - Education and consultancy: Providing qualified human resources and continuous consultancy services for researchers
  - IP protection: Supporting the protection of IPR of scientific inventions

- **Funding Mechanisms**

According to Law No. 6550[16], the income of research infrastructures consists of the income obtained from the services provided and projects carried out, donations received from domestic and foreign countries, project supports, income from IPR, income provided by the higher education institution, resources transferred from the central government budget and other incomes (T.C. Strateji ve Bütçe Başkanlığı, 2016).

- **Policies/ Strategies about TT**

UNAM, as a leading knowledge community and science-technology center in Türkiye (Bilkent Üniversitesi, 2023) UNAM's TT policies aim to provide high added value to the country by transferring the knowledge produced in nanoscience, nanotechnology, biotechnology and material sciences to the industry. In this context, an open laboratory model has been established with a world-class infrastructure, and interdisciplinary cooperation and innovation have been

prioritized. While qualified human resources are trained with the advanced education and machine techniques provided at Bilkent University, creative R&D ideas are supported by systematic innovation processes. UNAM aims to make sustainable contributions to Türkiye's science and technology ecosystem as a competitive TT center at national and international levels.

- **Internal Processes & Practices**
  - In order to train future academic and technological leaders, it provides thesis-based graduate education at the Materials Science and Nanotechnology Institute (MSN) within Bilkent University. In addition, it aims to attract talented scientists by conducting basic and applied advanced research in MSN and other fields (Bilkent Üniversitesi, 2023).
  - It provides machine training for advanced techniques using its infrastructure and trains qualified R&D workforce (Bilkent Üniversitesi, 2023).
  - In order to encourage qualified knowledge production in its fields of activity, it supports the development of creative ideas in basic and applied R&D studies. It also aims to contribute to Türkiye's scientific and technological achievements by using advanced technology platforms and systematic innovation processes. (Bilkent Üniversitesi, 2023).

Key Achievements

UNAM has been involved in important projects, the following successful projects are included in the 2023 activity report (Bilkent Üniversitesi, 2023).

- **TÜBİTAK 1004 A1 Program Execution:** UNAM has made significant contributions as a R&D center that stands out with its achievements in critical high-technology fields in Türkiye. In particular, within the scope of the TÜBİTAK 1004 A1 Program, it has played a leading role in the development of value-added high-technology products in strategic sectors such as Türkiye's defense industry, durable consumer goods, electronics and glass. As the executor of the program, UNAM aims to develop innovative technologies by collaborating with Türkiye's leading industrial organizations **TUSAŞ, Vestel and Şişecam**, as well as academic institutions such as Bilkent University, Eskişehir Technical University, Abdullah Gül University and The Union of Chambers and Commodity Exchanges of Türkiye (TOBB) University of Economics and Technology.
- **Türkiye's only optical fiber preform production infrastructure and optical fiber shooting tower:** UNAM makes significant contributions to Türkiye's industrial infrastructure in areas such as **nanomaterials, transparencies, structurals, avionic displays and advanced technology glass,** and aims to gain local and national technologies by upgrading these technologies to 6, 7, 8 and 9 readiness levels. Especially

panda type polarization protected optical fibers, which have a critical role in the defense industry, are produced in Bilkent UNAM's advanced infrastructure and these fibers are successfully used in the Turkish defense industry. UNAM draws attention with **Türkiye's only optical fiber preform production infrastructure and optical fiber shooting tower** and manufactures high-tech products such as commercial quality PM fibers that can be produced in lengths of over 100 kilometers in a single run.

- **Bilkent University MSN Program:** In addition, UNAM's contribution to scientific education and R&D projects is also significant. **Bilkent University MSN Program** educates future scientists by offering comprehensive R&D projects in different disciplines such as materials science and engineering, nanobiotechnology, nanocrystal LEDs and lasers, optical fibers and nanocomposites. Graduates of the program continue their careers in the world's most prestigious universities such as **Stanford, MIT, Yale, Cambridge, Harvard or in leading industrial organizations such as Aselsan, TUSAŞ, Intel, Apple.**

Metrics and Impact

- Over 500 patent applications, 137 national and 87 international patent registrations (UNAM, Personal communication, 2024)
- 29 startups/spin-off companies (UNAM, Personal communication, 2024)
- 53 licensed technologies (UNAM, Personal communication, 2024)

4.1.2.3 METU Micro-Electro-Mechanical Systems Center

METU MEMS Center is one of the leading research centers in Türkiye in the field of Micro-Electro-Mechanical Systems. Its foundations are based on the microelectronic infrastructure established within TESTAŞ A.Ş. in the 1980s. This infrastructure, transferred to METU in 1998, prepared the necessary ground for the start of MEMS research. Officially approved by the YÖK in 2008, METU MEMS Center is one of the first 4 National Research Centers in Türkiye, having received qualification within the scope of Law No. 6550[16] in 2017. The Center has become a world-renowned center of excellence in the fields of MEMS technology, microfabrication and microsystems development (ODTÜ MEMS, n.d).

Technology Transfer Office: METU MEMS TTO

METU MEMS TTO continues its activities for the commercialization of R&D outputs within the framework of Law No. 6550[16]. The center, which has a staff of 97, employs 55 researchers, a significant portion of whom have master's and doctoral degrees. TTO plays a central role in patent applications, licensing and industry collaborations.

Operations

- **Core Services**

METU MEMS's basic services are as follows (ODTÜ MEMS, 2024).

- TT and entrepreneurship support: Supporting entrepreneurship and TT processes to transform the produced knowledge into commercial value
- Private sector and academic cooperation: Preparing and implementing projects by collaborating with the private sector, universities and public institutions
- Project financing and management: Developing projects with national and international resources and providing financing for these projects
- Establishing a company and partnership: Establishing a company or becoming a partner in existing companies to commercialize the developed technologies
- IPR: Taking the necessary steps for the acquisition, protection and use of the produced IP

- **Funding Mechanisms**

According to Law No. 6550[16], the income of research infrastructures consists of the income obtained from the services provided and projects carried out, donations received from domestic and foreign countries, project supports, income from IPR, income provided by the higher education institution, resources transferred from the central government budget and other incomes (T.C. Strateji ve Bütçe Başkanlığı, 2016).

- **Policies/ Strategies about TT**

METU MEMS Center aims to be a leader in Türkiye by conducting scientific research in the field of MEMS and to contribute to the country's economy by transforming the knowledge it develops in cooperation with the private sector into a product. In line with this purpose, the center implements comprehensive policies and strategies regarding TT, as stated in the 2023 activity report (ODTÜ MEMS, 2024).

- **IP Management and Commercialization Strategies:** The Center takes the necessary measures to obtain, protect and transform the IPR obtained as a result of the research conducted into commercial values. The Center makes patent applications in order to protect the intellectual rights obtained and develops strategies for the transfer of these rights to private or legal persons. Thus, it is aimed to integrate innovative technologies that will contribute to the country's economy into the industry. IPR Policy; It is organized in accordance with the Research Infrastructure Legislation No. 6550[16].
- **Spin-off Creation:** METU MEMS follows strategies of establishing companies or forming partnerships with existing companies in order to accelerate the commercialization of the knowledge produced and

technologies developed. By supporting the creation of new technology-based initiatives, the center aims to accelerate the commercialization process of the innovations it develops and to establish stronger ties with the industry.

- **Cooperation with Private Sector and Project Development:** METU MEMS establishes strong cooperation with private sector, universities and public institutions and presents projects to national and international financing sources and carries out these projects. In this way, the integration of developed MEMS technologies with industry is facilitated and TT processes are accelerated.

- **Internal Processes and Practices**

The internal processes and practices carried out at the METU MEMS center are as follows (ODTÜ MEMS, 2024).

- **Innovative Approaches:** METU MEMS offers advanced technology solutions to both internal and external stakeholders by expanding the use of the technologies it develops in MEMS devices. This process is supported by the maintenance of innovative production techniques and the continuous updating of microfabrication capacities. In particular, clean area microfabrication technologies strengthen cooperation with defense industry and technopark companies.
- **Technology Licensing Processes:** METU MEMS attaches great importance to licensing processes within the scope of the application of developed technologies in new MEMS devices. Licensing strategies are continuously developed through collaborations with universities, institutes and industrial organizations. Regular and effective operation of these processes diversifies the Center's income sources.
- **Technology Marketing Strategies:** The Center provides services to its external stakeholders through the “METU MEMS Center Price List”. This strategy supports the commercialization of technologies and creates attractive collaboration opportunities for academic and industrial stakeholders. Requests for proposals through the website and the conversion of these requests into orders play an important role in the marketing of MEMS technologies.
- **Service Provision Conditions and Forms:** METU MEMS shares its infrastructure facilities with higher education institutions, public institutions and the private sector, and provides services based on the use of clean areas. The service provision conditions of the Center are regulated within the framework of rules determined by the Board of Directors, taking into account the costs of using clean areas. These services are used in a wide range from the defense industry to technopark companies.

- **Industrial Collaborations and Partnerships:** METU MEMS enters into partnership agreements with many institutions in order to develop its collaborations with the industry. As of 2023, 86 companies have requested proposals and 85 have been offered. The majority of these collaborations have turned into orders, and high-tech services are provided to various industrial organizations, primarily the defense industry.
- **Evaluation and Monitoring of TT Projects:** METU MEMS continuously evaluates and monitors TT projects. The Center's knowledge and services to external stakeholders provide regular income flows and increase the efficiency of TT projects. These projects contribute to the development of sustainable collaborations at both national and international levels.
- **Internationalization of TT Activities:** The Center has taken important steps within the scope of international collaborations and joint project applications as of 2023. These studies stand out as a strategic move for METU MEMS to increase its competitiveness in the global arena by internationalizing its TT activities.

Key Achievements

The highlights of the projects METU MEMS has carried out to date are as follows (ODTÜ MEMS, n.d).

- Development of High Precision MEMS Gyroscope Based Compass with ASELSAN
- Development of MEMS Based Touch Alcohol Detection System with TOGG
- Development of Chip Assembly Production Process and Prototype Production with ROKETSAN

Metrics and Impact

- 53 national/international patents (ODTÜ MEMS, n.d).

4.1.3 Public and Private Initiatives Supporting the TT Ecosystem

In Türkiye, innovation and technology balances are distributed proportionally between the public, universities and the private sector. Incentive programs that support R&D activities by determining regional and sectoral priorities, increase the development and competitiveness of the region and target sectoral growth with feasibility studies are transferred to the relevant ministries and public institutions through the state channel. Ministries and public institutions provide financial resources to the market through appropriate grant programs that will activate TT dynamics in line with national needs and priorities. While incentive mechanisms strengthen the focus on economic stability and growth, they also provide a

balanced environment that reduces regional economic distribution imbalances and supports social growth by educating the workforce.

In our country, different incentive programs for very different purposes such as increasing investments and employment, supporting international trade and SMEs, eliminating regional imbalances, supporting R&D activities are generally implemented by the Ministry of Foreign Affairs – Directorate for EU Affairs, Republic of Türkiye Ministry of Trade, Republic of Türkiye Ministry of Industry and Technology, TÜBİTAK, Development Agencies, KOSGEB (Small and Medium Enterprises Development Organization), Chambers of Commerce and Industry, and TÜRKPATENT. While these investment incentives contribute to increasing the competitiveness of companies with private sector investments, they also make a strong contribution to reducing regional development differences. As a result, thanks to state incentives for innovation and R&D activities, Türkiye guarantees a strong and dynamic innovation ecosystem.

4.1.3.1 TÜBİTAK

Mission and Objectives

TÜBİTAK; It is the country's largest scientific and technological research institution with the vision of leading Türkiye's national technology initiative and acting with the mission of determining Türkiye's Science and Technology policies for a sustainable future, conducting studies in these areas in cooperation with stakeholders and strengthening the ecosystem.

Operations

- **Services Offered**

TÜBİTAK is an administrative and financially autonomous organization tasked with organizing, coordinating and encouraging scientific and technological research and technological development in accordance with national economic development goals. Its activities are as follows:

  - Supporting the government in the formation of Türkiye's science, technology and innovation (STI) policies
  - Conducting, supporting and encouraging STI research
  - Supporting domestic and international academic activities of scientists with scholarships and awards
  - Funding R&D projects of universities, public institutions and industry
  - Supporting academic and industrial R&D studies and innovations

- **Policies/Strategies about TT**

TÜBİTAK has developed certain policies and strategies to customize Türkiye's scientific and technological processes to specific research and study areas and to encourage institutions in the TT process.

- **TÜBİTAK Prioritized R&D and Innovation (RDI) Topics:** The study, which has been prepared by TÜBİTAK every two years since 2013, is prepared to determine current priority topics in line with national needs and global trends in Türkiye's Development Plan (DP). Thus, it sheds light on the direction of the ecosystem in all grant and scholarship programs supported by TÜBİTAK.
- **Green Growth Technology Roadmap:** It is created to focus on R&D and innovation issues that will produce domestic solutions to the technological needs of private sector organizations in Türkiye that will enable them to adapt to green growth and to provide support in these areas. In line with the prepared Green Growth TRM (Technology Road Map); it is expected that new projects, initiatives and platforms will be created by academics, public research centers, public institutions and especially industrial organizations.
- **Technology Roadmaps Prepared for Priority and Key Technologies:** R&D and innovation studies that need to be planned for technological progress, products that are critical to be produced in our country and priority sectoral applications have been determined and TRMs have been prepared. In addition to giving priority to these TRMs in R&D and innovation support, it is aimed to guide universities, research organizations, private sector, entrepreneurs, investors and researchers who continue their work in the relevant field.
- **Entrepreneurial and Innovative University Index:** It is prepared by TÜBİTAK in order to trigger the innovation and entrepreneurship activities of universities and to measure their performance in this field. Within the scope of the index, the 50 most entrepreneurial and innovative universities are ranked according to 23 indicators under the dimensions of "scientific and technological research competence", "IP pool", "cooperation and interaction" and "economic and social contribution" and shared with the public (TÜBİTAK, 2023). Thus, it is aimed to increase the entrepreneurship and innovation-oriented competition among universities and to develop the entrepreneurship ecosystem.
- **Field-Based Competence Analysis of Universities:** The aim of this study is to enable comparative evaluation of the performances of universities based on their research fields. In addition, it allows analysis of which research fields a university conducts within its own body; is relatively more competent. In this context, it was carried out to support data-based decision-making mechanisms in various critical processes

such as determining national policies, regional plans, and institutional strategies.

- **Determination of TRL (Technology Readiness Level):** Considering the duties of TÜBİTAK to "support academic and industrial R&D and innovation activities" and "carry out R&D studies that serve determined national priorities", it has become necessary to create a TRL determination methodology for use in its own processes. For this reason, "TRL Determination Question Sets" and "TRL Calculation Methodology" specific to Türkiye have been developed. By using the developed TRL question sets, it is aimed to measure the success and levels of R&D and Innovation projects supported by TÜBİTAK in achieving technological progress.
- **TÜBİTAK Strategic Plans:** Plans are prepared for a period of 5 years, in line with Türkiye's DP targets, with a focus on implementing innovative and groundbreaking technologies that will provide added value to our country, supporting human resources in this direction, and increasing science and technology awareness in our society.

- **Internal Processes & Practices**

TÜBİTAK; continues its practices under the following 5 different directorates so that the target audience of the TT ecosystem (academics, industrialists, entrepreneurs, students, etc.) can benefit from national/international R&D grant programs, research and education scholarships, scientific event organization and event participation supports.

- **Directorate of Research Support Programs - ARDEB:** It is the directorate that carries out the application, evaluation, acceptance, monitoring and finalization processes of research projects proposed by universities, public institutions and the private sector.
- **Directorate of Technology and Innovation Support Programs - TEYDEB:** It is the directorate that supports project-based R&D activities in order to support the research-technology development and innovation activities of our country's private sector organizations and thus contribute to increasing the research-technology development ability, innovation culture and competitiveness of the Turkish industry. It carries out the application, evaluation, acceptance, monitoring and finalization processes of the projects submitted to the program.
- **Directorate of Scientist Support Programs - BİDEB:** It is the directorate that carries out the application, evaluation, acceptance, monitoring and finalization processes of the programs to be carried out to help the training and development of scientists and researchers during and after their education and to support entrepreneurship.

- **Directorate of International Cooperation - UİDB:** It is the directorate that carries out the application, evaluation, acceptance, monitoring and finalization processes of the establishment of multilateral and bilateral international cooperation programs and international cooperation projects within the scope of these programs.
- **Directorate of Science and Society - BİTO:** It is the directorate that carries out the application, evaluation, acceptance, monitoring and finalization processes of innovative projects that appeal to all segments of society in order to spread scientific awareness in society and encourage young generations to scientific research.

In addition, institutes and research centers affiliated with TÜBİTAK in various cities of Türkiye carry out R&D activities. The main duty of these institutes is to conduct basic and applied research in the field of positive sciences for public and private sector organizations.

In addition, the institution has a Technology Transfer Office for the purpose of protecting the IPR and other rights it owns, determining commercialization processes and managing transfer processes within this scope.

Major Achievements

Critical and high value-added projects are offered to Türkiye within the TÜBİTAK Center and Institutes. In this context, the important achievements developed by TÜBİTAK are presented below.

- **İMECE:** Designed and developed by TÜBİTAK Space Technologies Research Institute, it is Türkiye's first domestic and national high-resolution imaging satellite. With its electro-optic camera, communication equipment, flight computer and software, the satellite, which is designed and produced nationally, can receive images from anywhere in the world without any limitations (TÜBİTAK, n.d).
- **GÖKTUĞ Project:** Within the scope of the GÖKTUĞ Project, initiated by the Presidency of Defense Industries (PDI) and carried out under the prime contractorship of TÜBİTAK Defense Industries Research and Development Institute, it is aimed to meet the within-visual-range (BOZDOĞAN) and beyond-visual-range (GÖKDOĞAN) air-to-air missile needs of the Turkish Air Force Command (TÜBİTAK, n.d).

Funding Mechanisms

TÜBİTAK is financed by the Central Government budget. It transfers its financing resources to the market through non-refundable grant mechanisms in line with the priority areas analyzed in line with sectoral, national and regional needs.

According to the budget presentation prepared by the TBMM Planning and Budget Commission published by the Ministry of Industry and Technology of the Republic

of Türkiye, the budget allocated for TÜBİTAK for the years 2024-2025-2026 is presented below (T.C. Sanayi ve Teknoloji Bakanlığı, 2023).

	2024 Budget	2025 Budget	2026 Budget
TÜBİTAK	₺ 32.084.581.000	₺ 39.510.191.000	₺ 44.648.497.000

Table 3: TÜBİTAK's budget allocation by years

Metrics and Impact

The criteria provided by TÜBİTAK as a result of the strategies it developed, the services it implemented, and the internal procedures are as follows;

- 2,277 technology initiatives established with the support of TÜBİTAK Individual Young Entrepreneurs (T.C. Sanayi ve Teknoloji Bakanlığı, 2023)
- More than 22,520 national/international projects supported and concluded by TÜBİTAK
- 270 registered national patents, 45 registered European patents, 1 registered Eurasian patent, 56 international PCT patent applications of which TÜBİTAK is the rightful owner (TÜBİTAK, 2024)

4.1.3.2 TÜRKPATENT

Mission and Objectives

TÜRKPATENT; is an institution working under the Ministry of Industry and Technology of the Republic of Türkiye, with the mission of increasing industrial property awareness in all segments of society and contributing to the effective protection and commercialization of industrial property rights at national and international levels.

Operations

- **Services Offered**

The activities of TÜRKPATENT, which is the official national authority in Türkiye for applications for trademarks, geographical indications, designs, patents, utility models and traditional product names, cooperation with international patent organizations, registration and post-registration procedures, are as follows.

- To register patents, utility models, brands, geographical indications, traditional product names, designs and integrated circuit topographies in accordance with the relevant legislation and to carry out the procedures related to the protection of these rights
- To register and record license and transfer agreements
- To monitor the use of inventions, to evaluate new technologies and to direct and archive TT
- To cooperate with the EU, international organizations and foreign countries in the field of industrial property

- To contribute to the preparation of international agreements related to industrial property rights and to ensure the implementation of these agreements in Türkiye
- To cooperate with institutions and organizations related to technology and R&D in Türkiye and abroad and with information banks, to establish documentation centers
- To make publications related to industrial property rights
- To carry out the necessary work to inform and guide individuals and organizations in Türkiye on industrial property rights
- To carry out work to provide training to individuals and organizations in Türkiye and abroad in the field of industrial property, to support educational activities and academic studies

- **Policies/Strategies about TT**

TÜRKPATENT; implements innovative projects, memberships, support programs, incentive and reward mechanisms for the target audience in the academy, industry, student and entrepreneur ecosystem on a national and international basis.

- **Patent Workshop:** TÜRKPATENT; The Patent Workshop program is implemented with the aim of increasing the number of domestic patent applications in Türkiye, creating and raising awareness about patents in universities, equipping university students with information that they will use in their professional careers or academic studies, and encouraging students to engage in invention activities that have an important place in technological developments. It has been implemented since 2018 in order to provide interactive patent research and application training to secondary school and university students in cooperation with TÜRKPATENT and the Ministry of National Education.
- **'Patentle Türkiye' Competition:** It is a patent competition organized by TÜRKPATENT with the aim of creating awareness about patents in universities, equipping students with technical information that they will use in their future professional life or academic studies, and encouraging students to engage in invention activities that have an important place in the technological development of our country.
- **Industrial Property Advisory Unit:** In order to provide academics, entrepreneurs, industrialists, institutions and organizations conducting R&D studies with rapid access to information and documents on industrial property rights, there are 310 Industrial Property Advisory Units in 81 cities of Türkiye, within Universities, TTOs, TDZs, DAs, Provincial Directorates of Industry and Technology, Chambers of Commerce and Industry and Foundations. Industrial Property Advisors within the institutions carry out information activities on behalf of

TÜRKPATENT in order to meet the needs of the target audience in the patent ecosystem (TÜRKPATENT, n.d).

- **TÜRKPATENT PATİKA (Patent, Commercialize and Earn):** This is a program developed by TÜRKPATENT to support the technology and innovation production and commercialization processes of startups, to encourage them to apply for patents and utility models, to increase company valuation, to increase the TRL and to mediate TT transactions and commercialization activities.
- **International Invention Fair - ISIF:** It is organized together with TEKNOFEST every year in order to bring together national/international participants with inventions, R&D and innovation activities that will add value to Türkiye's development and to present the produced technical knowledge to the benefit of society by commercializing it. It is considered as a large-scale organization within the scope of the fair to promote inventions, create awareness about innovative works, bring inventors together with investors and encourage inventors with awards in different categories.

- **Internal Processes & Practices**

TÜRKPATENT; carries out the registration of instruments related to IPR in accordance with the relevant legislation and the procedures related to the protection of these rights under the units given below.

- Patents/ Utility Model
- Trademark
- Design
- Geographical Indication and Designation of Origin
- Integrated Circuit Topographies
- Re-examination and Evaluation: This directorate is responsible for the examination and evaluation of objections to decisions regarding trademarks, patents, utility models, designs, geographical indications and designation of origin, and integrated circuit topography.

Major Achievements

- The number of domestic patent applications, which was 414 in the early 2000s, has increased to 9,009, and the number of domestic patent registrations, which was 73, has increased to 3,407.
- Türkiye ranks 13th in the world in domestic patent applications, 5th in trademark applications, and 3rd in design applications.
- According to the country ranking within the scope of international applications; it ranked 16th with 1771 patent applications, 8th with 2550 trademark applications and 11th with 505 design applications (T.C. Sanayi ve Teknoloji Bakanlığı, 2023).

Funding Mechanisms

TÜRKPATENT; It is a special budget, independent legal organization affiliated with the Ministry of Industry and Technology. According to the budget presentation prepared by the TBMM Planning and Budget Commission published by the Ministry of Industry and Technology of the Republic of Türkiye, the budget allocated for TÜRKPATENT for the years 2024-2025-2026 is presented below (T.C. Sanayi ve Teknoloji Bakanlığı, 2023).

	2024 Budget	2025 Budget	2026 Budget
TÜRKPATENT	₺ 848.927.000	₺ 1.045.629.000	₺ 1.187.461.000

Table 4: TÜRKPATENT's budget allocation by years

Metrics and Impact

The criteria provided by TÜRKPATENT as a result of the services and internal procedures it has provided since its establishment are as follows (TÜRKPATENT, 2024);

- 103604 national, 158762 international patent applications
- 28619 national, 150357 international patent registrations (granted)
- 68244 national, 1326 international utility model applications
- 37618 national, 955 international utility model registrations
- 2184415 national, 330880 international trademark applications
- 1398848 national, 298015 international trademark registrations
- 879252 national, 28148 international design applications
- 790154 national, 27796 international design registrations
- 592 geographical indications and designation of origin

4.1.3.3 DEVELOPMENT AGENCIES (DAs)

DAs provide financial and technical support to regional actors in the areas determined in regional plans and programs, annual work programs and relevant application guides in line with predetermined eligibility criteria in order to accelerate the development process of regions in Türkiye and to implement activities that are critical for the region. DAs, which work for local development in 26 regions of Türkiye under the coordination of the Ministry of Industry and Technology of the Republic of Türkiye, are the coordination, financing and consultancy centers of the regions by dynamically analyzing regional needs in the face of changing public administration demands and activating appropriate structures. The plans implemented by DAs create a vision for local stakeholders' future visions, sustainability goals and the production of new initiatives that generate economic value (T.C. Kalkınma Ajansları, n.d).

Companies with a growing economic value that receive financial support with a vision of innovation increase the share of R&D expenditures in their operations in proportion to the development of their capacities, increase interaction with universities, provide job opportunities for R&D experts at the postgraduate level, and strengthen the TT ecosystem *through Agencies* on the way to becoming an R&D Center with patented technologies.

Mission and Objectives

DAs, within the innovation and R&D priorities, especially by identifying regional needs demanded by the private sector, implementing incentive programs sensitive to regional characteristics, and by mobilizing the existing potential at the local level with innovative and sustainable methods, carry out its work with the aim of strengthening the industry.

Agencies that have a vision of creating regions with strong economies, innovative and competitive, that preserve regional values and produce high value-added technologies, that are socially developed and integrated, that have a completed infrastructure, a sustainable environment and a high quality of life, adopt the principle of "Human-Centered Development of Local to National, National to Global".

Operations

- **Services Offered**

Agencies affiliated with the Republic of Türkiye Ministry of Industry and Technology, are powerful structures that mediate the transfer of financing resources to the region through regional technical support, financial support, feasibility support, guided project support and call-specific project proposals compatible with the development dynamics of the regions. Private sector organizations that receive financing input indirectly affect TT studies carried out by universities and other public institutions, and at the end of the day, they contribute to creating awareness of the region's value-creating products, transforming them into economic value, evaluating them within the scope of export, creating a growing brand value, revealing patented technologies and strengthening the ecosystem suitable for the commercialization of patents.

The basic services of 26 DAs, which are an intermediary institution in the qualified structure of Türkiye's regional values, are as follows:

- To prepare strategies related to regional development
- To conduct studies to identify the resources and opportunities of the regions, to accelerate economic and social development and to increase competitiveness and to support the studies carried out in this regard

- To support cooperation and coordination between public, private and civil society organizations in order to realize regional development goals
- To research and promote business and investment opportunities in the regions and to ensure that resources are attracted to the region
- To support entrepreneurship and the entrepreneurial ecosystem
- To contribute to the development of technical capacities of local governments and organizations in the region
- To conduct intermediary and coordination activities in the use of international funds by stakeholders in the region and to strengthen the R&D and innovation infrastructure of the region with all these components.

DA actively analyzes regional dynamics by preparing DPs, Regional Development National Strategy, Regional Plans, Regional DPs (Development Plans) and Specialized Commission Reports within the scope of Strategy Documents specific to the dynamics of the region for each region.

- **Policies/Strategies about TT**

DAs, established to ensure regional development throughout Türkiye, pursue strategic policies to mobilize regional potential, increase competitiveness and achieve sustainable development goals. In this context, DAs contribute to Türkiye's economic transformation by identifying regional needs on-site, providing innovative solutions and developing support programs that contribute to regional development (T.C. Sanayi ve Teknoloji Bakanlığı, 2022).

The policy areas carried out by DAs are as follows:

- **Economic Development:** Manufacturing industry, entrepreneurship, clustering, R&D, digitalization, smart specialization, foreign trade, low carbon economy, tourism, agriculture and rural development.
- **Social Development:** Human capital, health, social entrepreneurship, culture, social inclusion and harmony.
- **Infrastructure:** Environment, energy, transportation-logistics, telecommunications, urbanization and planning.
- **Investment Environment:** Institutional capacity building, investment promotion and incentives.
- **Collaborations for Development:** National and international partnerships.

Agencies also develop and implement important strategies in areas such as effective management of TT processes, protection and commercialization of IP rights.

- **Internal Processes & Practices**

DAs internal processes and practices are structured to support regional development and increase efficiency. These processes are detailed in the DAs General Activity Report published in 2022 (T.C. Sanayi ve Teknoloji Bakanlığı, 2022). Internal processes and practices are summarized below under basic headings.

- **Institutional Management and Structural Support:** Agencies operate in line with their strategic goals with advisory and decision-making bodies such as the Development Board and the Board of Directors under the coordination of the Ministry of Industry and Technology. This structure strengthens the cooperation of local governments, the private sector and civil society.
- **Audit and Control Mechanisms:** Agencies, which are subject to regular audits by the Ministry of Industry and Technology, continuously evaluate their internal audit processes and performance and resource management.
- **DAs Management System (KAYS):** KAYS is a central information system that accelerates the operation of agencies in a digital environment, facilitates document management and supports data sharing.
- **Support Programs:** DAs contributes to regional development goals by providing financial and technical support to local projects with programs such as 'Supporting Attraction Centers', 'Supporting Social Development' and 'Employed and Productive Youth Program'.
- **Monitoring, Evaluation and Impact Analysis**: Agencies monitor and evaluate the progress of projects in line with the goals, thus increasing effectiveness and paving the way for strategic improvements.
- **International Collaborations and Funding Sources:** Agencies develop joint projects with international organizations and benefit from international funds, especially in areas such as energy efficiency and green transformation.
- **Youth Employment and Entrepreneurship Support:** In order to increase youth employment, agencies support youth-oriented workforce and entrepreneurship projects and contribute to regional development goals.

Funding Mechanisms

DAs financing mechanisms are created with grants and support from various local and national sources. According to the data published in the 2022 General Activity Report, the financing mechanism used is as follows (T.C. Sanayi ve Teknoloji Bakanlığı, 2022).

- **Central Government Budget and Transferred Resources:** The largest share of the DAs' revenues consists of resources transferred from the central government budget. As of 2022, the share transferred from the central budget was 31%. This budget is one of the basic resources for agencies' general government expenditures and regional projects.
- **Shares Transferred from Provincial Special Administrations and Municipalities:** Shares transferred from provincial special administrations and municipalities to agencies are used in agencies' local development projects, and the share transferred from municipalities was 27% in 2022. The share received from provincial special administrations constituted 1.4% of the total budget.
- **Contributions from Chambers of Commerve and Industry:** The 1% share allocated from the previous year's budget revenues of chambers of industry and commerce is among the financing sources of the agencies. This share constituted 0.5% of the agency revenues as of 2022.
- **International Funds and Other Revenues:** In addition to national resources, DAs also benefits from international funds such as the EU and other donor sources. In particular, these funds provided for projects developed by agencies in areas such as international projects and green transformation constitute 2.7% of total revenues.

Metrics and Impact

Various criteria and metrics are used to evaluate the performance of DAs and measure the effectiveness of their activities. These criteria play an important role in determining the contribution of agencies to regional development and the level of achievement of strategic goals. According to the General Activity Report published in 2022, the main criteria and metrics are as follows:

- **Number and Budget of Supported Projects:** The number of projects supported by agencies and the budget allocated to these projects indicate the volume of activity and financial contribution. In 2022, DAs provided 657 million TL support to a total of 1087 projects, and the total budget of these projects was recorded as 1.3 billion TL.
- **Post-Program Evaluation and Impact Analysis:** Agencies conduct impact analysis within three years of program closure to evaluate the impact of financial support programs. As of 2022, DAs have conducted a total of 352 evaluation studies for support programs, and 56 studies were conducted in 2022 alone. In addition, impact analysis studies for 79 financial support programs are ongoing.
- **Utilization of National and International Funds:** In addition to national funds, DAs also benefit from international funds to support local development, and this use of funds is considered an important indicator of the resource creation capacity of agencies. For example, agencies have

provided support for projects using more than 300 million Euros of international funds in the last 5 years.

- **Economic Impact and Employment Contribution:** The contribution of projects supported by agencies to regional economic development and employment is an important criterion in measuring the success of development activities. In 2022, 973 million TL was spent on projects focused on youth employment, and 5280 young people were directly employed. When ongoing projects are completed, this figure is expected to reach 69.136.
- **Analysis and Reporting Studies:** Analysis, strategy and planning studies carried out to achieve regional development goals are also one of the criteria of the agencies. In 2022, approximately 310 analysis, strategy and review studies were carried out by DAs, and these studies guided regional strategic planning.

4.1.3.4 THE UNION OF CHAMBERS AND COMMODITY EXCHANGES OF TÜRKİYE (TOBB)

Mission and Objectives

TOBB is the supreme organization that officially represents each industrial organization in Türkiye, with the mission of ensuring unity and solidarity between chambers and commodity exchanges, ensuring the development of the profession in accordance with general interests, facilitating the professional activities of chamber and commodity exchange members, and carrying out the necessary work for the development of the country and the economy.

In Türkiye, there are Chambers of Commerce and Industry, Chambers of Commerce, Chambers of Industry, Chambers of Maritime Commerce and Commodity Exchanges under the TOBB umbrella organization. Although TOBB is a public institution, it is a professional umbrella organization with legal personality (able to own assets and incur debts under the law). There are 365 Chambers and Exchanges within TOBB throughout the country, and over 1.2 million registered companies in all professional sectors determined by the Nace code, including export industrialists who lead the country's industry (TOBB, n.d).

Among the basic duties of industrial companies that contribute to the TT infrastructure with the vision of developing Turkish industry on a global scale by increasing the sustainable competitive power and competencies of industrial companies are;

- Increasing the visibility and sphere of influence of the country's industrialists by organizing and participating in national and international congresses, meetings and fairs,

- Preparing reports on the country's economic situation, examining and evaluating reports prepared by the chambers and stock exchanges within its body on relevant issues,
- Providing information and consultancy services through chambers and stock exchanges so that SMEs get their rightful share from the economy,
- Establishing institutional ties with foreign equivalent organizations and signing cooperation agreements,
- Representing the Turkish private sector in multilateral chambers and international organizations within the scope of its duties related to international relations,
- Leading and leading the work of Turkish entrepreneurs.

Operations

- **Services Offered**

TOBB has a comprehensive operations structure to increase the competitiveness of the business world in Türkiye, support local economies and ensure sustainable development (TOBB, n.d). The services offered are summarized below under basic headings.

- **Management of Financing Programs:** TOBB manages various financing programs to facilitate access to financing resources for the private sector throughout Türkiye. These programs include loans, guarantee systems and financial support projects, especially to ensure that SMEs have access to the resources they need. TOBB implements appropriate credit opportunities by collaborating with banks and financial institutions to provide fast solutions to the financing needs of its members.
- **Implementation of Training and Development Programs:** TOBB offers training programs through TOBB Academy so that the business world can adapt to developing technology and business processes. These trainings are provided on topics such as sectoral knowledge, business management and digitalization.
- **Networking and International Collaborations:** TOBB offers networking and collaboration opportunities to open up Turkish businesses to international markets. In this way, Turkish companies can access business opportunities abroad, connect with potential partners and gain competitive advantage in international trade.
- **Management of Support Programs:** TOBB runs support programs to meet the development needs of its members. In this context, it supports R&D and innovation projects, export-oriented studies, and projects in areas such as digitalization and green transformation.

- **Trade Facilitation and Digitalization:** TOBB offers digital solutions to enable its members to conduct their commercial activities quickly and reliably.

- **Internal Processes & Practices**

The various policies and strategies adopted by TOBB within the framework of internal processes and practices contribute to a wide range of technology and innovation-focused studies.

- **Innovative Approaches:** TOBB develops various programs to ensure that its members gain a strong position in the global competitive environment with innovative business models and technology-based solutions. One of the studies carried out within this scope is the implementation of the TOBB Türkiye 100 program to support the 100 fastest growing companies in Türkiye. This program increases the visibility of fast-growing companies in the international arena and supports their innovative approaches.
- **Technology Licensing Processes:** TOBB cooperates with universities and research organizations to facilitate TT and licensing processes. The Joint Education Model implemented by TOBB University of Economics and Technology for the business world ensures the strengthening of UIC and the training of qualified human resources needed by the business world.
- **Technology Marketing Strategies:** TOBB develops various marketing strategies to support industrial organizations to expand abroad. In this context, the Cooperation Offers from Türkiye System enables local companies to evaluate business opportunities in the international market, and it is aimed to increase commercial relations by translating cooperation offers from around the world into Turkish and sharing them with companies.
- **Service Provision Conditions and Forms:** TOBB aims to increase institutional capacity and improve the quality of service provided to members with the Chamber and Commodity Exchange Accreditation System. This system ensures that accredited Chambers and Commodity Exchanges provide services according to the determined quality standards and ensures the establishment of corporate governance principles.
- **Industrial Collaborations and Partnerships:** TOBB conducts supplier development programs with large institutions such as CERN, Turkcell, and ASELSAN within the scope of industrial collaboration projects. These collaborations enable SMEs to integrate into the supply chain of large companies and provide training and guidance activities to support SMEs with deficiencies.

Funding Mechanisms

TOBB has established various financing mechanisms to support the economic development of its members, meet their financial needs and ensure the sustainable growth of their businesses (TOBB, n.d). The financing mechanisms are as follows;

- **Credit Guarantee Fund (CGF):** TOBB has a 28.30% partnership share in CGF. This fund is a support mechanism designed to facilitate SMEs' access to financing. TOBB works in partnership with institutions such as KOSGEB and TESK to help SMEs overcome the problems they encounter in obtaining loans from banks. CGF, which is a member of the European Guarantee Institutions Association and the SME Finance Forum, plays an important role in SMEs' access to financing.
- **KOBİ Venture Capital Investment Partnership Inc. (KOBİ VCIP Inc.):** KOBİ VCIP was established with the participation of TOBB, Halk Bankası, KOSGEB and various chambers of commerce and industry in order to provide capital support to businesses in need of innovative projects and capacity increase. This partnership supports the growth of businesses by investing in various sectors, especially in the IT sector, in line with the determined criteria and contributes to their capital needs.
- **International Trade Documents (ITD):** TOBB offers ITD Carnet and transit document services to increase Türkiye's international trade volume. ITD Carnet is a tool that facilitates temporary import and export transactions and is provided to its members by TOBB with an average annual guarantee of 150 million Euros. In addition, TOBB provides solutions to transit problems encountered by transporters abroad with the transit document services it provides.
- **TOBB Türkiye 100 Program:** The "TOBB Türkiye 100 Program", which was initiated to determine and promote the 100 fastest growing companies in Türkiye, is carried out in partnership with the Turkish Economic Policy Research Foundation. The program increases the recognition of rapidly growing companies in national and international markets and facilitates their access to new financing sources.
- **TOBB Supplier Development Program:** This program encourages large enterprises to cooperate more effectively with local suppliers, and supports SMEs in developing the capacity needed to become suppliers to large companies. TOBB provides training and guidance services to eliminate the deficiencies of SMEs with supplier potential, facilitating the integration of these companies into the supply chain of large enterprises.
- **International Funds and Investments:** TOBB cooperates with international organizations such as the EU to provide funds in areas such as international projects and green transformation. These funds enable

enterprises to be more competitive in sustainability, environmental compliance and digital transformation.

4.2 Main Conclusions on TT Processes and Practices

Universities, research centers and public institutions in Türkiye play an important role in the development of the country's TT ecosystem. These institutions; with their units/offices/structures supporting TT, strategies and R&D studies, carry out various processes and applications in order to commercialize the knowledge produced, cooperate with the industry and contribute to the country's economy.

These institutions, which carry out working policies within the scope of TT components, create an innovation-friendly ecosystem by evaluating national/international grant programs, grant programs supporting UIC, mechanisms to protect intellectual and property rights for new products and processes emerging from R&D studies, and entrepreneurship and corporatization supports.

Universities and Research Centers activate TT components with various good practice methods on academicians, inventors, entrepreneurs and companies. The support and call mechanisms developed by public institutions to activate the TT ecosystem provide a sustainable structure with the approach adopted by universities and research centers within the system.

Universities, research centers and public institutions, which form the basic framework of the structures where TT activities are carried out, develop innovative processes and applications through their TTOs, application and research centers, technoparks, innovation, intellectual industrial property rights, R&D units and institutes.

Although institutions have structures that activate common innovative values, they develop different experiences with their process adoption and implementation. In order to provide a general perspective on similar processes, headings are included and innovative applications are included in the processes.

4.2.1 Popular TT Processes and Applications

- **IPR Management**
  - Patent Application and Registration (Granted) Processes
  - Licensing
  - TT Agreements
  - IP Valuation Services
- **Determination of Technology Market Areas**
  - Market Research

- Technology Promotion
- Technology Promotion Materials

- **Entrepreneurship Supports**
  - Accelerator and incubation programs
  - Access to financial resources
  - Developing business plans and business models
  - Educational programs
  - Networking
  - Office facilities
  - Company establishment support

- **Collaboration Projects**
  - Joint research projects
  - Consortiums

- **Consulting Services**
  - Consulting on TT processes
  - Business plan preparation consultancy

4.2.2 Commonalities and Differences

Commonalities

- **Contribution to UIC (University Industry Collaboration):** Institutions in the TT ecosystem carry out studies to transfer the knowledge of the university to the industry and to encourage the formation of UIC. While some institutions can be stakeholders in this collaboration, some institutions act as interfaces or grant providers for the development of this collaboration.
- **Protection of IPR:** For institutions in the TT ecosystem, it is inevitable to protect IPR in line with the activities they carry out or the services they provide. While some of the institutions in this context carry out work to protect the IPR that arise within their organization, some act as interface or support institutions at this stage.
- **Innovation and Entrepreneurship:** Universities, research centers and public institutions are developing support mechanisms for entrepreneurship and corporatization processes in order to contribute to the TT ecosystem. These institutions offer incubation centers, acceleration programs, office and laboratory facilities, provide financing support and organize training programs to encourage and support the formation of new enterprises. All these support elements are structured to accelerate the development of technology-based enterprises and ensure their integration into the innovation ecosystem.

Differences

- **Focus areas**
  - **Universities:** Universities have the function of conducting basic research, producing knowledge and training qualified human resources. In this context, universities focus more on the production of scientific and academic knowledge and generally operate through TTOs in the commercialization of research results. Their basic duties are to produce, develop and present scientific knowledge for the benefit of society. In this context, the goal of academic excellence is at the forefront; therefore, the commercialization process of research at universities can be longer and based on theoretical infrastructure.
  - **Research Centers:** Research centers mostly focus on applied research and produce concrete solutions for the needs of the private and public sectors. These centers work on more practical and directly industrial or public projects, and aim to bring the projects closer to commercialization. For this reason, research centers tend to achieve results more quickly than universities. They ensure the commercialization of the technologies they develop, especially by collaborating with universities and industry in applied R&D studies.
  - **Public and Private Enterprises:** Funding institutions undertake the task of financially supporting R&D projects and TT activities and providing resource allocation. These institutions manage resource allocation and investment decisions with a strategic perspective in order to ensure the sustainability of the TT ecosystem. Funding institutions do not directly conduct research or development, but they conduct evaluation and monitoring activities on the projects they provide financial support. These institutions indirectly support innovation and ensure the development of the ecosystem.
- **Sources of Finance**

Although the way universities and research centers in Türkiye use their sources of finance to carry out TT activities is similar, the methods used by Public and Private Initiatives Supporting the TT Ecosystem differ.

- **Universities:** Universities benefit from public resources, national/international grant funds and private sector collaborations for basic research and knowledge production. In addition, IP revenues are used as an additional source of funding for universities.
- **Research Centers:** Research centers benefit from national and international project funds, private sector resources and R&D incentive programs to provide financing for applied R&D studies and industry-oriented projects. Research centers aim to achieve faster results by

focusing on industry collaboration projects and, in this direction, they turn to grant and support programs that can provide direct financing for their projects.

- **Public and Private Enterprises:** Public institutions and private initiatives play a role in providing financial support to ensure the sustainability of the TT ecosystem. These institutions provide financial resources for the projects of universities and research centers by providing grants and support programs for R&D projects. They also contribute indirectly to the TT ecosystem through investment funds and strategic resource allocations. These institutions contribute to the development of the ecosystem by providing the financial resources necessary for the implementation and commercialization of innovative projects.

- **Coverage of services**

When large institutions contributing to the TT ecosystem are examined, it is seen that the scope of the services they offer varies according to the institutions' founding purposes and target audiences. Each institution offers services aimed at the development of the ecosystem in line with its own area of competence:

- **Universities:** Universities provide services to the TT ecosystem in the areas of UIC, national and international project support, protection of IPR, entrepreneurship and corporatization. Within the framework of their function of producing knowledge and conducting scientific research, universities manage the process for the commercialization of research results, especially through TTOs, and support innovative projects by creating collaboration opportunities with industry.
- **Research Centers:** Research centers offer similar services to universities, but also engage in activities to commercialize scientific knowledge and integrate it into industry for the specific needs of the sectors they focus on. These centers, which mostly focus on applied research, aim to quickly put innovative solutions into practice by conducting their projects in a framework closer to industry. To this end, they establish direct collaborations with the sector and develop projects in related areas.
- **Public and Private Enterprises:** Public institutions and private initiatives, in line with their mission to support the TT ecosystem, offer various services that universities and research centers can benefit from. These services include access to national and international funding sources, protection of IPR, development of sectoral cooperation networks, etc. Public and private initiatives play an important role in increasing the sustainability of the ecosystem and cooperation opportunities by providing support for TT processes.

4.3 SWOT Analysis

- **Strengths**
  1. Legal arrangements have been made on TT.
  2. Different supports have been designed for TT areas and different actors in this field.
  3. There are different funds and support mechanisms for the development of technology, innovation and entrepreneurship.
  4. There are legal arrangements and regulations in place for the establishment and operation of Academy-funded interface structures.
  5. Support provided by TÜBİTAK for interface structures is available.
  6. TTOs are generally staffed by young and dynamic personnel.
  7. TTOs have developed good relations with ecosystem actors at local level.
  8. TTOs are aware of legal regulations concerning different actors due to their structure.
- **Weaknesses**
  9. There is a lack of knowledge/experience on how to cooperate with each other between the 2 different ends of the ecosystem: academia and business.
  10. There is a lack of well-trained and experienced TTO staff.
  11. There is no/limited free and documented training material for new staff.
  12. Insufficiently developed international cooperation and transnational TT.
  13. The commercialization rate of IPR is very low worldwide.
  14. Lack of knowledge/experience in the valuation of IPR.
  15. Lack of network (national/international investors, companies, universities etc.).
  16. Actors (university - business world) not trusting enough in the knowledge and experience of the other party.
- **Opportunities**
  17. Since TTO specialization requires expertise in different disciplines, it can both feed and be fed by different sectors in terms of HR.
  18. The increasing demand from the business world for TT processes due to increasing global competition.
  19. Türkiye has a developing economy and the share allocated to R&D has increased over the years.
  20. The development of the startup ecosystem, increased support for entrepreneurs, the emergence of unicorns and the recognition of entrepreneurship as a career path.
  21. The country has policies to improve the investment, entrepreneurship and innovation environment.

22. With digitalization, physical distance is no longer a problem, and cooperation can be established with business representatives in remote regions.
23. Providing incentives in many areas such as patents, incorporation, market access.
24. Publicly set targets (R&D centers, etc.) for both academia and the private sector to encourage cooperation between the parties.
25. Encouraging the establishment of start-up and spin-off companies and not demanding royalty fees and not putting obstacles in their way.

- **Threats**

26. Employing qualified TTO staff creates a financial burden for the relevant institutions.
27. Initiatives for the transfer of qualified personnel from different sectors.
28. Financially strong TTOs transfer qualified personnel from less strong ones.
29. Dysfunctionalization due to TTOs being assigned different missions other than their current responsibilities.
30. Increased operational costs due to the cumulative cost of managing, protecting and commercializing IP.

Türkiye's TT ecosystem has been presented by considering different frameworks. In this context, in order to guide different ecosystem actors and policy makers at both national and international levels, the relevant factor has been classified in a prioritization matrix according to its difficulty of achieving or its probability of emergence and the magnitude of the impact it will/will create.

In this context, factors are the starting point for both practitioners and policy makers, in other words, low hanging fruit. The High/high section, which includes structural regulations, includes important factors for determining the foundation and framework of the ecosystem. While factors in areas with low difficulty/probability and low impact are of a nature that practitioners and policy makers can leave to later stages in the planning plane, it is possible to achieve long-term improvement by providing holistic/ecosystem-based development in factors in areas with high difficulty/probability and low impact.

Fulfilment Difficulty / Chance of Occurring		Impact		
		High	**Medium**	**Low**
	High	[Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.]	[Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.]	[Hata! Başvuru k aynağı bulunamadı.]
	Medium	[Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.]	[Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.]	[Hata! Başvuru k aynağı bulunamadı.]
	Low	[Hata! Başvuru k aynağı bulunamadı.]	[Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.]	[Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.] [Hata! Başvuru k aynağı bulunamadı.]

Table 5: Prioritization matrix

5 Conclusion

This report analyzes the scope and importance of Türkiye's TT ecosystem in detail, and presents the current status, strengths and weaknesses of this ecosystem, and strategic recommendations for the future. TT in Türkiye has an important role in the commercialization of innovations and the creation of economic value. This ecosystem has a complex structure formed by the cooperation of universities, public and private research centers, technoparks, TTOs, VCs, public institutions, and other stakeholders. This structure is of critical importance for Türkiye to increase its global competitiveness and to spread innovation activities.

The report uses different methodologies to analyze Türkiye's TT ecosystem and provides a detailed assessment of the current situation through PESTEL and SWOT analyses. According to the PESTEL analysis, the factors influencing Türkiye's TT are multidimensional, with political, economic, social, technological, environmental and legal dynamics having a significant impact on the ecosystem.

For example, among political factors, the support given by the state to technology development and innovation activities stands out. DP issued in Türkiye aim to increase UIC and support the development of TTOs. The state's policies and incentives in this area create an important leverage effect in TT processes. In particular, technology-focused development strategies and R&D investments are planned to increase the effectiveness of this process.

Economic factors also significantly affect TT. In particular, the limited financial support in Türkiye and the concentration of these supports in certain areas constitute an obstacle to the development of innovative initiatives. Lack of financing makes it difficult for SMEs to participate in TT. In this context, efforts are being made to provide financial support for TT in Türkiye through institutions such as TÜBİTAK, KOSGEB and DAs. These programs play a vital role, especially in the commercialization of innovative products and their integration into the industry.

Universities, TTOs, public institutions and industry are among the main actors of the TT ecosystem. While universities play an important role in the production of knowledge and innovation, TTOs play an important role in the transfer of these innovations to industry. The increase in the number of TTOs in Türkiye, especially since the 2000s, and the critical role played by these offices in the commercialization of innovations in universities are noteworthy. For example, the METU Technopark TTO, established in 2007, plays an active role in the transfer of the university's research outputs to industry and in supporting academic entrepreneurship.

With the development of TTOs, professional approaches have been adopted in the licensing and commercialization processes of inventions at universities. This increases the potential of academic inventions to create economic value. Industrial Property Law No. 6769[8], which entered into force in 2017, supports TT processes by ensuring that universities play a more active role in the patent ecosystem. With this law, the rights of academics and universities are protected within the framework of revenue sharing in the commercialization process of inventions developed at universities, and commercialization incentives are provided. In addition, the establishment of patent and IP management units within universities is encouraged in order for these processes to proceed more quickly and efficiently. These units provide both technical and administrative support to academics, facilitating patent application processes and enabling the more effective transfer of inventions at universities to industry.

Another important component of the stakeholders in Türkiye's TT ecosystem is technoparks and R&D centers. Law No. 4691[5] on Technology Development Zones enacted in 2001 supported the establishment of technoparks, and in this context, zones were established to ensure the transfer of knowledge and technology between universities and industry. As of 2024, the number of technoparks has reached 105, and many TTOs and R&D centers operate in these technoparks. These structures serve as a bridge for the innovations needed by the industry to come from universities, and thus TT is carried out more quickly and effectively. The capacity of technoparks to attract local and international investors also offers a significant advantage. In particular, increasing international collaborations and including foreign investors in technoparks contributes to Türkiye's technology ecosystem.

The SWOT analysis conducted within the scope of the report reveals that Türkiye's TT ecosystem has strengths such as legal regulations, TÜBİTAK support and a young and dynamic staff structure, but weaknesses such as lack of experience in academia-industry collaboration, high staff turnover and inadequacies in international cooperation. The ecosystem is expected to benefit from the increasing demand for TT in an increasingly competitive global environment, Türkiye's developing economy, strengthening entrepreneurship ecosystem and the opportunities brought by digitalization. However, the ecosystem also faces threats such as high costs of qualified personnel, competition for personnel transfer between institutions, and increasing costs in the management of IPR.

As a result, Türkiye's TT ecosystem continues to develop with the cooperation and coordination of various actors. However, in order for this ecosystem to become more effective, it is important to increase the level of cooperation between stakeholders and to disseminate innovations. In this context, effective use of national and international funding sources for TT processes, increased UIC and strengthened the role of TTOs are required. In addition, it is essential to overcome the obstacles encountered in the commercialization process of innovations and to make the necessary arrangements to manage this process effectively. These arrangements include strengthening the infrastructure for TT and making industry-university collaborations more efficient.

Considering future trends (increase in the rate of development of deep technologies, green technology trends, etc.) and expected developments, the importance of TT is expected to increase even further. As a result of this expectation, stakeholders in the TT ecosystem need to increase their cooperation. The collaboration between the public and private sectors is of critical importance in order to increase Türkiye's TT capacity, support innovative initiatives and maximize the contribution of this process to the economy. This collaboration will not only accelerate TT processes but also contribute to the growth of the national economy. In this way, Türkiye's TT ecosystem will become more sustainable and

will be provided with a more competitive position in the international arena. In order for Türkiye to successfully manage this process, it is of great importance to develop dialogue and coordination between public institutions, the private sector, universities and other stakeholders. All these efforts aim to increase Türkiye's international competitiveness in TT and to ensure the integration of innovative technologies into the national economy. Thus, Türkiye's TT ecosystem will be addressed from a broader perspective in a way that will contribute to both economic and social development.

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