AN ANALYSIS ON TECHNOLOGICAL DEVELOPMENT LEVELS OF THE STATE-OWNED ENTERPRISES IN TURKEY

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ABSTRACT

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In Turkey, institutions whose capital is fully owned by the state, are defined as State-Owned Enterprises (SOE) with the Decree-Law numbered 233. It is important to ensure the continuity and strengthening of existing structures of SOEs due to their significant contribution to the Gross Domestic Product, employment, regional development as well as market and sector development in Turkey. In today's world where technological development is gaining importance, one of the most important steps for SOEs to keep up with the times and compete in free market conditions is to ensure their technological progress. In this thesis, the technological development levels of SOEs in Turkey are analyzed in the light of determined indicators existing in the literature. As a result of the analysis, it has been determined that the SOEs are in need to increase their capabilities in technological development. . It has been evaluated that the legislative restrictions, the duties and obligations given for social benefit, restricted employment policies and budgetary reasons may cause this need. It has been concluded that the need to adhere to many legal and traditional requirements can limit the fields of action of SOEs in Turkey, hinder their operational and budgetary independence, and create obstacles to technological progress. For this reason, there is a need to design new policies that will manage these restrictions and obstacles so that

the SOEs maintain their competitive power; as diversifying the funding sources of technology and innovation activities, increasing support and incentives, enabling more flexible budget and employment regimes.

Keywords: SOE, GDP, technology, development, policy

ÖZ

TÜRKİYE'DEKİ KAMU İKTİSADİ TEŞEBBÜSLERİNİN TEKNOLOJİK GELİŞİM SEVİYELERİ ÜZERİNE BİR ANALİZ

TÜRK, Tuğçe Gül
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Türkiye'de, sermayesinin tamamı devlete ait olan kuruluşlar 8/6/1984 tarihli ve 233 sayılı Kanun Hükmünde Kararname ile Kamu İktisadi Teşebbüsleri (KİT) olarak tanımlanmakta olup ulaşımdan haberleşmeye, enerjiden tarıma kadar farklı sektörlerde faaliyet göstermektedir. Gayri Safi Yurtiçi Hasılaya (GSYİH), istihdama, bölgesel kalkınmaya veya gelişmekte olan ekonomilerin pazar ve sektör gelişimine önemli ölçüde katkıda bulunan ve önemli sektörlerde öncü olarak faaliyetlerini sürdürmekte olan ve bu nedenle devletin önemli politika araçlarından biri olan KİT'lerin devamlılığının sağlanması ve mevcut yapılarının güçlendirilmesi önemlidir. Teknolojik gelişmenin giderek önem kazandığı günümüzde KİT'lerin de çağa ayak uydurabilmeleri ve serbest piyasa koşullarında rekabet edebilmeleri için belki de en önemli adımlardan biri, KİT'lerin teknolojik ilerlemesinin sağlanmasıdır. Bu tez çalışmasında Türkiye'deki KİT'lerin teknolojik gelişim seviyeleri literatürde yer alan bazı göstergeler ışığında tespit edilmeye çalışılmıştır. Yapılan analiz sonucunda Türkiyedeki KİT'lerin teknolojik gelişim kapasitelerini artırabilecekleri değerlendirilmiş; KİT'lerin tabi tutulduğu mevzuat kısıtlamaları ve sosyal fayda amacıyla verilen görev ve yükümlülükler ile sınırlandırılmış istihdam politikaları ve bütçesel sebeplerin buna sebep olabileceği değerlendirilmiştir. Çok sayıda yasal ve

geleneksel gerekliliğe bağlı kalma ihtiyacının zaman zaman Türkiye'deki KİT'lerin eylem alanlarını sınırlayabildiği, operasyonel ve bütçesel bağımsızlıklarını engelleyebildiği ve hatta alanlarında ilerleme ve teknolojik gelişme önünde engeller oluşturabildiği sonucuna varılmıştır. Bu nedenle, KİT'lerin rekabet güçlerini sürdürebilmeleri için bu kısıtlamaları ve yasal engelleri tamamen ortadan kaldırmadan optimum seviyeye indirgeyecek yeni politikaların tasarlanması ihtiyacı hasıl olduğu değerlendirilmiştir. Özellikle teknolojik gelişme ve ilerlemenin en önemli araçlarından olan istihdam politikaları ile teknoloji ve inovasyon faaliyetlerine ayrılacak bütçenin daha esnek hale getirilerek fon kaynaklarının çeşitlendirilmesine ve desteklenmesine yön verecek yeni politikaların tasarlanması gerektiği değerlendirilmiştir.

Anahtar Kelimeler: KİT, teknolojik gelişim, inovasyon, GSYH

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LIST OF ABBREVIATIONS

SOE	State-owned Enterprises
PE	Public Enterprises
PA	Privatization Administration
MoTF	Ministry of Treasury and Finance
OECD	Organization of Economic Cooperation and Development
ICT	Information- Communication Technology
R&D	Research & Development
CEEP	European Center for Public Employers and Enterprises
EU	European Union
SNA	System of National Accounts
GFSM	Government Financial Statistics Manual
SEE	State Economic Enterprise
PEI	Public Economic Institution
SDIF	Savings Deposit Insurance Fund

CHAPTER 1

1. INTRODUCTION

The definition of SOE is provided within the Decree Law No.233 dated on 8/6/1984 in Turkey as, in a nutshell, the entities whose capital all belongs to the state.

The SOEs subject to the Decree Law numbered 233 operate in different sectors, from transportation to communication and energy to agriculture. Currently, there are 19 SOEs operating within this concept in Turkey.

Despite the government's initiatives to ensure the operational and financial independence of SOEs, as well as the fact that SOEs in Turkey have their own distinct budgets, the need to adhere to numerous legal and customary requirements can occasionally limit their scope of action, impede their operational and budgetary independence, and even create obstacles to advancement in their fields. Due to certain obligations placed upon them by the government, some public firms cannot conduct their business, likewise merchants. There are organizations that do not overlook the social benefit but are administered according to commercial principles, in addition to those that exist solely to generate social benefit. In this instance, public enterprises are in a unique circumstance compared to businesses that operate in the private sector. The culture of the organizations and their standing in the market are both impacted by this predicament. Some organizations might need to take greater precautions (act in a risk-averse manner) while making decisions as a result of these public obligations. Organizations frequently have to abandon dangerous projects as a result but taking

chances is essential for innovation and making a difference. It is unrealistic to anticipate that all R&D efforts will yield results. Projects that could result in financial losses can occasionally be carried out. Because of this, public enterprises' aforementioned missions, for instance, do not foster innovation.

SOEs constitute significant shares of the gross domestic product (GDP) and contribute substantially to employment, regional development or market and sector development of developing economies and they still operate as pioneers in important sectors in Turkey.

Of fact, the SOEs' contribution to economic growth and development goes beyond the aforementioned numbers. Long-standing monopoly structures in their operating sectors, investments in those areas that no private company would make within the parameters of profitability, and consequently the assumption of public service responsibilities by SOEs. After liberalization, these SOEs, which helped to grow the sectors, pioneered and eventually gave considerable know-how shares to several private enterprises.

SOEs are once again being recognized as weapons of economic and governmental policy on significant industries around the globe, concentrating investments in R&D and advancing economics. Argothy and Alvarez bring up the paper by Kowalski et al. (2013) and point out how important SOEs are to global trade, with their combined sales accounting for more than 10% of the combined sales of the top 2,000 global companies. They argue that the State plays a significant and, in some circumstances, recently expanding role in the economy of developing countries. Public enterprises (PE) are important in the global market, as shown by comparisons between private and public firm indices, with PEs performing better in a number of categories (Argothy & Alvarez, 2018).

Due to their impact on the economy, development, and sectoral scope, SOEs have the potential to be significant contributors to economic growth. In order to fulfill the nation's social obligations properly, it is crucial that the SOEs, which are incredibly important for economic growth, maintain and even improve their muscular and solid structures without losing efficiency. It is essential to adapt them to evolving technology breakthroughs along this road to prepare them to compete with market forces and overcome difficulties caused by the technological and digital gap with their private counterparts.

Although various theoretical contributions examining incentives, control, and government influence within public organizations garnered a lot of attention in economic literature during the 20th century, one of the most significant findings of recent literature that used the private sector as a comparison was that public enterprises suffer from inherent efficiency problems because of management laxity (Stiel, 2017). Many organizations in the public sector have become ill and closed. Around the world, initiatives are being undertaken to revitalize or restore them. In the new Industrial policy, the performance evaluation of the system has gained increased attention. When these companies' performance declines and they are unable to halt it, they must go through an organizational turnaround, but they can also revitalize and recover with more work. For this type of organization, efficiency gains are essential, and can be attained through smart technology management (Sinha, P.C.Jha, & Mesra, 2013).

Similar to the rest of the globe, SOEs in Turkey are severely constrained in their areas of operation and are subject to state control in terms of law and custom, as previously mentioned. As previously noted, this condition results in a significant inefficiency issue. SOEs have historically been used to boost employment or as a political tool, but over time, all of the legal restrictions may have made SOEs

ineffective. In Turkey, a lot of SOEs have also undergone restructuring or privatization.

While SOEs continue to contribute significantly to the economy and the industries in which they work, in the age of digitalization and technology in which we now live, it has become necessary to develop new policies for SOEs globally in order to remove or optimize the barriers and restrictions that limit their ability to move freely and to force them to adapt to the digital environment like their private counterparts.

Public firms had inherent efficiency problems due to sloppy management, excessive government supervision, and insufficient incentives for innovation, according to a body of literature that utilized the private sector as a point of comparison (Stiel, 2017). However, asserting that their public ownership is the cause of their inefficiency and burdensome can be misleading. Belloc (2014) argues that political, legal, and cultural factors—rather than government ownership—are to blame for SOE inefficiency. New rules that will provide SOEs greater flexibility in their operations and management will make them more dynamic and functional businesses that can accept the rapidly emerging digital environment, as opposed to outright outlawing SOEs or eliminating public ownership.

Despite their significance, SOE’s innovation is sometimes ignored or not considered in academic research on innovation. Some articles, including those from the United States, Italy, the United Kingdom, Australia, and Brazil among others, have focused on the study of public innovation. However, there aren't many publications that look at innovation in SOEs. Some of them look at the structure and concentration of SOEs, the contribution of SOEs' R&D to industry, the function of DFI regarding SOEs' R&D, and the SOEs' role in R&D and innovation policies (Argothy & Alvarez, 2018).

Considering their sizable capital structures, expertise, and market shares in their respective industries as well as their robustness or resilience, which enables a business to persist even when changes have a negative impact, SOEs should be seen as one of the tools that will play a significant role in the technological development of nations.

One of the most crucial tasks to improve SOE efficiency so that SOEs can adapt to the modern age and grow their technological development is to minimize or maintain governmental interventions, restrictions, and barriers at an optimal level. The SOEs' ability to advance technologically will be hindered by any changes made to the workforce, employee rights and payments, investments, budgets, and expenditures. It will therefore be advantageous for their technological advancement and innovation if these constraints are loosened and the SOEs become economically and administratively independent. This study therefore; is trying to find the answers to the research questions of what are the challenges that SOEs are facing as barriers for their technological development and what needs to be done to increase their capacity to adapt higher technologies? The research question that is presented aims to explore the challenges faced by SOEs in their technological development, and how they can increase their capabilities to attain more innovative environment. To assess the technical innovation and development potential of SOEs and answer all these questions instead of the other methods in the literature and briefly mentioned in the thesis, indicators were determined and the course of numerical indicators, especially in the last ten years, was followed. A holistic study was conducted by analyzing some subjective data as well as numerical indicators. OECD Frascati and Oslo Guidelines were taken as a basis while determining the indicators. The indicators defined have

been provided to have the following characteristics determined by the Oslo Manual: (OECD & Eurostat, 2018)

- relevance,
- accuracy,
- reliability,
- timelines,
- coherence,
- accessibility

The indicators of this thesis are designed to cover the following innovation activities determined by the Oslo Manual; (OECD & Eurostat, 2018)

• R&D activities

• engineering, design and other creative work activities

• marketing and brand equity activities

• intellectual property (IP) related activities

• employee training activities

• software development and database activities

• activities related to the purchase or lease of tangible assets

• innovation management activities

The study aims to address all aspects of technological progress that would enable the effective operation of SOEs in Turkey rather than simply concentrating on one, such as research and development capabilities or just invention. Examples of this include:

-invention or innovation in professional fields

-research and development in professional fields

-using advanced technologies in professional fields

-using advanced technologies as managerial tools

These indicators for SOEs which are determined in the light of these principles, were analyzed to see the standings and levels of technological development of SOEs with this thesis. Then, the restrictions and barriers in front of their technological progress were determined and new policy suggestions to support their progress were proposed in the light of the indicator analysis. The main objective of this study is to set the basis of a needed comprehensive policy that would broaden the visions of the state and SOEs in terms of technology and innovation.

From the analysis conducted within the thesis; it has been revealed that one of the key challenges faced by SOEs in this regard is the lack of sufficient funds and resources to invest in R&D and acquire new technologies. Another major barrier is the bureaucratic and hierarchical nature of SOEs, which can hinder their ability to innovate and adapt quickly to new technological advancements. To address these challenges, it is important to focus on improving the overall governance structure of SOEs, and creating a more conducive environment for innovation and R&D. Additionally, SOEs need to prioritize the development of a skilled workforce and create partnerships with academic institutions and private firms to facilitate knowledge transfer and collaboration in research and development.

CHAPTER 2

2. STATE OWNED ENTERPRISES

Although the concept of public enterprise or namely, state-owned enterprises differ from country to country, enterprises in which a public administration has a majority share or whose management is controlled by a public administration are called public enterprises. In this context, the concept of public enterprise is associated with the concept of share ownership on the one hand and control in management on the other.

In the international literature, different definitions of public enterprises are made based on various perspectives. Some of these definitions of public enterprises are given below.

2.1. Public Enterprise According to International Classifications

In European Union (EU) regulations, public enterprises are handled in terms of capital and management control, regardless of central or local administration. The EU emphasizes the necessity of a framework regulation that will ensure the transparent management of administrative and financial relations between public shareholders and their businesses in member states, and a reporting system that will reflect these relations.

2.1.1. Public Enterprise According to EU Regulations

According to the Transparency Directive 2006/111/EC, public undertakings;

• More than half of its paid-in capital belongs to the public (central or local),

• More than half of the voting rights are under public control, or

• The public has the right to appoint more than half of the members of the board of directors or supervisory board defined as businesses.

According to this definition; in Turkey, more than half of the voting rights through preferential shares or arrangements, although more than half of the capital is not owned by the state, and companies that belong to local administrations (province special administrations, metropolitan municipalities and municipalities) excluding public enterprises, half of which are owned by the Ministry of Treasury and Finance or the Privatization Administration. Enterprises that are under public control or where more than half of the members of the management or supervisory board are appointed by the public can also be called public enterprises.

2.1.2. System of National Accounts (SNA 2008)

According to SNA 2008, developed by the United Nations, public enterprises are defined as companies under the control of public units. In the aforementioned system, control is expressed as the authority to determine the general corporate policy through the appointed managers. In this context, the fact that the public has more than half of the voting rights in a company, that the shareholders can control more than half of their voting power, that they are equipped with the power to determine the company policy or appoint company managers with a special law, decision or regulation

indicates the existence of the concept of control. While not directly under the control of a public administration, other businesses controlled by enterprises which are controlled by a public administration are also classified as public enterprises.

2.1.3. European System of Accounts (ESA 95)

ESA 95, developed by the EU, adopts the same approach as SNA 2008 for the classification of public enterprises.

2.1.4. Government Financial Statistics Manual (GFSM 2001)

In the GFSM 2001 developed by the IMF, public enterprises are similarly defined as companies controlled by general government units.

The IMF divides the public sector into general government and public enterprises. It classifies public enterprises as financial and non-financial public enterprises.

2.1.5. European Center for Public Employers and Enterprises (CEEP)

Enterprises whose financial needs are provided by central or local public administrations, or for which these administrations are responsible for the results of their operations and supervised by these administrations, are called public enterprises by CEEP.

Apart from the definitions above, another issue that should be mentioned about public enterprises is the distinction between the aforementioned enterprises and the general management units. Because in various countries, some public units that are currently classified as a part of the general government may display the characteristics of public enterprises, while some organizations structured as public enterprises may

actually have the characteristics of general government sector units. On the other hand, international classification standards for the distinction between the public and private sectors show a parallel approach, except for minor differences.

According to this;

• Under the control of general management units,

• Has a full accounting system and can borrow and lend on its own behalf,

• Selling most of its products at an economically meaningful price,

• Commercially operated and managed like a company

Institutions are considered as public enterprises. It is generally accepted that the unit in question is operating and selling its products at economically meaningful prices if the sales revenue covers more than half of the operating expenses.

2.2. State-Owned Enterprises in Turkey

In Turkey, the definition of “public enterprise” or “state-owned enterprise” (SOE) according to the legislation- is not exactly compatible with international approaches. While some of the state-owned enterprises in our country are evaluated within the concept of "public economic enterprises", many enterprises and subsidiaries in which the central government and local administrations undertake the shareholding function are subject to different legal regulations outside this concept.

The declared definition of the SOE is defined within the Decree Law No.233 dated on 8/6/1984 in Turkey. According to the Decree, The SOE is a joint venture of State Economic Enterprise (SEE) and Public Economic Institution (PEI) subject to Decree Law No. 233 and whose capital all belong to the state.

According to the Decree the definitions of SOE and PEI are;

SEE: is a SOE of which the whole capital is paid by the State and is established to operate in conformity with the commercial principles in the field of economy with a profit motive.

PEI: is a SOE of which the foundation capital is paid by the State and established especially for the maintenance of public services and goods named as concession, to execute production and marketing of the monopoly goods and services. They are undertakings that produce and market monopoly goods and services in the economic field, taking into account the public interest (KEGM and DHMI).

In this context, although the shareholders are public, state-owned banks, institutions in the privatization portfolio, local administration enterprises and the Savings Deposit Insurance Fund (SDIF) subsidiaries and the public enterprises which operate subject to the Turkish Commercial Code or their own private laws are not within the scope of Decree No. 233 and are not included in the definition of SOE in this Decree.

The SOEs subject to the Decree Law numbered 233 are operating in different sectors ranging from transportation to communication and energy to agriculture. Currently, there are eighteen SOEs operating within this concept, and apart from that there are seven other public enterprises subject to the Turkish Commercial Code as well as their own private laws derived from Commercial Code. The list of SOEs under the portfolio of the Ministry of Treasury and Finance (MoTF) can be viewed in the following table:

Table 1 - SOE's in Turkey

No	SOEs	Abv.
1	Boru Hatları ile Petrol Taşıma A.Ş.	BOTAŞ
2	Çay İşletmeleri Genel Müdürlüğü	ÇAYKUR
3	Devlet Hava Meydanları İşletmesi Genel Müdürlüğü	DHMİ
4	Devlet Malzeme Ofisi Genel Müdürlüğü	DMO
5	Et ve Süt Kurumu Genel Müdürlüğü	ESK
6	Eti Maden İşletmeleri Genel Müdürlüğü	ETİ MADEN
7	Elektrik Üretim A.Ş.	EÜAŞ
8	Kıyı Emniyeti Genel Müdürlüğü	KEGM
9	T.C. Devlet Demiryolları İşletmesi Genel Müdürlüğü	TCDD
10	Türkiye Elektrik Dağıtım A.Ş.	TEDAŞ
11	Türkiye Elektrik İletim A.Ş.	TEİAŞ
12	Türkiye Elektromekanik Sanayi A.Ş.	TEMSAN
13	Tarım İşletmeleri Genel Müdürlüğü	TİGEM
14	Türkiye Kömür İşletmeleri Kurumu	TKİ
15	Toprak Mahsulleri Ofisi Genel Müdürlüğü	TMO
16	Türkiye Petrolleri A.O.	TPAO
17	Türkiye Taşkömürü Kurumu	TTK
18	Türkiye Raylı Sistem Araçları Sanayii A.Ş.	TÜRASAŞ
19	Türkiye Şeker Fabrikaları A.Ş.	TŞFAŞ

Source: Hazine ve Maliye Bakanlığı (2022)

Within the scope of this thesis, only the state-owned enterprises which are subject to Decree Law No. 233 under the portfolio of MoTF listed above are going to be analyzed.

2.3. The Legislation and Limitations of State-Owned Enterprises in Turkey

2.3.1. Turkish Legislation

The legal framework of the SOE system in Turkey has been regulated by the Decree Law numbered 233 and Annual General Investment and Financing Programs

which are determined through Presidential Decisions in general. The purpose of the Law is identified by article 2 of the Decree Law as follows;

"a) Concerns the establishment of State Economic Enterprises, Public Economic Institutions and their subsidiaries, foundation of their affiliates, autonomous management of these establishments according to economic principles.

b) To maintain the organization of the activities of the State Economic Enterprises in conformity with the conditions of economy under the principles of productivity and profitability and their working in harmony with the national economy and among themselves and this way, aid for the purpose of the accumulation of the capital and create more sources of investments.

c) To maintain the execution of the duties assigned and public services in accordance with the economic and social conditions by the Public Economic Institutions in the light of the principles of productivity.

d) To set out the principles of coordination and cooperation in applying the provisions of the Law No. 2983 dated 17.4.1984 concerning the encouragement of Saving and Acceleration of Public Investment in State Economic Enterprises and Public Economic Institutions and their subsidiaries and affiliates.

e) To organize the auditing of the State Economic Enterprises Public Economic Institutions and their subsidiaries and affiliates in order to achieve the realization of the goals."

Apart from that, in order to determine the strategies and methods that will enable public enterprises to carry out business activities and maximize their own values by using the country's resources effectively and efficiently, Annual General Investment and Financing Programs prepared by MoTF are being enacted through Presidential Decisions every year.

The Decree Law Nr. 233 and the abovementioned Annual Programs set a general framework and rules for the SOEs under the ownership mechanism in Turkey. Apart from this main legislation, SOEs are subject to different several codes restricting and confining them.

These legal regulations and others not mentioned above set certain restrictions and barriers on SOEs and the rules they have to comply with. The restrictions and barriers set by the regulations are presented in the following section.

2.3.2 Barriers and Restrictions

Despite the government's policies to make SOEs operational and economically independent, and the fact that SOEs in Turkey have their own separate budgets, being obliged to comply with many legal and customary regulations may sometimes narrow their field of action and hinders their operational and budgetary independence and even sets barriers to progress in their fields.

The table listed below indicates the legal and customary restrictions that SOEs are subject to comply with;

These constraints that SOEs have to comply with, which can be seen below, are spread over a wide area, from personnel assignments of SOEs to their fields of activity, from their budgets to the formation of their boards of directors.

Apart from the ones detailed in this table below, there are many restrictions for the SOEs in Turkey due to the conventions.

Table 2 - Barriers and Restrictions of SOEs in Turkey

Subject	Explanation	Legislation
1-Assignment and Reassignment of Staff	- In personnel assignments, the board of directors is authorized to appoint up to 75% of the personnel who left in the previous year for openly and/or transfer, and up to 10% of the personnel subject to the transfer due to privatization practices reported to the Ministry of Labor and Social Security. - All personnel assignments of SOEs to which capital transfer is made are subject to the approval of the MoTF - Retired personnel cannot be employed.	Annual Investment and Financing Program Article 4
2-Additional Staff Assignment	- SOEs may request additional personnel from the Ministry of Labor and Social Security by obtaining the approval of the MoTF or, depending on interest, of the PA, up to 50% of the number of personnel who left the previous year, at the most only under the identified conditions. - Additional personnel assignments to be made within the scope of investments are made with the decision of the MoTF or, depending on interest, of the OIB, -In organizations whose employment costs are partially or completely covered by international organizations; In order to meet the minimum number of employment conditions determined by international standards, the appointments of pilots, seamen and maritime traffic operators who will work in the pilotage and towage services and ship traffic services system are not subject to restrictions, provided that they are employed only in the relevant field	Annual Investment and Financing Program Article 5

Table 2 - (continued)

Subject	Explanation	Legislation
3-Compulsory Employment	Appointments to be made in the following compulsory employment situations are not subject to restrictions: 1-Assignments of personnel who are required to be employed in accordance with special laws and relevant legislation, provided that there is a quota deficit within the relevant year. 2-Assignments related to the duties assigned by a Decision of President and to positions equivalent to these duties. 3- As per the provisions of the relevant legislation, the appointments of the personnel who are obliged to serve the enterprise within the scope of the training or assignments sent by the enterprise. 4-Assignments of personnel who return to their duties in the enterprise after military service. 5-Assignments of personnel who returned to the enterprise after serving as a professional trade unionist.	Annual Investment and Financing Program Article 5.
4-Examinations	-In the General Regulation on the Examination for First-Time Appointed Persons for the positions and positions included in the Schedules (I) and (II) of the Annex of the Decree Law No. 399; for worker status, it is done within the framework of the procedures and principles determined in the Regulation on the Procedures and Principles to be Applied in Recruitment of Workers to Public Institutions and Organizations. - SOEs may appoint to positions with special qualifications in terms of their field of activity by means of a corporate written examination and interviews.	-Decree Law No. 399 -Annual Investment and Financing Program Article 7.

Table 2 - (continued)

Subject	Explanation	Legislation
5-Temporary Workers	- SOEs may employ temporary workers only in seasonal works and/or campaign works, not to exceed 179 premium days during the year. - The total man/month period for which temporary workers will be employed in the concerning year cannot exceed the previous year and is determined by the approval of the MoTF of OIB. - Under no circumstances may the undertakings request additional temporary workers.	- Annual Investment and Financing Program Article 8 - Law Nr. 5620
6-Employee Payments	SOEs can assign staff as civil servants or contracted personnel. Salaries and personal benefits of these civil servants are identified through Law Nr. 657 and laws of annual central management budgets.	-Law Nr. 657 - Annual Laws of Central Management Budget
7-Service Procurement	- Services defined in the public procurement legislation can be procured through tenders. - SOEs can start multi-year service procurement by making their operating budgets to cover the period of these years within the scope of the Program. - Service procurement for more than three years is made with the opinion of the MoTF and Presidency of Strategy and Budget of Development and the decision of the relevant Minister. - The ceiling for the amount of service procurement to be purchased through tenders is determined by the MoTF.	- Annual Investment and Financing Program Article 13 - Law Nr. 4734 - Law Nr.4857

Table 2 - (continued)

Subject	Explanation	Legislation
8-Additional Service Procurement	- When determining additional service procurement requests; a) the board of directors of the public enterprise, if an increase of up to 10% is required, b) If an increase of more than 10% is required, MoTF or OIB is authorized. - Service purchases to be made under extraordinary conditions are not subject to restrictions. - The costs of service purchases to be purchased from outside within the scope of exports by exporting organizations and service purchases required to be made in emergency situations, which are vital in terms of ensuring system supply security of organizations operating in the field of energy, are outside the limitations. .	- Annual Investment and Financing Program Article 14
9-Overtime Work	- SOEs may have overtime work, provided that the overtime limit (hours/year) determined by the Annual Investment and Financing Programs shall not be exceeded. - The Board of Directors is authorized to increase the ceiling determined by the MoTF up to 10%, if necessary.	Annual Investment and Financing Program Article 10
10- Composition of the Board of Directors	- The board of directors consists of a chairman and five members. - The general manager is the chairman of the board of directors and is appointed by a joint decision upon the proposal of the relevant Minister. - From the members of the board of directors; two of them are appointed by the relevant Minister, one of them by the MoTF and two of them are appointed by a joint decision upon the proposal of the relevant Minister from among the deputy general managers of the enterprise.	- Decree Law Nr. 233 Article 6

Table 2 - (continued)

Subject	Explanation	Legislation
11- Qualifications and Conditions of the Board of Directors	- Those who will be appointed as members of the board of directors of organizations must meet the general conditions of being appointed to the civil service, have completed higher education and have administrative and professional expertise related to the field of activity of the enterprise. However, one of the members appointed upon the proposal of the relevant minister is not required to have administrative or professional expertise. - The chairman and members of the board of directors of the undertaking; cannot be a member of the board of directors of another undertaking. - Public officials who have the qualifications determined in accordance with the relevant legislation can be appointed to the board of directors of organizations. Members of the board of directors appointed to continue their main duties cannot act as members of another SOE, subsidiary or supervisory board.	- Decree Law Nr. 233 Article 7
12- Term of Office of the Members of the Board of Directors of the Enterprise	- The term of office of the members of the board of directors is three years. - Those whose term of office has expired can be reappointed. - In case the membership becomes vacant before the term expires or the qualifications and conditions sought for membership are lost, an appointment is made to complete the remaining term.	- Decree Law Nr. 233 Article 8
13- Duties and Powers of the Board of Directors of the Enterprise	- Duties and powers of the Board of Directors are determined by the relevant legislation.	- Decree Law Nr. 233 Article 9

Table 2 - (continued)

Subject	Explanation	Legislation
14- Operating Budget	- Organizations make their operating budgets within the framework of the Annual Investment and Financing Program and notify the MoTF, Presidency of Strategy and Budget and PA, depending on their interest, until the last day of January of the relevant year. - MoTF is authorized to make changes in the operating budgets during the year. - The relevant ministry may request the preparation of an operating budget for longer periods when necessary. - In case of changes in the investment and financing programs of the SOEs, necessary adjustments are made in the operating budgets in accordance with this change.	- Annual Investment and Financing Program Article 16 - Decree Law Nr. 233 Article 29
15- Target Detection and Tracking	- MoTF, determines quarterly financial or non-financial targets for the SOEs. - As of the end of March, June, September and December, SOEs convey to the MoTF whether the targets set for them by the MoTF have been achieved, and if not, the reasons for this until the end of the following month.	- Annual Investment and Financing Program Article 22
16- Profit Distribution/ Dividend Payment in Enterprises	- SOEs transfer a certain percentage of their profits during the year to the MoTF as dividends, within the scope of the relevant legislation. - The dividend amount and the payment schedule for the dividend are determined by the Minister of Treasury and Finance. Dividends not paid on time are collected by applying a late fee in accordance with the Law No. 6183 on the Collection of Public Receivables. For the additional periods given by the Minister, no late fee is applied.	- Decree Law Nr. 233 Article 36

Table 2 - (continued)

Subject	Explanation	Legislation
17- Revenue Share Payments	- SOEs make a revenue share payment of up to fifteen percent of their gross revenue, the amounts in question and the payment time is determined by the Council of Ministers. Revenue shares that are not paid on time are collected in accordance with Law No. 6183 dated 21.7.1953 by applying an increase at the rate determined by the Council of Ministers. However, no increase is applied for the additional periods given by the MoTF. - Revenue share rates to be received from organizations; 1- TPAO: 10% of its gross revenue, 2- DHMI: 14% of its gross revenue, 3- DMO: up to 10% of its gross revenue, and 4- KEGM: 10% of its gross revenue.	-Law Nr. 5018 Article 78 - 30/12/2005 Tarihli ve 2005/9916 Sayılı BKK -22/12/2006 Tarihli ve 2006/114742 Sayılı BKK
18- Vehicle Numbers	- The maximum limits for the number and amount of vehicles to be purchased or leased by SOEs are determined within the scope of the relevant legislation.	-Law Nr. 237 -Annual Laws of Central Management Budget
19- Offset	- The dividend amounts corresponding to the Treasury and all or a part of the other equities from the profits of the previous years of the SOEs can be deducted from the unpaid capital or duty loss receivables of the relevant institution. The Minister, to whom the Undersecretariat is affiliated, decides on the set-off transactions.	- Decree Law Nr. 233 Article 36
20- Duty Loss	- SOEs may be assigned duties related to their fields of activity by the Presidential Decree - The amount of duty loss to be paid to organizations is determined by the MoTF	- Decree Law Nr. 233 Article 35
21- Capital Transfer	- Capital transfers are made to the SOEs in order to meet the investment and financing deficits of the institutions.	- Decree Law Nr. 233 Article 37

Table 2 - (continued)

Subject	Explanation	Legislation
22- Preparation of Investment and Financing Programs	- Annual general investment and financing programs of institutions are prepared by the MoTF, taking the opinion of the Presidency of Strategy and Budget.	- Law Nr. 4059 - Presidential Decree Nr.1
23- Appointment of Subsidiary Supervisory Board Members	- The supervisory board of subsidiaries consists of three members.	- Decree Law Nr. 233 Article 25

Source: The Author

Many legislative implementations and government interventions detailed above are only direct ones for the SOEs. Apart from these, the indirect interventions or the pressures and restrictions created by the direct interventions with their spillover effect above force the SOEs in many ways. Some public enterprises cannot operate like prudent merchants due to some public responsibilities imposed on them. In addition to the organizations that operate only to create social benefits, there are also organizations that do not ignore the social benefit but are managed according to commercial principles. In this case, unlike enterprises operating in the private sector, public enterprises have a special situation. This situation affects the culture of the organizations and their position in the market. Due to these public responsibilities, some organizations may have to act more cautiously (risk aversive manner) while making their decisions. For this reason, organizations often have to give up risky projects. However, in order to make a difference and innovate, it is necessary to take risks. It cannot be expected that all R&D activities will reach results. Sometimes, projects that can cause a loss of money can be implemented. For this reason, the mentioned mission of public enterprises does not support innovation, for example.

As might be expected, technological development depends on many conditions, from the budget, human resources, corporate vision to physical facilities. Any situation that may set barriers or restrict such conditions will indirectly or directly hinder the achievement of technological development. For this reason, it would be useful to first consider what kind of restrictions and barriers SOEs are subject to and to what extent they may affect the technological development of SOEs.

2.4 The Contributions of State-Owned Enterprises to the Turkish Economy

The decree in law no.233 (DL.233) defines SOEs in Turkey and forms its framework. According to the DL. 233, the SOEs are institutions whose capital is owned by the state. In our country, the ownership and related functions arising from public ownership are carried out by the Ministry of Treasury and Finance (MoTF). Duties assigned by authorized bodies for restructuring, such as downsizing, dividing or merging, partial or complete, temporary or indefinite suspension of their activities, closure or liquidation, arranging the employment structure, and changing the organizational structure, in order to ensure the effective and efficient operation of state-owned enterprises or to prepare them for privatization are some of the duties and responsibilities undertaken by the MoTF.

The first SOE of Turkey which was operating in the financial sector Sanayi ve Maadin Bankası was established in 1925. After that period, several SOEs were subsequently established in different sectors. Since the end of the 1970s and early 1980s for economic purposes such as; increasing the economic efficiencies, productivities and profitabilities and improving performances of the state-owned

enterprises (SOEs), creating a level-playing field or financing the balance of payments deficits and budget deficits, many SOEs was privatized or liberalized.

According to DL. 233, currently, there are 19 SOEs in Turkey actively operating in their professional fields and apart from the concept of DL. 233, there are also several public entities operating under several laws like Turkish Commercial Law.

SOEs constitute significant shares of the gross domestic product (GDP) and contribute substantially to employment, regional development or market and sector development of developing economies. In many developing economies like Turkey, SOEs play active roles by operating in different sectors ranging from transportation to energy and agriculture to industry.

Many of the SOEs in Turkey are still occupying dominant roles or appearing as frontiers in different sectors basically as follows;

- Agriculture,
- Energy (Natural gas, mining, petroleum, electricity production etc.)
- Transportation

The SOEs are distributed according to their sectors in the table below;

Table 3 - Sectoral Distribution of SOEs

Energy	Agriculture	Transportation	Industry
Boru Hatları ile Petrol Taşıma A.Ş.	Toprak Mahsülleri Ofisi Genel Müdürlüğü	T.C. Devlet Demiryolları İşletmesi Genel Müdürlüğü	Devlet Malzeme Ofisi Genel Müdürlüğü
Elektrik Üretim A.Ş.	Çay İşletmeleri Genel Müdürlüğü	Devlet Hava Meydanları İşletmesi Genel Müdürlüğü	
Türkiye Elektrik İletim A.Ş.	Tarım İşletmeleri Genel Müdürlüğü	Kıyı Emniyeti Genel Müdürlüğü	
Türkiye Kömür İşletmeleri Kurumu	Et ve Süt Kurumu Genel Müdürlüğü	Türkiye Raylı Sistem Araçları A.Ş.	

Table 3 - (continued)

Energy	Agriculture	Transportation	Industry
Türkiye Taşkömürü Kurumu	Türkiye Şeker Fabrikaları A.Ş.		
Türkiye Petrolleri A.O.			
Eti Maden İşletmeleri Genel Müdürlüğü			
Türkiye Elektromekanik Sanayi A.Ş. Genel Müdürlüğü			
Türkiye Elektrik Dağıtım A.Ş.			

Source: Hazine ve Maliye Bakanlığı (2022)

As can be seen from the table above, SOEs still operate as a pioneer in important sectors and even take place as a monopoly in some areas in Turkey. In particular, it can be said that the energy sector of our country is largely dominated by the SOEs. BOTAŞ as an example; is responsible for the transportation of crude oil and natural gas and pipeline operations, importing, exporting, marketing, storage and sales of natural gas and LNG, despite the fact that the industry is open to competition and liberalized, is still dominating. TEİAŞ, on the other hand, is taking charge of the security of electricity supply. When shifting focus on the transportation sector, TCDD, acting as the main railway infrastructure operator and leading other businesses with negligible market share, monopolizes rail traffic on the national rail infrastructure network while its affiliate Taşımacılık A.Ş. solely undertakes railway passenger transportation in the nation.

Figure 1 shows the added-value (calculated by subtracting interest, exchange difference, depreciation and employment costs from profit/loss) created by SOEs in the last ten years. As can be seen from the graph, SOEs created an added value of approximately 29,5 billion TL in 2021 despite the Covid-19 epidemic. This amount corresponds to 0,41% of GDP. Although the added-value provided by SOEs generally increased over the years, the increase and decrease in the period profits of the SOEs or

fluctuations in the exchange rate in some years caused changes in the ratio of value added to GDP. For example, in 2013 and 2016, the total profit of SOEs increased considerably compared to other periods, and this situation reflected positively on the increase in added value. BOTAŞ had a large share in the increase in profits in the related years.

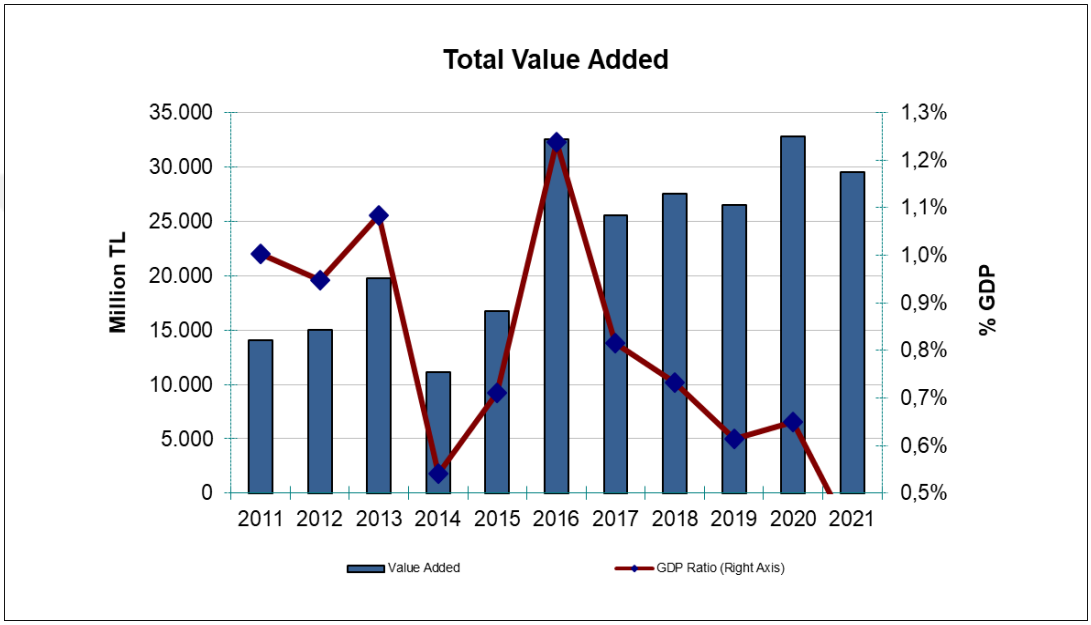

Figure 1 - Total Value-Added of SOEs[1]

Apart from value-added, SOEs contribute significantly to the general budget by paying dividends and revenue share. The graph below shows the contribution of SOEs to the general budget in the last ten years, excluding taxes. In the last ten years, they have contributed to the budget amounting to 38 billion TL in total by paying approximately 31 billion TL of dividends and approximately 7.3 billion TL of revenue

[1] Hazine ve Maliye Bakanlığı (2022)

share payments. [2] The effect of the dividend amount paid by EÜAŞ after the high profit yield in 2013 and 2014 was great in the high increase in 2013 and 2014.

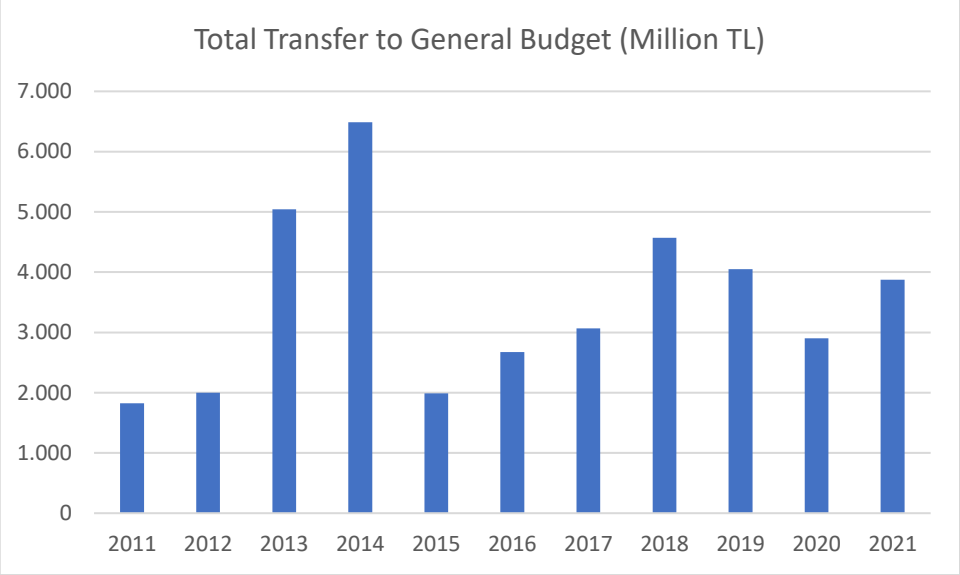

Figure 2 - Total Transfer to General Budget from SOE's[3]

SOEs also contribute to a decrease in unemployment rates by creating employment in Turkey. In 2021, 99 thousand personnel were employed by the SOEs with a corresponding cost of 17,3 billion TL (Hazine ve Maliye Bakanlığı, 2022). This figure constituted 0.35% of the total employment of 2.8 million in Turkey.[4]

One of the most important means by which SOEs contribute to a country's economy and growth is investment expenditures. SOEs undertake many investments that the state is obliged to make within the framework of social responsibility, thus both providing services to the public and making their investments profitable as much as possible and contributing to the country economically. In addition, they set an

[2] Hazine ve Maliye Bakanlığı, https://www.hmb.gov.tr/kamu-sermayeli-kurulus-ve-isletmeler-istatistikleri , 2.11.2022
[3] Hazine ve Maliye Bakanlığı (2022)
[4] TÜİK, https://data.tuik.gov.tr/Bulten/Index?p=%C4%B0%C5%9Fg%C3%BCc%C3%BC-%C4%B0statistikleri-2021-45645&dil=1 ; 2.11.2022

example by paving the way for private companies in the related sectors with their investments. The ratios of investments made by SOEs to GDP are given below (Hazine ve Maliye Bakanlığı, 2022).[5]

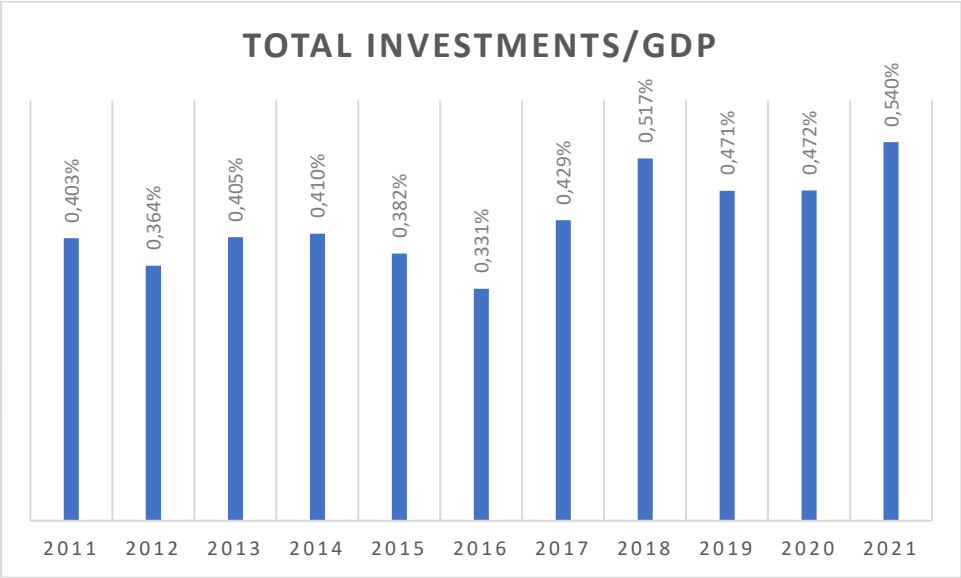

Figure 3 - Total InvestmentS/GDP of SOEs[6]

As can be seen from the graph, SOEs' investments reached 39 billion TL in 2021, which constitutes 0,54% of the GDP of Turkey.

The contribution of SOEs to economic growth and development is of course not only the numerical values mentioned above. SOEs have maintained their monopoly structure in the sectors in which they operate for long periods, have made investments in the sectors that no private firm would make within the framework of profitability, and thus assumed public service obligations. These SOEs, which contributed to the development of the sectors, later provided significant shares of

[5] Hazine ve Maliye Bakanlığı, https://www.hmb.gov.tr/kamu-sermayeli-kurulus-ve-isletme-raporlari ; 2.11.2022

[6] Hazine ve Maliye Bakanlığı (2022)

know-how to many private companies after liberalization and pioneered. For example, after the regulation of the legislation paving the way for the liberalization of the railway sector took place in 2013, companies that have stepped into the sector or want to do so today obtain know-how from TCDD and its subsidiaries.

2.5. The Need for a New Technology Policy for SOEs in Turkey

From a global perspective, public sector has grown in prominence as a result of both the government's socioeconomic policies and the fact that economies of scale prevented the private sector from making big capital investments in the core industry. The Indian government noted that the public sector had, up until that point, been essential to its view of development and had been crucial in: preventing the consolidation of economic power, reducing inequities by geography, making certain that projected development benefited the general good (Sinha, P.C.Jha, & Mesra, 2013).

In important industries, SOEs are being rediscovered as tools of public and economic policy, focusing investments in R&D and promoting economics. Argothy and Alvarez mention the article of Kowalski et al. (2013) and indicate that the article shows the significance of SOEs in global commerce, where the overall sales of SOEs account for more than 10% of the total sales of the 2,000 biggest businesses worldwide. They defend that the role of the State in the economy is substantial in rising nations, and in certain cases, it has grown recently. When comparing indices of private and public firms demonstrate the significance of public enterprises in the global market, with PEs doing better in various categories (Argothy & Álvarez, 2018).

Although studies on SOEs are fewer, existing studies commonly consist of comparisons of short-term performance indicators or links of SOEs with monopolies

or oligopolies such as railways (Atkinson & Halvorsen, 1986). In addition, SOEs can generate financial resources to regulate technology investments, as they contribute to increasing employment and laying the groundwork for all kinds of technological innovations.

Innovation is usually possible by importing technology-intensive goods or transferring technology from foreign countries. Therefore, companies need R&D to adapt technology to local needs. One of the cases that can be examined in this context is the Russian Railways. One of the countries where SOEs play an important role in the economy and development in China.

In the last two centuries, the USA has had a serious advantage in technological progress, and therefore it has been one of the first countries to be addressed in studies on the effect of technology on employment (Acemoğlu, 2010). The technological infrastructure of the USA has allowed this factor of production to accelerate. These; innovations such as R&D support, tax reductions, development of the legal system, patent rights, development of education and clearing the way for individual entrepreneurship. These paved the way for technological breakthroughs (Acemoglu, Moscona, & Robinson, 2016).

Therefore, the USA has a high level of labor losses as a result of its technological production power. The fact that the tasks performed by the workforce are carried out by accelerated automation and artificial intelligence, and the strengthening of these areas without slowing down, has brought up the concerns that labor will be worthless.

Considering Russia's history and long years of existence, it will be understood how difficult it is for SOEs to have a place in the country's economy. Nevertheless, the weakness of the innovation system in the country has attracted attention, and

studies in this direction have shown that progress will only be possible by turning SOEs into innovation powerhouses (Gokhberg & Kuznetsova, 2011).

In Russia, owing to SOEs, a large part of the population in both urban and rural parts of the country has been employed and thus the distribution of wealth has also been streamlined. In addition to all this, the innovation system was rebuilt with government intervention, as the inadequacy of SEOs in maintaining innovations was noticed.

The inadequacies of SOEs in some cases, necessitate the involvement of other innovation actors. These actors are actors such as universities, research institutions, SMEs, venture funds, and while developing regional innovations with the technology platforms they create, they can also offer innovation development programs to states.

Russia's interest in innovation systems and SOEs have also attracted the attention of other countries' economies. One of these countries is China. Recognizing the impact of adapting foreign technologies on economic growth, the Chinese economy has turned to innovation systems. Thanks to their innovation systems, they have reached the status of a developing country in terms of culture, economy and politics (Klochikhin, 2013).

In fact, government investments still play an important role in China's economy, but it's SEO that sustains the Chinese economy, raises it rapidly and also contributes to government investments. In other words, SEOs are one of the elements that characterize the Chinese economy. In addition, SEOs are one of the most important elements that contribute to the national economy as well as enable the country to connect with the world.

In the face of their contribution to the economy and development and their scale effects on the sectors, SOEs potentially play a valuable role in economic growth.

It is critical that the SOEs, significantly essential components of economic growth, preserve and even enhance their robust and solid structures without losing efficiency in order to effectively meet the country's social duties. Through this path, adopting them to changing technological developments to make them ready to compete with market forces and to struggle with the challenges arising from the technological/digital gap with their private counterparts is crucial.

The concept of technological development is going to be analyzed in the following section of this study. To put it in a nutshell, technological development with its simple definition- the systematic use of scientific, technical, economic and commercial knowledge to meet specific socio-economic objectives. - covers many dimensions from invention, innovation and diffusion of technology and it appears to be one of the inevitable targets of firms in order to achieve an efficient way of operating and going onward and not to be left behind from their counterparts. In the face of the importance of SOEs in the overall economy, making SOEs operate effectively and preparing them for advanced technologies is an important issue that shouldn't be neglected. However, although there have been attempts to improve and reform SOEs to adapt to new economic environments and operate more efficiently (liberalization of PTT or Turkish Railways), these attempts generally ignore or overlook issues focusing on SOEs' technological progress which would also lead to productivity. Similarly, althgouh many academic studies have been carried out to increase the effectiveness of SOEs' in Turkey, academic studies just focusing on the technological capabilities of SOEs' are still required.

Although the effectiveness of public businesses attracted a lot of attention in economic literature during the course of the 20th century, with diverse theoretical contributions examining incentives, control, and government influence inside public

organizations, it is now one of the most important findings of current literature which used the private sector as a comparison, were that public enterprises suffer from intrinsic efficiency issues because of management laxity, excessive government control, and inadequate incentives for innovation inside public firms (Stiel, 2017). Many public sector businesses have succumbed to illness and shut down. To revitalize or restore SOEs, efforts are being made throughout the world. The evaluation of the system's performance has received more emphasis in the new Industrial policy. Such businesses must undergo organizational turnaround when their performance continues to deteriorate and they are unable to stop it, but they are also capable of rejuvenating and recovering with increased efforts. Efficiency gains are crucial for this kind of business and may be achieved via smart technology management (Sinha, P.C.Jha, & Mesra, 2013).

As in the rest of the world, SOEs in Turkey are also under the control of the state in terms of legislation and customs, as detailed above, and their areas of action are significantly restricted. This situation leads to an important inefficiency problem, as mentioned. For long periods, SOEs have been used to increase employment or as a political tool, however, all legislative constraints have rendered SOEs inefficient over the years. Many SOEs have also been restructured or privatized in Turkey.

Sinha, P.C. Jhan and Mesra mention in their article that; serious problems are being observed related to SOEs (Sinha, P.C.Jha, & Mesra, 2013);

1. Insufficient growth in productivity
2. Poor project management
3. Overstaffing
4. Lack of continuous technological upgradation
5. Inadequate attention to R&D and human resources development

6. Very low rate of return on capital investment

While SOEs are still making a great contribution to the economy and the sectors in which they operate, in the era of digitalization and technology in which we are living, there has been a need to produce new policies for SOEs globally so as to remove or optimize the restrictions and barriers restricting the range of motion for SOEs and to make them adopt to the digital environment as their private counterparts.

The main findings from the body of work in literature, which used the private sector as a point of comparison, were that public enterprises had intrinsic efficiency issues because of management laxity, excessive government control, and inadequate incentives for innovation (Stiel, 2017).

However, it is not easy to say that public ownership itself turns them into inefficient and cumbersome companies.

According to Belloc (2014), cultural, legal, and political reasons rather than government ownership are to blame for the inefficiency of SOEs. In addition, Belloc (2014) argues that government ownership can foster SOE innovation by providing research funding free from the demands of profit and revenue expectations, having a higher tolerance for risk and uncertainty than private players, and making collaboration with other organizations easier (Belloc, 2014). In this way, rather than outright banning SOEs or destroying public ownership, new policies should be introduced that will make SOEs more flexible in their activities and management turning them into more dynamic and functional companies which can adapt the newly emerging digital environment.

According to this justification, the New Public Management (NPM) movement called for the implementation of market-oriented practices in all areas of public administration, including the delivery of public services. Public businesses are urged

to focus on their core competencies by using subcontracting, reform their organizational structures toward greater autonomy and less direct government influence, and benefit from knowledge reverberations from joint ventures with the private sector in order to increase efficiency (Stiel, 2017).

Numerous South African SOEs for example, acknowledge that the future is digital and that the evolution of digital technology is changing their business environments. They have developed strategies to prepare for this future by leveraging new technologies and pursuing opportunities provided by technologies like 5G, cloud computing, big data analytics, artificial intelligence, and machine learning and the South African Government puts SOEs central to achieving digital society (Venter, 2018).

Despite their importance, academic studies on innovation mostly do not consider or ignore innovation in SOEs. Researching public innovation has been the subject of some articles, including those from the United States, Italy, the United Kingdom, Australia, and Brazil among others. There aren't many publications, nevertheless, that examine innovation in SOEs. Some of them examine the SOEs' structure and concentration, the contribution of the SOEs' R&D to industry, the role of DFI with regard to the SOEs' R&D as well as the SOEs' role in the policies of R&D and innovation (Argothy & Álvarez, 2018). Argothy and Alvarez (2018) in their study define external and internal determinants for innovation in SOEs of Ecuador and their model reveals that labor, technology, and government policies are the primary factors for innovation in public firms. Size of the enterprise and environmental care are two factors that have a detrimental impact on the likelihood of innovation (Argothy & Álvarez, 2018).

Technology is essential to a nation's growth, hence it is critical that this resource is managed both at the national and corporate levels. The administration of the technology and its development cannot be left to chance. SOEs should be considered as one of the tools that will play an important role in the technological development of countries, considering their large capital structures and their know-how and market shares in their own sectors as well as their robustness or resilience that allows a business to persist even when changes have a detrimental impact.

Governments, especially those in emerging economies, have high expectations for SOEs to enhance domestic technical capabilities and foster innovation because of their significance to the economy. These governments' view SOEs as essential participants in modernizing sectors and regions because of their scale effects and implications on suppliers and customers. The potential contribution of SOEs to the improvement of national and regional economies and industrial structures is thought to be significant given their substantial investments in R&D and innovation, as well as their great potential for strategic intelligence and worldwide market reach (Meissner, Sarpong, & Vonortas, 2019).

Minimizing or keeping state interventions, restrictions and barriers at an optimum level is one of the most important steps to increase the efficiency of SOEs so that SOEs can adapt to the technological age and increase their technological development. Many of the limitations mentioned in detail above undoubtedly undermine the technological development of the SOEs. Any intervention to the number of personnel, personnel rights and salaries, investments, budgets, and expenditures will be an obstacle to increasing the technological capacity of the SOEs. Therefore, reducing these restrictions and making the SOEs economically and administratively independent will be beneficial for their technological development

and innovation. In this study, as Argothy and Alvarez (2018) work on Ecuador, indicators and criteria will be examined to determine the technological development and innovation potential of SOEs, and then some policy recommendations will be presented in the light of the analysis of these indicators. Instead of just focusing on one dimension of technological development such as research and development capabilities or just invention, with this study, I will be trying to cover all dimensions of technological development that would enable efficient functioning of SOEs in Turkey. Therefore, with study, a new and comprehensive technology policy for SOEs of Turkey is tried to be designed intended to cover all possible dimensions of technological development such as;

-invention or innovation in professional fields

-research and development in professional fields

-using advanced technologies in professional fields

-using advanced technologies as managerial tools

In parallel with technological developments, the increasing central role of the private sector has made SOEs and their contributions to technological development more and more important. SOEs are especially important as they contribute significantly to the national income, employment and market capitalization of developing economies.

Although government investments are generally common in sectors such as infrastructure, fields such as aviation, automotive industry, defense industry are also possible in areas that require high technology. At this point and in many cases, SOEs, including R&D and innovation, may become dominant in various sectors that are fully or partially funded by the government.

Aforementioned international experiences show that the role of SOEs is quite large in the development of countries, in the production of technology, in adapting and adopting existing technologies from outside. In today's world, which needs new perspectives and cannot explain the observable phenomena of society with traditional views, it would be an appropriate method to consider SEOs in order to understand and measure technological developments and changes.

In Turkey, SOEs are nearly dominant players in key sectors such as energy and transportation as mentioned. They have significant know-how and share their expertise with newly emerging companies, while also creating employment and contributing to the general economy. However, while they generate important revenues and contribute significantly to the budget, the indicators studied within this thesis suggests that there is need to trigger SOEs to expedite the technology adoption and creation.

To address this issue, this thesis studies on some indicators existing in the literature or used worldwide to measure SOEs' technological development levels, as well as identifying direct and indirect limitations on their technology adoption. Increasing SOEs' technological development capacities is likely to have a positive impact on the entire country's level and effectiveness.

The analysis suggests that there are several regulatory barriers and restrictions that negatively affect SOEs' technological development. Addressing these barriers and promoting a culture of innovation within SOEs could lead to increased competitiveness and productivity, as well as stronger economic growth overall. Therefore, this thesis proposes specific measures to enhance SOEs' technological capabilities, such as providing incentives for innovation, encouraging partnerships with private companies, and investing in training programs for employees.

CHAPTER 3

3. TECHNOLOGICAL DEVELOPMENT AND HOW TO MEASURE

3.1. The Concept of Technological Development

The primary engine of technology is politics, with a very close and necessary relationship to the economy, and these three elements are so intertwined that technology cannot function independently. While the conceptual reality of each may seem to express separation and distinctiveness, the movements of politics and economics increasingly affect technology in an unusual and massive way.

Technology is developing rapidly and entering our lives. The "high technology" enforced by defense needs emerged after the Second World War and is a very cost-intensive field. High-tech products are generally compared to their predecessors; smaller, lighter, more reliable and energy-efficient, less costly and more readily available (Strandberg, 2002).

Owning technology in a field does not only mean having a set of knowledge but also skills and abilities specific to that field. Therefore, as in every skill and competency ownership, the road to technology ownership passes not through a "purchasing" process like ownership but through an evolutionary competency development process based on education, investment and knowledge. The necessary parts and components for production can be purchased from any country, but purchasing them itself is not enough for a country or a company to become

technologically developed or cannot be called innovative. The technology acquisition process; can be defined as knowledge, infrastructure (facility, machinery, device, trained workforce, etc.) and skills required for the definition, design, development, production, use, support, institutionalization of a product or production method by converting it into derivative products and production methods, and the management of all these stages. In other words, the knowledge and skills should be used for the effective and efficient realization of an industrial process that includes research, development, production, marketing, sales and after-sales service in order to mention the existence of technological development and innovation (Zaim, 2001).

Technology transfer on the other hand is generally understood in the international community as "transferring production techniques and knowledge from developed countries to developing countries". Developed countries use the concept of technology transfer as a process definition. In this process, knowledge and techniques related to a high-tech field believed to have reached the industrialization stage are transferred to the relevant sector, namely the industry, in order to create the high added value expected from this field. On the other hand, having technological capacity is to have the potential of having a modern system that meets the needs of the user, all of the knowledge and skills required to design, develop, produce, test, operate, provide logistical support to this system and manage this whole process (Zaim, 2001).

Thus, when technological development is considered conceptually, the first point to be underlined is that technological development is a process. Technological development is a process that develops in parallel with innovation.

Technological developments are values that should be evaluated with an innovative perspective that would enable countries to use their existing economic

resources and production factors more efficiently, and that increase production outputs and thus directly economic growth.

Technological development is a concept that is triggered by innovation, affects economic and social life completely, and causes cultural transformations. Technological development, in a sense, means the replacement of the existing technology with a new one, and in this process, many processes, especially the production methods, the qualitative needs of the workforce, the management processes, the use of energy resources, undergo changes. The point that needs to be underlined here is that the replacement of old technologies by new technologies is only effective in the sector it is related to. Technological development affects other sectors besides the sector in which it emerges or is applied. In other words, innovation changes and develops other sectors along with the sector in which it was born with its spillover effect.

Technological developments are important in realizing structural investments in countries within the scope of human and physical capital. When technological developments are evaluated in terms of production factors, it is one of the main factors that trigger economic growth in terms of increasing productivity and developing innovative activities.

When the literature on the concept of technological development is examined, it is generally seen that a distinction is made between input (resources) and output (performance) (Mytelka, 2001). According to major literature; the S&T input and output indicators are as follows;

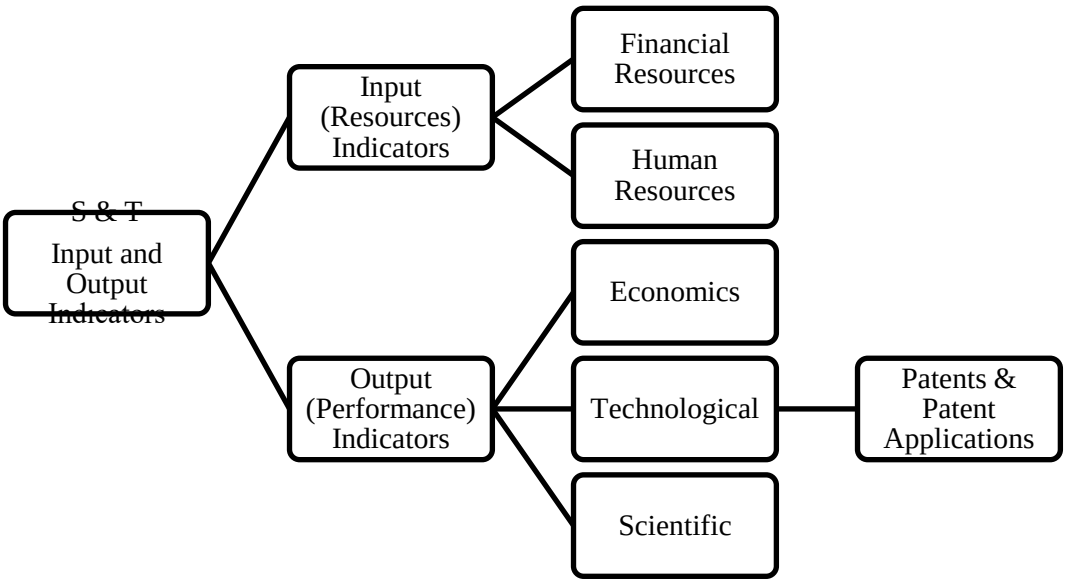

Figure 4 - S&T Input and Output Indıcators

Source: (Çavdar Çalışkan & Aydın Dilek, 2015)

Technological development is considered as a critical function in gaining a competitive advantage. Technological development brings with its patents and patent applications, and these two values are important tools at the point of protecting the innovation process. Kale and Little (2007) state that the existence and strength of patent laws are important for the effectiveness of technological developments and innovation uses these tools. In other words, technological development is everything related to every invention, product innovation and productivity increase in existing production factors that enable the production of a product or service.

When the historical process is examined regarding the concept of technological development, it is seen that one of the most important lines is the industrial revolution. Industrial revolutions take place in a continuum in the form of different successive phases. The invention of steam-powered machines towards the end of the 18th century led to significant changes in the economic and social structure. This first revolution,

which radically changed the production processes, is called the first Industrial Revolution. Because of this revolution, more raw materials could be used and more products could be produced with the technical possibilities provided by mechanical machines. In addition, thanks to the developments in the field of transportation, the goods have reached 171 more consumers, so both production and consumption have increased, thus factories with large capital and large numbers of people have emerged (Öcal & Altıntaş, 2018).

The second industrial revolution began at the end of the 19th century, when electrical energy was used extensively. Mass production has begun on moving lines working with electric motors. The third industrial revolution began in the 1970s with the application of electronic and information communication systems and industrial robots that automate production processes in addition to them. In the last 20 years, digital technologies have been developing rapidly in production processes. This rapid change is accepted by many as the beginning of a new industrial revolution. This process is called the fourth industrial revolution or “Industry 4.0”. In fact, this concept was introduced for the first time at the Hannover Fair held in Germany in 2011 and was mostly put forward as a reference to the development movement of European countries. It can also be called "Smart factories", "Smart industry" or "Advanced manufacturing". The fourth industrial revolution, like all other changes and transformations that cause rapid changes in human life, includes sudden leaps in productivity in the design, manufacture, workmanship and maintenance of production systems. With the fourth industrial revolution, more flexibility is provided in production processes, better quality and more efficiency are provided by adapting the production to rapid change in line with customer requirements at the maximum level, and by increasing the production speed. In order to stay in the market and compete,

companies need to exploit these advantages, invest in new equipment, information and communication technology, and conduct data analysis that will be at hand throughout the global value chain (Karabegović, 2017).

In modern understanding, the level of integration of basic research studies and new product and production technology development studies in countries is considered as the development level of a country (Zaim, 2001).

Being competent in science and technology does not only mean becoming competent in producing science and technology. If a nation has the ability to rapidly transform the findings of scientific and technological research into economic and social benefit (new marketable product, new system, new production methods and new social services), in short, if it has the ability to innovate/innovate only then it can provide a competitive advantage in world markets; can have a say and a decision in global processes.

In other words, it can be said that one of the most important points to be underlined at the point of technological development is the relationship between technological development and competitiveness. Its effect on competitiveness can be realized through different channels. The first of these is the reduction of labor costs. The most common consequence of using new technology is a reduction in the labor cost per unit of output. While this situation ensures a rapid increase in production with the use of advanced technologies, it does not cause any decrease in the total number of employees. The labor force substituted by technology is again employed by technology in a new business area. For example, with the widespread use of computers in production, many new business lines such as computer engineering, programming and technical service have been born and new job opportunities have been created (Simpson, Love, & Walker, 1987).

The point to be noted here is that while the cost of labor decreases with technological change, the need for qualified labor increases (Dönek, 1995). Because a qualified workforce is required to produce high-tech products and use them in the most effective way. Another effect of technological change on competitiveness is the decrease in capital costs. In the absence of advanced technological developments, companies had to keep stocks of raw materials, semi-finished products and finished goods.

Another effect of technological change on competitiveness is to increase the quality of products and services. Especially with the use of new technologies in engineering fields and the adoption of the total quality management principle, product quality has increased and it has become possible to produce in different shapes, sizes and designs. In addition, new technologies enable the diversification of products and services, making it possible to respond to changing and developing consumer needs. Offering a wider range of products and services to consumers than before gives companies competitive power (Narin, 1999).

In addition to what has been said above, it has emerged that in today's competitive environment created by new technologies and globalization, the ability to reach international competitiveness is actually based on competence in technological innovation. For this reason, it is accepted that technological innovation is one of the most basic determinants of gaining international competitiveness as well as being able to produce rapidly (Ansal, 2004).

Another issue that needs to be addressed when evaluating the concept of technological development is the relationship between technological development and economic growth. Although economies have their own internal functioning and dynamics, sectors within the economy need the concept of "advanced technology" in

order to accelerate their competitiveness in a positive way. It would not be wrong to call this concept generally as innovative technology (Zhou & Luo, 2018).

At the same time, when looking at products that include advanced technology, it is possible to associate these products with higher added value and higher earnings (Hasan & Tucci, 2010). Industries using advanced technology take their place as sectors that contribute to the strong expanding and dynamic structure of the existing trade in the world (Pradhan R. , Arvin, Bahmani, & Bennet, 2017).

In the new environment, broad specialization is being replaced by general productivity growth, and technology capacity, which is considered as more than just factor stocks, is becoming increasingly significant in order to save costs. The importance of technologies regarding their growth roles in the economy is increasing, which is an undeniable reality for developing countries, especially considering the endogenous growth model (Romer, 2014). When we look at the world economies, it is seen that international competition has moved to higher levels. As a result, the method of using technology determines the top ranking of the countries. There is a clear economic advantage of those who produce technology over those who transfer technology (Weerawardena, 2003).

When we look at the literature on growth, the thoughts about when the relationship between growth and technological development started, especially since 1950, with Solow's Neo-Classical growth model (1956). According to this model; with the technology, there is an increase in income per capita, which stimulates both savings and investments. Therefore, real GDP increases and contributes to the growth of the economy. Considering all these interactions, it is clear that if there is any problem in the development of technology, economic growth will be adversely affected by this situation. According to neo-classical economists; although there are positive effects

on technological innovations, existing technological developments should be external variables. For this reason, they cause a lack of answers about the source of the developments in technology (Spear & Young, 2015).

In order to fill the gap stated in the Neo-Classical model, different models have been developed that adopt the view that technological development is internal (see: (Lucas, 1988); (Romer, 1986). From this point of view, one of the first systemic models is Romer (1990)'s Solow (1956) is the endogenous growth model on which his views are based (Pradhan R. , Arvin, Bahmani, & Bennet, 2017).

Innovation is needed in response to technical or technological development (Fagerber, 2005). Innovation may signify many things in different contexts, just like "technology." According to Schumpeter (1934), the term "global process of innovation" refers to a collection of activities that support the creation of novel products and services or production using entirely novel forms or methodologies (Teixeira, 2012).

As mentioned above, technological development and innovation have a significant contribution to the economic growth and development of countries and, from the same perspective, to increase the productivity of companies and to hold on to competitive markets. Just like economies, companies also need to increase their competitive potential in their own sectors. Being open to technological development and innovation has become the most important step they can take in this sense. In order to be sufficient in terms of technological development, supporting the factors that assist innovation and technological development as well as removing the obstacles and impediments in front of this is the most important step that companies can take, just like countries.

The OSLO Manual puts forward two sets of factors to be considered in this sense;

- Various informational sources help the innovation process: sources within the company, sources from the outside market, institutes of higher learning and research, and publicly available data;
- Economic considerations, business-related problems, and a variety of other variables might hinder innovation. (OECD, EC, & Eurostat, 1996)

The Manual defines the assisting informational sources as: internal sources within the firm or business group: in-house R&D, marketing, production, other internal sources and external market/commercial sources as competitors, acquisition of embodied technology, acquisition of disembodied technology, clients or customers, consultancy firms, suppliers of equipment, materials, components and software; educational/research institutions as higher education institutions; government research institutes, private research institutes and lastly generally available information as; patent disclosures, professional conferences, meetings and journals; fairs and exhibitions (OECD, EC, & Eurostat, 1996).

The Manual also lists impediments or hurdles to innovation or technological development that has been determined to be pertinent in several surveys. They might be explanations for why innovation efforts are not carried out at all or why they don't provide the desired outcomes. The list can be adjusted to satisfy national standards; (OECD, EC, & Eurostat, 1996)

Economic factors

− excessive perceived risks;

− cost too high;

− lack of appropriate sources of finance;

− pay-off period of innovation too long.

Enterprise factors

− innovation potential (R&D, design, etc.) insufficient;

− lack of skilled personnel;

− lack of information on technology;

− lack of information on markets;

− innovation expenditure hard to control;

− resistance to change in the firm;

− deficiencies in the availability of external services;

− lack of opportunities for cooperation.

Other reasons

− lack of technological opportunity;

− lack of infrastructure;

− no need to innovate due to earlier innovations;

− weakness of property rights;

− legislation, norms, regulations, standards, taxation;

− customers unresponsive to new products and processes

Even though the basics of encouraging technological progress and economic transformation are well known, many developing governments, particularly Least Developed Countries (LDCs), have not shown noteworthy success in doing so. This is mostly caused by ingrained managerial inefficiencies in the public sector, along with inadequate production frameworks, which, when used together, provide a barrier to economic and technical development. The public and private sectors are the two most important agents in supporting technical advancement and economic development.

Other agents also play important roles. (Teixeira, 2012). Within this perspective, this study will concentrate on the public side, specifically the role of SOEs.

3.2. The Effects of Technological Development

When evaluated, it is important to first understand the macroeconomic values in which technological developments interact in order to understand the indicators of technological development. With this point of view, firstly, the relationship between technological development and unemployment will be evaluated.

Adam Smith, who is seen as the father of capitalism, emphasized in his book "The Wealth of Nations" that the interest of the worker overlaps with the interest of society and that the worsening of the worker's situation will adversely affect the owners. Smith drew attention to the fact that in the times when the economic situation was bad, the wages of those who lived on their wages were reduced first, and as a result, the working class had difficulty in sustaining the family's livelihood. Smith underlined that in this case, a social collapse is possible and that the layer of owners will be adversely affected by this collapse.

According to him, workers are incapable of defending their rights because they do not have enough education to seek rights. “The interest of the second strata, i.e. those who live on their wages, is as strictly related to the interest of society as that of the first (owners). As has been shown, workers' wages are never as plentiful as when the demand for labor is constantly rising, or the amount of labor employed increases considerably each year. When this real wealth of society comes to a standstill, workers' wages soon drop low enough to make it possible for the worker to raise children or continue the working breed. When the community begins to collapse, it falls below even that. The wealth of society perhaps benefits the strata of the owners more than

the strata of workers. But there is no stratum that suffers more from the collapse of society than the owners. While the worker's interest is closely tied to the interest of society, the worker is not capable of grasping this interest or understanding its relevance to his own interest. The situation of the worker does not leave time for him to obtain the necessary information. Although his knowledge is complete, his education and habits often make him unfit to judge. That is why in public debates, the voice of the worker is little heard. It is never possible to listen to this. Only in some extraordinary situations, when dozens of people are hurt, provoked and supported for their own purposes, not for their own purposes, the worker's clamor is heard." (Smith, 2016).

The labor factor has always been one of the most basic research topics of economics. The effect of technology on employment has been an important topic on which other economists, notably David Ricardo, Karl Marx and John Maynard Keynes, later focused on.

David Ricardo later abandoned the idea that technology would bring equal welfare for both the capitalist and the worker, which he initially advocated, and argued that the replacement of human labor by machines is mostly against the worker. According to him, the convenience and high level of output brought by the machines would spread to the whole society and workers would benefit from it by increasing their wages. However, he did not initially anticipate that the capitalists would not need more workers, despite the productivity of the machines. Later, he realized that the capitalist would favor more gains and that they would demand luxury with these gains, so he concluded that there would be no general welfare.

Although the first person to find the machine and use it beneficially may make an extra profit by making big profits for a certain period of time, as the use of that

machine becomes more widespread, the price of the good will fall to the level of the cost of production due to competition, in which case the capitalist's profit in money will be at the same level; since the capitalist could command more pleasure and entertainment with the same monetary income, with more income, he could only receive a share of the general good as a consumer.

The working class would benefit equally from the use of machinery; they would be able to buy more goods at the same money wages; in such a case wages would not fall either, since the capitalist could have the power to demand and employ the same amount of labor as his influence; of course, he might no longer want to employ this labor in the production of a new, different good. When four times as many socks could be produced with the same amount of labor, thanks to the innovations in machinery, the demand for socks would only double, and the laborers working in the socks manufacturing would inevitably be cut off from this line of business; but since the capital that employs them still exists and the owner will want to use this capital productively for his own benefit, I thought that this capital would be used to produce another good which is useful to society and which is impossible not to be in demand.

Adam Smith's craving for food is confined in everyone to the narrow volume of the human stomach. But the desire for structure, clothing, outfits and comfort in home furnishings and ornaments seems to have no limits, and the truthfulness of his words had a direct impact on me. I thought that since the demand effect for labor would remain the same and wages would not fall, the working class would also share in this benefit, along with the other classes, in the lower prices of goods as a result of the introduction of machinery.

The questions to be asked here are; does technological development negatively affect unemployment? Are technologically advanced countries more intensely unemployed?

The problem of unemployment has found its place in many disciplines. Various social scientists and writers have addressed the social dimensions of this issue. One of them is the German philosopher Martin Heidegger. Heidegger, in his book "Technology and the Future of Humanity", which he wrote about technology, has elaborated the relationship between the individual and the developing technology. “As we conceive of technology as a tool, we become tempted to dominate it and essentially fall outside and compete with technology.” (Heidegger) (O'Brien, 2011). He underlined that technology integrates modern cultures and cannot be evaluated independently of the individual. Yuval Noah Harari, one of the important historians of our time, said, in his book "21 Lessons for the 21st Century", he predicted that technological progress could have serious consequences for the future. Harari stated that there are two opposing views on this issue, namely that according to the first view, technology will create new jobs, and according to the other view, there is no common conclusion that the majority of the society will be unemployed. “We have no idea what the job market will look like in 2050 (Harari, 2018).

It's a common belief that machine learning and robotics will impact almost every line of business, from yogurt-making to yoga instructors. There are only opposing views on the nature and nature of change. Some in as little as ten to twenty years. While billions of people will be rendered dysfunctional to maintain the economic order, others believe that even in the long run, automation will continue to create new jobs and ensure prosperity for all” (Harari, 2018).

In the last two centuries, the USA has had a serious advantage in technological progress, and therefore it has been one of the first countries to be addressed in studies on the effect of technology on employment (Acemoğlu, 2010). The technological infrastructure of the USA has allowed this factor of production to accelerate. These are innovations such as R&D support, tax reductions, development of the legal system, patent rights, development of education and clearing the way for individual entrepreneurship. These paved the way for technological breakthroughs (Acemoğlu, Robinson, Moscona, 2016).

Therefore, the USA has a high level of labor losses as a result of its technological production power. The fact that the tasks performed by the workforce are carried out by accelerated automation and artificial intelligence, and the strengthening of these areas without slowing down, has brought up the concerns that labor will be worthless.

As the recent declines in the labor share in the national income and low-cost digital technologies increase the use of robotics and artificial intelligence, it is seen that the labor share is gradually decreasing. In addition, there are serious decreases in compensation and social rights (Acemoğlu & Restrepo, 2018).

The problem of unemployment is one of the unresolved issues in economies. According to analysts, the low growth rate is effective in increasing unemployment or keeping it stable. It is argued that the low growth rates of the recessionary periods are a negative factor in employment rates. To boost growth, “Recession experts” think that only higher rates of innovation and technical progress will save the economy from its current woes. This has become a cyclical situation, solutions are inadequate and inconclusive. The problem is growing, but there is no strong indication of a solution (McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012).

Opponents of this view have argued that over the past 200 years, new technologies have increased employment by creating new jobs. On the other hand, another group claimed job losses, decrease in wages and prolongation of employment, especially in Europe and the USA, as negative effects. Here we can speak of a group of workers who have not been taken into account. If human resource had adapted to these new developments with technological progress, these historical problems would not have existed. Wages could rise and the value of labor preserved (Acemoglu, Gancia, & Zilibotti, 2015).

While this historical issue was heard loudly in the negative periods of the economy, it was mostly ignored during the non-crisis periods. However, in the first half of the 20th century, despite the positive course of the economy, the effects of technology caused concern. During the widely discussed Great Depression of 1929, John Maynard Keynes (1930)'s article "Economic Possibilities for our Grandchildren," predicted that we could perform all operations of agriculture, mining, and manufacturing with a quarter of the effort available. Keynes predicted that these developments would not cause problems in the short run, but in the long run, "it's just a temporary stage of dissonance." (Keynes, 1930) said. He found the solution in low working hours, raising living standards and its spread (Keynes, 2010).

Production methods based on robotic technology have become indispensable elements of today's developed economies. So much so that the investments made in this field are increasing day by day. The use of robots in the production sector has had many benefits for the entrepreneur, especially by reducing costs and providing predictability. However, workers working in the production sector were adversely affected by this technology. Technological robots used in production are revolutionary, but while this revolution is a positive development for capital owners,

it can be said that it is the beginning of a bad scenario for workers. There is no complete consensus on the consequences of technological developments. Some, the automation process; While others see it as a harbinger of widespread unemployment with developments such as computer numerical control machines, industrial robots and artificial intelligence, others comment that it will offer new jobs, raise wages, and increase people's rest and vacation times. This controversial situation seems to continue, similar to the historical dimension of the problem (Acemoğlu, Restrepo, 2018).

While technology has destroyed some jobs, it has created some new jobs. Occupational changes increased at this stage. One of the advocates that technology causes a displacement effect is Joel Mokry. According to him, there are many direct examples of the displacement effect, both in the present and in the past, but with the Industrial Revolution in England and there where the first problem first arose, the fact that many jobs in spinning and weaving done by craftsmen were done by machines was the starting point of the problem for workers. Mokry referred to the importance of the Luddite Uprisings that developed during this period, adding a historical symbolic value to the subject (Mokyr, 1990). However, it is not possible to say that these uprisings hindered technological developments. On the contrary, technology has gradually spread and accelerated. The mechanization of agriculture, which gained momentum with horse-drawn reapers, combines and plows in the second half of the 19th century and with tractors and combines in the 20th century, meant unemployment for agricultural workers (Acemoğlu, Restrepo, 2018).

In the first years when technology started to develop, machines were developed to replace the work done by the hands of the employees, while the computer technologies used today are at a level that can compete with human intelligence and

ability. Therefore, while few professions were in danger of extinction in the past, today almost every profession is facing extinction or a decrease in demand (Ford, 2015).

Today, too, we are witnessing an era of rapid automation, and the jobs of highly skilled worker groups are also at stake. The level of technology that causes unemployment has changed a lot, and new technology is no longer a machine, but a robot and artificial intelligence. Software and artificial intelligence programs, which are today's technology, have replaced accounting, sales, logistics, trade and some highly skilled management jobs performed by white-collar workers (Acemoğlu, Restrepo, 2018).

High technological developments have a very important place in determining the targeted production level and duration. With artificial intelligence technology, robots perform very sensitive tasks smoothly and more cheaply. Thanks to this technology, precision in production has increased (Beaney, 2018). For example; Advanced computer technologies used in the health system provide important contributions to the diagnosis and treatment of cancer by collecting specific data for each patient. In this way, important successes have been achieved in providing individual treatment and diagnosis by examining the genetic and family structure of each patient. Another important development is the advanced algorithms that provide strong predictions in financial systems. Thanks to the data evaluation functions provided by artificial intelligence, it has strengthened the predictions in financial planning and investment preferences (Frey & Osborne, 2016).

We can say that computer technologies are very effective in labor-intensive areas and therefore low-skilled worker groups are eliminated. However, this does not mean the end of all work. Even in this age when we have very powerful technologies, human labor and intelligence continue to maintain their importance. Here, the skills

and education level of the employees make a difference, but distinctive skills become important. These skill gap studies, which are reflected in academic studies today, show that low-skilled workers are losing the race against the machine.

On the other hand, we know that digital technologies are an indispensable power in today's economy and the basic dynamic of growth. Therefore, it is difficult to expect that investments in technology will decrease (McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012). Especially in the last two decades, very serious developments have been made in artificial intelligence and robots, and it is predicted that these advances will be much faster in the future. We do not have a definitive interpretation of how automation in general, artificial intelligence and robotics in particular, affects the labor market and productivity. Based on the past, most economists claim that technological breakthroughs increase the demand for labor and wages and they have optimistic views on the future (Acemoğlu & Restrepo, 2018).

However, with the invention of the computer, a revolution has taken place in technology and the employment sector has been greatly affected. This revolutionary innovation enabled the value of education and skill, and workers who were more educated earned higher wages.

3.3. Measuring Technological Development

One of the most important problems of studies in the field of technology is how to measure technological developments. Solving this fundamental issue requires principally to understand the evolution of technology. Arrow (1962) describes that the evolution of technology as changes in production processes or institutional arrangements that make it possible with particular resources to produce (Arrow, 1962).

Baumol (2002) evaulated that the evolution of technology as production more or qualitatively superior products than a given product or service. Technology evolution is a fundamental reason of rising life quality in modern economies, and differences in technological capabilities between countries determine international differences in living standards and quality (Baumol & William, 2002).

Since one of the most important indicators that determine the development level of countries and institutions is technological development level, the literature proposes various approaches to measure the level of technology and changes in technology. In the information age, it is clearly seen that it is technological developments that make important contributions to economic growth. The countries and institutions that produce and export technology are gaining an advantageous position on the world scale.

Although technological developments are among the main factors that will stimulate economic growth with the realization of investments in the human and physical capital structures of countries, increasing the efficiency and number of production factors, and innovative activities to be carried out, they are not a sufficient factor on their own to ensure a sustainable economic growth (Berber, 2006).

The sustainable economy of the modern age and stable success of institutions will be possible through technological developments. In this context, pursuing, understanding and measuring technological developments and changes are gaining more importance day by day.

The technology level, can be expressed as the sum of the production process, product output, marketing of this output and after-sales experience in the most general sense. The increase in this sum, on the other hand, creates technological development. However, in order for this increase to be accepted economically, the parties performing

the production must transform the technological development into a commercial product, namely innovation (Kibritçioğlu, 1998).

Joseph Schumpeter (1939), associates the sustainable economy of the modern age with technological creativity. According to him, technological creativity arises from the interaction of two different but complementary processes: invention and innovation. Schumpeterian invention is being able to discover things about natural phenomena. Schumpeterian innovation is the application of existing knowledge in new ways to meet particular human needs (Schumpeter, 1939).

Nevertheless, since Schumpeter sees innovation as the main source of economic development, it places more emphasis on the concept of innovation than invention. He argued that the invention untogether does not create an economic effect and does not lead to innovation. Schumpeter claimed that innovative initiatives that change the economic structure internally, destroy the old and create the new bring along the process of creative destruction and that this is necessary for the continuation of capitalism (İçke, 2014).

Considering innovation as a system has brought different system understandings to the agenda. Although the systems developed in this context and their contents are complementary to each other, each system has its own differences. Theoretical and applied studies allow the use of innovation as a correct tool in the context of increasing welfare. It also guides policy makers and regional actors. In many policy documents prepared based on development plans, the effects of innovation on the country's economy are discussed in detail.

Technological advances, which are the basis of growth and development, cannot find a place for themselves in traditional growth theory. Therefore, new perspectives are needed. It is necessary to understand and measure the place of

technological developments in economies in order to understand that technology producing and exporting countries are in a more advantageous position compared to other countries due to the contribution of advanced technology to economic growth. Mutual support and reinforcement of technological developments is an important development that increases the speed, efficiency and capacity of productivity.

In developed countries, investments in technology have become one of the main factors affecting economic development over a period of time. Advances in technology every day have also played an important role in production processes, enabling the production elements to be used more effectively and efficiently. This situation increases the quality of life and welfare of individuals living in a country where economic development has increased.

Schumpeter is a groundbreaking actor in the field of technological innovation. Studies dealing with technological innovation in the economic literature also refer to Schumpeter for his contribution to the inclusion of technological innovation in economic studies. However, Maclaurin (1907–1959), who developed Schumpeter's ideas and had systematic studies on technological innovation, analyzes technological innovation as a process consisting of several stages or steps.

These views of Schumpeter on economic analysis show that he acted with a different approach from Neo-Classical economics. Instead of balancing and optimizing, Schumpeter stated that the dynamic imbalance created by the innovative entrepreneur is the norm of a healthy economy and is central to economic theory and practice (Drucker, 1984). Because economic life operates with dynamic processes in a state of constant change.

For Schumpeter, the imbalance had a positive meaning and Schumpeter tried to find the balance within the imbalance in his economic analysis. According to

Schumpeter, it is necessary to benefit from the world of subjective knowledge against the problems posed by concrete life. At this point, Schumpeter stated that the mathematical models of Neo-Classical economics based on extreme rationality are not very sufficient to explain economic analysis

In fact, Maclaurin's contribution to understanding technological innovation is the major and important contribution to the study of technological innovation. In the 1940s and 1950s, Maclaurin offered a theory of technological innovation, later called the linear model of innovation. By this means, Maclaurin created one of the first taxonomies used to measure technological innovation.

In the early 1940's Maclaurin started a research project on the economics of technological change. Although it is a project undertaken in the discipline of economics, this work of Maclaurin has turned into an interdisciplinary study over time. However, this project was not successful for various reasons (Backhouse & Maas, 2016). Because in this period, although many economists have been interested in technological changes for a long time, they have done very little work on the factors affecting the rate of technological progress (Bright & Maclaurin, 1943). Until then, technology had only attracted the attention of a small number of economists studying the impact of mechanization on employment and productivity.

Maclaurin attributes technological change to rates of technological change in the industry and to conditions that allow technological progress. During this time, technological changes and innovations were often associated with economic growth and for this reason, many empirical studies have been conducted to address the effects of innovation on growth. In fact, this time was the period of a revolution in the concept of innovation. Afterwards, studies were carried out for the further dissemination of technological innovations.

All these changes have led researchers to determine and measure the effects of innovations on economic growth (Brozen, 1951). The most important pioneering work in this field belongs to Solow (1957). After this time, neoclassical economic approaches that initially focused on factor accumulation, then focused on technological progress and endogenous growth models.

Innovation in the workplace depends on a range of tasks, from production engineering to institutionalized R&D. It has been emphasized that innovation does not occur in a straight path from product R&D to final commercialization. Instead, the components of innovation work together throughout each stage to create a complex web of connections. Therefore, the issue of measuring technological development is incredibly challenging Archibugi and Pianta (1996) state. (Archibugi & Pianta, 1996).

Industrial innovation may be divided into three primary categories. First, codified and tacit knowledge are impacted by technological development. Second, the firm's internal or external sources of innovation are both possible. Thirdly, innovations can either be embodied in tangible commodities and products or disembodied, that is, they might be the know-how included in designs, patents, licenses, R&D operations, or talented workers. These characteristics already point to the complexity and diversity of technological development. They demonstrate why it is challenging to identify metrics that adequately capture the dimension, intensity, pace, and direction of inventive activity (Archibugi & Pianta, 1996).

Due to its abstract and intangible aspects, measuring technological development or innovation even specialists find it challenging to measure the technical condition as to mention. However, there are various techniques for measuring the status of technology in both in literature and practice.

The Solow model is a model based on the history of neoclassical economics and based on long-term economic growth. This model examines and analyzes capital accumulation, labor and population growth and productivity in parallel with technological developments. The Solow model of technological progress focuses on theoretical models of technological change in economic growth. This model has become a frequently used model to analyze macroeconomic phenomena (Godin, 2008).

The Solow model, with the addition of the human capital variable, is a model that better describes real life and is a reference to many scientific studies. This approach attributes the differences in output per labor force between countries for two reasons. These are the differences in the effective labor supply and the level of capital per worker (Durlauf, Kourtellos, & Minkin, 2001).

In the model, it is claimed that countries with a lower initial capital/labor ratio will have higher per capita growth rates than countries with higher capital/labor ratios and will converge with developed countries. Because countries with lower capital/labor levels have higher marginal returns. Therefore, they grow faster than developed countries (Barro, 1991).

There are three components in the Solow model. These are technology, capital accumulation, and saving. The technology component comes from the aggregate production function. Since the Solow model is a dynamic model that is frequently used in macroeconomic theory, it is a model that should be examined methodologically.

The model assumes that GDP is produced according to an aggregate production function technology. However, most of the results that can be obtained using the Solow model can also be obtained using one of the standard production functions seen in microeconomic production theory (Whelan, 2003).

The technology component of Solow model represents the unexplained portion of economic growth excluding labor and capital growth. Therefore, it is essentially a variable that is not included in the model and it is called the Solow residue. In an economy where capital increases more than the labor force, while technology is exogenous and fixed, countries with low per capita income will grow faster than countries with high per capita income, catching them in a common stagnant state. However, although technological progress is accepted as an exogenous factor for economic growth, it is known that technological progress is the best way to create useful products and services with scarce resources (Schiliro, 2017).

The Solow model states that each country will grow faster the further it is away from its steady state, the slower it gets as it approaches its steady-state equilibrium and conditional convergence will prevail. This contribution has increased the importance of the Solow model, the validity of which was discussed in the 1980s (Murach, Wagner, Kim, & Park, 2022).

In addition to all these, the model is criticized for not taking into account other factors affecting the efficiency of labor other than technology, for developed countries to amortize the capital effect lost in the convergence process with technological development, for not specifying the source of the technology that is assumed to be external and fixed, and not explaining the contribution of technology to growth by reducing the unit cost.

While the labor force participation rate is important for national economies, it is also important to know the qualitative structure of the labor force and the characteristic features of production companies. Labor force participation rate, by definition, refers to the ratio of the sum of active workers and job seekers defined as labor force in a country to the working age population.

A high labor force participation rate may not, in all cases, provide the desired contribution to output or to real output, which is the monetary value of that output. For this reason, in our study, the relationship between labor force participation rate and income per labor force was investigated in the context of the basic Solow model. The validity of the basic Solow model was tested on selected Islamic countries and the effect on income per labor force was discussed by adding the labor force participation rate variable to the model.

Kim (2012) classifies measuring methods into five types: scoring models, data analyses, surveys, growth models, and indicators. The scoring model which is also known as Martino's Model defines the technological state in terms of the total score using the following equation; The capital letters represent the factors that affect the technological state. A and B are overriding factors. (C, D, E), (F, G), and (I, J) are exchangeable factors within brackets. I, J, and K are costs or undesirable factors;

$$\text{Score} = \frac{A^{a}B^{b}(cC + dD + eE)^{z}(fF + gG)^{y}(1 + hH)^{x}}{(iI + jJ)^{w}(1 + kK)^{v}}$$

$$(c + d + e = 1, \quad f + g = 1, \quad i + j = 1, \quad a + b + z + y + x = 1, \; w + v = 1)$$

For a scoring model to achieve its goal, it must adhere to a number of standards. The variables should be quantifiable, reflective of the state of the art, and have access to data for measurement. Technology, however, is too abstract to be quickly categorized. The task of gathering the data is challenging as well (Kim, 2012).

Since technological development will be handled with its inclusive definition focusing on increasing the innovation and technological development capacity of SOEs in general, this method, which only serves to get a result with tangible data, was not preferred in this study.

Growth models are also being used for measuring technological levels sometimes, but generally, they are being used for forecasting rather than measuring. The S-shaped curve is utilized in the same way as the growth model is. There are several S-shaped curves such as Bass, Pearl, Gompertz, and so on. The Bass model is an early-stage S-shaped curve model. Nowadays, Pearl (1) and Gompertz (2) are commonly utilized as S-shaped curve models. L represents the highest limit of technological growth in both equations (Kim, 2012).

$$Y(t) = L/(1+\alpha e^{-\beta t}) \quad (1)$$

$$Y(t) = Le^{-\beta t-at} \quad (2)$$

S-shaped curves can serve as a model for the dynamic development in technology, but they come with a number of assumptions. These presumptions consist of a valid equation, a clear upper limit, appropriate fitting, and others. Since the upper limit is a mostly theoretical idea, it is difficult to define among them.

Growth models have recently been used to measure the degree of technology. For instance, between 2008 and 2010, the KISTEP used the methodology to assess national key technologies. Even though they had drawbacks like the upper limit issue, they are regarded as advanced situations in terms of assessing dynamic technology (Kim, 2012).

Total factor productivity (TFP) growth rate, on the other hand, is a popular metric used by economists to measure technological developments. Nevertheless, the OECD manual on productivity measurement (OECD, 2001) notes that, in reality, there is no clear connection between the TFP increase and technical improvements, and econometric analyses reveal that R&D expenditures only explain a relative portion of the TFP growth (Li, 2016).

A small proportion of the TFP's yearly average fluctuations. To put it another way, empirically speaking, not all aspects of change are captured by TFP, and the measured TFP may incorporate other nontechnology elements, such adjustment costs and measurement mistakes. The TFP growth rate is also helpful for comparing productivity through time for a particular nation or area at various times in time, but it is far less helpful for comparing the relative productivity of different countries with its residual approach (Li, 2016).

Although the growth model method gives us dynamic results about the technological level, it is not discussed in this study, since it would be difficult to determine the upper limit for each SOE in the equation and to include non-tangible technological developments in the managerial processes.

Surveys are also among the methods used to measure technological development, which is easier to conduct relative to the other methods.

The survey method's fundamental assumption is that specialists are well-versed in the status of technology. In other words, the survey approach makes use of experts' implicit knowledge. Many agencies have lately employed the Delphi survey, one of the survey methodologies, to measure technology. One of the early foresight techniques was the Delphi survey. The Japanese government started conducting extensive foresight surveys using the Delphi approach in the early 1970s, and they have since been conducted roughly every five years. In a Delphi survey, a large number of experts are questioned repeatedly with the same questions, and the responses from earlier rounds are sent back to the respondents so they may be revised and a consensus can be reached (Kim, 2012).

Some might question the accuracy of the survey answers and defend that surveys may not be reliable and can be subjective. Assuming data gathered by surveys

are accurately combining with the data analysis method surveys may be very useful in measuring the technological levels.

Data analysis is another measurement technique that employs information from specific technologies that can be categorized in accordance with established criteria. Patents and technical performance are closely related says Kim (2012). Any other criteria or indicators that may help measure the technological level can also be used within this technique.

The most importantly with the data analysis method is to conduct it complementarily by choosing the data otherwise the method may not be sufficient enough to measure the level of technology.

Lastly, in order to assess technological development indicators are being used. Some economists and agencies have created new indicators that utilize measuring technological development. From the most used ones; patents and journal articles to R&D expenditures and R&D personnel or trademarks and the number of researchers, range of different indicators are being used.

The extent to which accessible indicators overlap or provide information on many parts of science is the first of two major concerns that need to be solved activities related to technology; second, the degree to which indicators of the same activities provide similar results. There are two ways to sum up these difficulties. Which indication provides the answer to which query? Do various indicators produce the same outcomes? (Archibugi & Pianta, 1996).

Perhaps the most important part of the indicator method is to choose the indicators in an inclusive way in accordance with the purpose. Indicators can consist of numeric data as well as uncountable, interpretive data. After gathering the data on

indicators via some techniques existing in the literature like surveys and interviews, the data analysis shall be conducted to get confidential results.

By combining some of these methods, trying to measure the technological development of companies can cover the deficiencies of each method. When it comes to measuring SOEs' technological level, it is better to conduct a hybrid method combining determining comprehensive indicators and performing data analysis afterwards would be reasonable considering the data that can be collected.

3.4. Indicators for Measuring the Technological Development of SOEs

The implementation of science and technology is defined as scientific and technological activity (STF). This concept was developed by UNESCO. According to UNESCO; scientific and technological activities related to the production, development, dissemination and application of scientific knowledge in the field of science and technology include research and development (R&G), scientific and technical education and scientific and technical service activities (UNESCO, 1978).

Scientific and technical education includes non-university specialized higher education, undergraduate education, graduate and doctorate education, and all kinds of technical education activities organized for scientists and engineers (UNESCO, 1978). Scientific and technical services are; activities that contribute to the production, dissemination and application of scientific and technical knowledge related to research and development (OECD, 1980).

These activities are; scientific and technical manpower, resource scanning units, collection, coding, recording, classification, dissemination, translation, analysis and evaluation studies, scientific and technical information dissemination and consultancy service units, and scientific conferences and meetings (OECD, 1980).

The technology capacity of a country develops with scientific and technological activities. It sets the trend in the growth and development of the country. The process of making technological innovation generally consists of activities that do not exhibit a stable structure, and that is complex and variable, acquiring and producing new knowledge. Although there are case-specific differences, it is generally in the form of R&D stages, technological knowledge acquisition (patent, license, non-patentable invention, model, design and scientific-technical consultancy and services) and the acquisition of performance-improved machinery-equipment, device and software, which are the inputs of the innovation process (TÜBİTAK, 2005).

As expressed in the TÜBİTAK dictionary, these activities constitute indicators that will express scientific and technological activity. At this point; OECD divides the indicators of science and technology activities into two as science and technology activity inputs (STFG) and science and technology activity outputs (CTFF) (OECD, 1994).

While STFG covers R&D personnel, R&D expenditures and technical consultancy services, know-how expenditures and R&D-intensive hardware investments, CTFF covers scientific publications and patent applications. On the other hand, indicators such as techno-metric standards, innovation tests, R&D-intensive goods trade, production volume and technology evaluations can be perceived as indicators of science and technology activities (Bozkurt, 2006).

It coincides with the 1960s, when computers came out of the laboratory and began to be widely used in various fields. The realization that science and technological activities accelerate development by increasing productivity and the development of technology-oriented economic theories coincide with the same period. In this framework, science policy has also begun to emerge as a science-research field

and many research units have been established in this field in Europe and the USA (Acun, 2001).

The OECD, of which Turkey is a member, is one of the most important international institutions operating in the field of science policy since its establishment. Today, many countries have made science and technology the main axis of their development models (plans). Thanks to the developed science policies, activities in the field of science and technology are directed and financed to achieve certain social (economic-political and general welfare) goals, necessary infrastructure and institutions are established, and those that are not necessary are removed (Acun, 2001). In this context, it is useful to examine the indicators of technological development that provides an international competitive advantage. Among them, indicators used by the OECD are helpful in providing an illustration from the set of metrics that are generally acknowledged. A comprehensive range of conceptual and practical tools for creating and utilizing the current technical indicators and data sources are offered by the "family" of OECD Manuals (Archibugi & Pianta, 1996). Under the heading "The Measurement of Scientific, Technological and Innovation Activities," the OECD publishes a number of measurement guides. Each document provides recommendations for collecting, reporting, and using data and indicators related to science, technology, and innovation that have been accepted globally (STI). While Frascati and Oslo Manuals are building the basis of innovation indicators, there are also guides for different indicators.

More guides have been added throughout time, including the OECD Patent Statistics Manual. The manuals in this series are routinely updated to reflect fresh difficulties and advancements (OECD & Eurostat, 2018).

For R&D statistics, there is a set of rules known as the Frascati Manual. Since the Manual's release in 1963, six revisions have been made. The Frascati principles have been crucial in many statistics and scoreboards developed by the OECD and other nations since R&D statistics are among the most significant indicators of economic development in terms of technological advancement. As a result, not only in OECD member nations but also in other organizations like UNESCO, the European Union, and others, the Frascati standards have emerged as the de facto norm for R&D surveys and data worldwide (Kim, 2012).

Since 1992, the Oslo Manual has been published three times and has a stronger emphasis on innovation-related activities. Results of surveys to create and gather information on the process of invention was included in the first edition, which was published in 1992. The second edition, published in 1997, modified its framework to broaden the study's scope and the idea of innovation. It also refined the indicators used to measure innovation so that they could be compared across OECD nations. A significant quantity of data and information from numerous surveys were incorporated in the third version, which was published in 2005. It broadened its methodology for measuring innovation to include pertinent businesses, services, and innovation categories including organizational and marketing innovation (Kim, 2012). This manual addresses changes that occur at the level of the specific firm. It excludes some of the other types of innovation outlined by Schumpeter, including the opening of a new market, capturing a fresh supply of raw materials or semi-manufactured commodities, or restructuring an industry. More recently, in 2018, the 4th edition of the Manual was released to strengthen its relevance as a source of conceptual and practical guidance for the provision of data, indicators and quantitative analyses on innovation. The Oslo Manual cooperates and complies with United Nations' statistical

classifications. These include the SNA 2008 set by the European Commission and the International Standard Industrial Classification of All Economic Activities (ISIC) set by the United Nations in 2008. Since the SNA does not currently recognize many types of innovation activities as capital formation (other than R&D and software), Oslo Manual is grounded as a base for a comprehensive study in this thesis (OECD & Eurostat, 2018).

Other widely used metrics exist as well, such as IMD World Competitiveness. Even while the IMD indicators contain a few sub-indicators, such as scientific and technical infrastructure, etc. The Composite Science and Technology Innovation Index (COSTII, South Korea), the Japanese Science and Technology Metrics (Japan), and other indicators are available locally. Although these yearly statistics are released by each country, they also contain data on other competing countries like the United States, Germany, the United Kingdom, China, etc. Therefore, it is possible to think of such metrics as criteria for comparisons between important countries (Kim, 2012).

Neither handbook/guide nor manual can be used as a concrete example of technical development of a company or a country on the other hand but they do offer some objective and fundamental standards for R&D and innovation data and indicators, though. However, more precise data and information would be required in the event of evaluating a particular technology company's technological level or a country.

Given the fact that we need more specific and to the point technology indicator, in literature there exists several studies about the subject. Li (2016) in his study called New Technology Indicator for Technological Progress, introduces a new technology indicator, the industry-specific R&D depreciation rate, indicating how much a firm can appropriate the return from its investment in R&D for an industry's global

technical competitiveness for example (Li, 2016). Since not all SOEs of Turkey that I am studying on within this thesis operate in industrial sectors, this indicator for example would not be appropriate for this study.

Taking into account that measuring the technological development in SOEs is the basis of this study, while determining the indicators, although the mentioned manuals are taken as a basis, it has also been tried to choose indicators that can be specific to SOEs of Turkey and the conditions of our country taken into account of being able to accurately gather the accurate and related data. In addition to some countable indicators well-known as R&D or patents, other innovation indicators that may give an impression about companies' innovation strategy but cannot be measured are analyzed within this study. That is, I will conduct the two approaches to collect data on innovations by SOEs defined by the Oslo Manual: the "subject approach" which starts from the innovative behavior and activities of the enterprise as a whole; and the "object approach" which concentrates on the number and characteristics of individual innovations. (OECD, EC, & Eurostat, 1996).

The Oslo Manual defines business innovation activities as; (OECD & Eurostat, 2018)

- R&D activities
- engineering, design and other creative work activities
- marketing and brand equity activities
- intellectual property (IP) related activities
- employee training activities
- software development and database activities
- activities relating to the acquisition or lease of tangible assets
- innovation management activities

The criteria/indicators of the study for measuring the levels of technological development reflect above-mentioned activities.

The Oslo Manual, as mentioned before, deals with the innovation processes in the business enterprise sector and the Manual states that the business enterprise sector consists of private enterprises and public enterprises. According to the statement, for public enterprises, the degree to which the unit functions on a market basis determines the boundary between the business firm and government sectors. A unit is regarded as a business entity if its primary function is the production of goods or services at commercially viable pricing. (OECD & Eurostat, 2018). Since, the SOEs in Turkey despite their duties given by Presidency by setting prices under costs, when looked in general they can be called as business enterprises and the indicators given below with details are being tried use to measure SOEs' level of technological development.

The indicators defined within this study ensured to have the following properties set by Oslo Manual; (OECD & Eurostat, 2018)

- relevance,
- accuracy,
- reliability,
- timelines,
- coherence,
- accessibility

In order to measure the level of technological development/progress and innovation in the literature and practices today, many indicators have been put forward depending on the situation and conditions, and the most appropriate indicators for each situation are selected and analyzed. Within this thesis, the indicators which are being used as tools to measure technological development of SOEs are selected to be used

whose data can be obtained from the SOEs in the most accurate way and reflect their level of technological progress in the best way among many indicators used in literature and practices today which comply with the features and properties in the Oslo Manual. That is, the chosen indicators of this study are expected to provide relevant, accurate, reliable, coherent and accessible data on the technological levels of SOEs.

3.4.1. Research&Development

Research and experimental development (R&D) is the creative work carried out on a systematic basis to increase the knowledge of people, culture and society and to use this knowledge to design new applications. The term R&D covers three activities: basic research, applied research and experimental development. The concept of R&D includes both regular R&D in R&D units and non-regular or occasional R&D activities in other units (OECD, 2002).

In terms of businesses, it is aimed to develop new products with R&D activities, to increase the quality standards of the products produced and to gain competitive advantage by providing cost advantage, and economic and social benefits are provided by this rational behavior. For R&D country economy in general, It serves the purposes of using resources effectively, continuously increasing knowledge and producing national technologies (Büyükdığan, 2012). The three main activities covered by R&D are (OECD, 2002);

- Fundamental Research is experimental or theoretical work that has no apparent specific application or use and is primarily conducted to acquire new knowledge of the foundations of phenomena and observable facts.

- Applied Research is also original research conducted for the purpose of acquiring new knowledge. However, applied research is primarily aimed at a specific practical purpose or goal.
- To produce new materials, new products or devices using existing knowledge from experimental development, research and/or practical experience; are systematic efforts directed at establishing new processes, systems and services or significantly improving those already produced or installed.

Activities of professional R&D units (Özsağır, 2007);

- Obtaining new technical information that will provide scientific and technical/technological developments in order to clarify the uncertainties in the scientific and technological field,
- Research and development of new methods, processes and processes for production,
- Developing new methods or producing new techniques for creating new products, substances and materials, tools, processes, systems,
- Researching new techniques/technologies that reduce the cost of products, increase quality standards and performance,
- It can be listed as software activities based on the original design.

R&D as an institution emerged in 1870 when an industrial establishment in Germany decided to conduct research for the production of new products in a more systematic way. Since the beginning of the 19th century, large R&D laboratories have been established for the chemical and electrical industries (Yaşar, 2007).

R&D expenditure is an important factor at every stage of technological activities such as developing new products and/or production methods, effective use

of existing and/or imported technology, adaptation or modification processes (Kaymakçı, 2006).

Experts state that the development gap that has increased between countries in recent years is due to the openness in science and technology. Advances in science and technology are possible by increasing R&D activities. In this direction, the position of countries in the world in the context of science and technology can be determined by R&D activities. In order to obtain information about R&D activities of countries and to make comparisons, indicators such as the size of R&D expenditures, the share of expenditures in GNP, the number of researchers, and the structure of R&D expenditures are used (Dura & Atik, 2002).

3.4.2 Patents

In a knowledge-based economy, in addition to R&D activities, another indicator showing the capacity of a country to produce technology is the number of patents purchased by that country. A patent is a document showing the right of the inventor to produce, use, sell or import the inventive product for a certain period of time. Patent right is a right related to an intangible property that is more relevant to developing countries, especially as it is a means of technology transfer (TİSK, 2007).

The number of patents in a country or company reveals the spirit of innovation in that country/company and is a proof of how many new inventions have been made. Therefore, the high number of patents is an indicator of the success of the R&D system in that company or country. Patents, which are the criteria of R&D output, enable the innovations to be transformed into a commercial product and give the manufacturer monopoly power (Ünal & Seçilmiş, 2013).

Schmookler (1966) states that although the differences in patenting tendencies of countries, sectors and companies are more evident in developing countries, patent data is one of the most important indicators of ITF. Patent data and information about them can be easily accessed in the computer environment. Firm-level patent data provides information about firm strategies, such as in which areas the firms invent and why they apply for patents. It also gives information about the technological fields or sectors in which the companies are engaged in production and their strategies for the economic and commercial activities they have carried out in these fields (OECD, 1994).

On the other hand; patent data of firms shows the distribution of innovations according to firm size and the degree of concentration in the market (OECD, 1994)

3.4.3. Information Communication Technologies

"Observations show that today's world economy is undergoing a major structural change. This change is determined by two forces. The first is globalization, the second is the information and communication technologies (BİLTE) revolution. Both powers give life to a "superior structure", which is called the "new economy" (Dura & Atik, 2002)

In this context, another dynamic of scientific and technological indicators in the new economy is 'ICT-Information and Communication Technologies'. Information communication technology is defined as a set of technologies that enable the collection, processing, storage, transmission of information to any place when needed, or access to this information from any location (Ceyhun & Çağlayan, 1997).

In the last thirty years, information technologies have developed rapidly. Computers formed the basis, thus making it easier to store, process and use

information. Thanks to these applications, the costs have been reduced. This shows that it is economically beneficial with an efficiency effect. It is seen that the information economy has started to develop in developed countries, with the investments made in information technologies. Technological investments reduce costs, increase productivity and positively affect product quality. Developments in information and communication technologies have had permanent effects on the economy. This new state of the economy is called "information economy", "digital economy", "virtual capitalism", "knowledge-based economy", "internet economy". In general, it is possible to summarize the effects of information technology on the economy with the following three items:

- Collecting and processing information and putting this information into service through databanks and databases; Depending on this information, it will increase the efficiency of the serving sectors.
- The increase in productivity in production will reduce costs and the intensified competitive environment with the reduction of costs will force companies to restructure and review their market strategies.
- Finally, information technology will have an impact on education and training, will allow for an increase in research and development activities, and will cause a structural change in the workforce as well as a change in the quality of the employed personnel.

From a macroeconomic perspective, information technology has a great impact on employment, investment and production structure. With the technological developments, the world societies are on the move from industrial society to an information society. Competition in international markets; It is based on developing

technological infrastructure and dynamics rather than labor, capital and natural resource equipment (Durdu, 2003).

There is a great interest in the use of information technologies in order to achieve higher efficiency, productivity, service quality and profitability. As a result of the opportunities provided by information technologies, not only the emergence of companies producing new technology and sectors producing information technologies in the world, but also the necessity of strengthening the communication infrastructure of the companies of the old economy and being able to operate with the help of the internet and computer gains importance (Savrul & Kılıç, 2001)

ICT has three components: information technology hardware (computer and related hardware); communication devices and software. ICT investments have been the most dynamic component of total investments in the late 1990s and late 2000s. These investments enabled new technologies to enter the production process, expand, renew the capital stock and sustain economic growth. As a result of bitcoin investments, countries or global companies can benefit from the software, communication, computers, digital systems, internet, etc. They started to produce and export ICT products such as ICT goods exports are highly dependent on global economic conditions. Flea goods have been among the most dynamic goods of international trade in the last decade.

3.4.4. Scientific Publications and Number of Researchers

Researchers are the basic elements of the R&D system. Researchers are professionals in charge of creating new knowledge (innovation), products, processes, methods and systems. In addition, they are responsible for project management. Researchers work in civil and military research in the public sector, universities and

research institutes, as well as in the private sector. The number of researchers is the number of personnel employed in the R&D sector working full-time. The ratio of R&D workers in general employment is an indicator of the importance and support given to studies in the field of science in that country (Adaçay, 2007).

If a country or company wants to carry out R&D activities successfully, to get effective results and therefore to gain a competitive advantage, it has to employ more R&D personnel in terms of quantity and quality (Ünal & Seçilmiş, 2013).

Another indicator of scientific and technological development is the number of scientific publications in countries. In recent years, three criteria that highlight "international publication activities" have been generally accepted in determining the place of countries in the world in the field of science, comparing the scientific qualities of countries or universities and evaluating the academic performance of scientists (A.K. & Gülmez, 2006)

- Number of publications published in international scientific journals,
- Science indexes of publications. publication in scanned scientific journals,
- Number of citations to publications. Indexes prepared by various organizations in America and Europe on the basis of international publications and references to these publications have started to be used by higher education institutions and countries to evaluate scientific performance.

Data sources have been created that measure and compare publications worldwide as a result of scientific research. These data sources also try to measure the value of publications. Two data sources are used, namely Web of Science (Thomson Reuters) and SCOPUS (Elsevier). In Turkey, TÜBİTAK receives information about

the number of scientific publications from Thomson Reuters and provides information about publications. Scientific publications are important outputs of the national innovation and entrepreneurship system in terms of dissemination of the knowledge produced. Turkey increased the number of scientific publications in the internationally accepted Thomson Reuters Citation databases approximately fivefold between 2000 and 2012, reaching 25 thousand publications in 2012. This is an indication that the number of scientific publications in our country is the driving force in the process of catching up with developed countries.

3.4.5. High Technology Export

Advanced technology is defined by measuring the R&D intensity of an industry sector, directly or indirectly measured. Direct R&D intensity is the value added to R&D expenditures for each sector or country. Indirect R&D intensity refers to technology that includes intermediate and capital goods purchased or imported into the domestic market. To calculate this, the technical coefficients of the manufacturing industry taken from the input-output matrices are used. In the early 1980s, the definition of high, medium and low technology industries was made by the OECD and accepted by the member countries. Exports of technology-intensive products were the reason for the increase in trade growth over the last decade. It grew faster than total manufacturing exports in all OECD countries. This applies to the export of high-tech products (OECD, Commission, & Eurostat, 2005).

The fact that a country's total exports are dominated by technology-intensive products is the main indicator of how advanced that country is in technology production. At the same time, export values are an illuminating indicator in terms of

'globalization', which emerges as a basic element in the knowledge economy (Adaçay, 2007).

One of the sectors where R&D investments are made most intensively is the advanced technology sector. As advanced technology sectors, defense and space technologies sector, pharmaceutical sector, semiconductors and advanced metal alloys sector can be given as examples. Innovations in the field of advanced technology require the employment of a much higher qualified workforce compared to other sectors. As the quality of the workforce increases, there is a parallel increase in the labor costs. However, the high added value of high-tech innovations created as a result of R&D investments in this field is sufficient to cover these costs, therefore both large multinational companies and public and universities invest in R&D in the field of advanced technology. Governments provide incentives and subsidies to companies investing in advanced technology in various ways, leading companies to invest in this field (Özer & Çiftçi, 2009).

3.4.6. Trademarks

Today, almost all businesses benefit from this technology in the execution of the activities of the business. Information technologies, which find use in many ways from planning to control and decision making, provide important advantages to businesses in increasing efficiency, reducing costs and offering better quality goods and services to the market, and increasing competitiveness. However, this technology has led to the development of different, positive management models and strengthened the communication between the structures within the enterprise. The problems experienced were quickly understood and contributed to the shaping of the management behaviors used in its solution. While simulation is used for design

purposes, especially by lower-level managers in businesses, it is also important for top-level management who need to make strategic decisions. In addition to supporting decision making, coordination and control, it assists managers and employees in analyzing problems, approaching complex issues, and introducing new products (Tekin, Güles, & Burgess, 2000).

The managers of the companies that reach a large trade volume on a world scale have to make use of the information resources at the highest level in order to be superior in competition. With this change in management thinking, information has become the most important strategic weapon of the business world. Thus, the management information system, which is an effective tool in producing and managing this resource, has become the most important issue on the agenda of organizations (Turgay, 1995).

The advantages offered by Information Technologies are too many to ignore and it has become one of the most important tools to be used for the success of the business. Today's organizations refine large amounts of various information obtained from many sources through information technologies and make it available to managers. In organizational processes, while information technologies contribute to the operational efficiency of the organization, it also contributes to the realization of its strategic goals (Daft, 1991)

3.4.7. Design

There are various legal rights attached to the intellectual property. The most well-known and most common of these are patents. These are known in practice as utility patents and can be for any product, part of the product or even process. The design (also known as design patents) on the other hand is about the appearance of the

products. Turkish Patent and Trademark Office defines design as the way a product, or an ornament on it, looks as a consequence of elements like line, shape, form, color, material, or surface texture. It can apply to the entire product, or only a portion of it[7]. A utility patent includes a comprehensive technical description, drawings (if necessary), and one or more claims. A utility patent's claims specify the components of the invention and define the scope of the patent's protection. In contrast, the design patent largely communicates what is protected through the drawings. There is only one claim in the design patent. This claim often refers to the drawings as a standard of what is protected rather than naming any structures or verbally defining the design. While unique, useful, and non-obvious innovations may be granted a utility patent, a design patent is more concerned with the attractive design of a commercially available good than with utility (Silverman, 1993).

A design must meet the requirements for decorative novelty, be unique to the inventor or inventors seeking protection, and be new in the sense that no one, identical design already exists in the previous art. When viewed through the eyes of a fictitious designer adept in the craft, it must also be obscure in light of any prior design or collection of designs. Furthermore, aesthetic elements that are concealed when the object is in use are ineligible for design patents. A design patent is often sought for a product's visually pleasing aspects. Furthermore, it has been said that the theme must be the result of aesthetic talent and creative imagination. (Silverman, 1993).

In recent years, companies have come to appreciate the usefulness of design patents to safeguarding their intellectual property (IP). For instance, there were multiple patents engaged in the battle between Apple and Samsung over smartphones and tablets, some of which were design patents. Many businesses that formerly

[7] https://www.turkpatent.gov.tr/en/design

depended on utility patents are revising their IP protection strategy in light of the growing importance of design patents. They are considering the advantages of obtaining design patents as an additional means of defending their goods and bolstering their total IP portfolios (Gaff & Cuomo, 2013). That is why examining design patterns is now required in addition to utility patterns.

Many nations provide intellectual property (IP) protection similar to a US design patent but call it a "registered design." In certain nations, such as those that are a part of the EU, obtaining a registered design may be as simple as submitting the right papers and paying the requisite costs. Before registering a design, some nations like Japan and South Korea give an application more thorough scrutiny. Depending on the nation, the duration of protection for designs under these procedures can range from five years or less to twenty years or more.

The Hague Agreement permits design patent applicants to submit a single worldwide application to seek an industrial design right in those nations that have ratified the treaty, provided that some formal requirements are met. Turkey signed the Agreement in 1985. Lastly, by passing the Patent Law Treaties Implementation Act in 2012, the US ratified the Hague Agreement that require ongoing maintenance fees in contrast to utility patents (Gaff & Cuomo, 2013).

US patent law considering its pattern term design patents lasts longer. The US Patent Office evaluates design patent applications more rapidly compared to utility patent applications—one year versus three years. Furthermore, design patents do not necessarily require ongoing maintenance fees in contrast to the utility patents (Gaff & Cuomo, 2013).

As mentioned above, although design patents have many advantages over other patents in some areas, a utility patent will be required for the protection of the functions

or functioning of any product or process. Therefore, rather than just looking at the patent or just the design, it will offer a more realistic conclusion to look at both sets of data when a company's technical advancement is assessed.

3.4.8. Collaboration (University) /Innovation Projects

Centers of science and research are universities or scientific institutes. Information flow is a critical phase in the innovation process. It is one of the prerequisites of innovation to ensure the flow of information from where the data is created to where the data is utilized. On the other hand, companies have the capacity to produce data in their fields of activity, just like scientific institutes. The important thing here is to ensure that the information is transferred from the place where it is produced to the place where the information will be used to support innovation.

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The fact that information is created, distributed, and used by numerous players in an innovation system, such as corporations, universities, public research institutes (PRIs), customers as users of product innovations, and people, has sparked interest in knowledge flows. For their innovative efforts, firms rely on external sources of information). Although information can be communicated, it is not valuable until it is comprehended and transformed into knowledge (OECD & Eurostat, 2018).

Oslo and Frascati Manuals suggest the use of infrastructure and services as a policy instrument to support innovation. Infrastructure and services supporting corporate innovation activities, such as subsidized access to R&D, testing, or

prototyping facilities or giving access to essential data, networking, or consulting resources, can be provided directly or indirectly. This may involve providing vouchers to businesses to enable them to get specific sorts of specialized services from recognized providers such as colleges, research centers, or design consultants (OECD & Eurostat, 2018).

Industry-university collaborations (IUCs) have a long history in many countries across the world, and universities play an important role in attaining economic growth in today's knowledge-based society. Policymakers' and universities' desire to develop "third missions" in addition to the two traditional core missions of research and teaching, and to commercialize academic knowledge, for example, through continuing education programs, patenting, technology transfer offices, science parks, or incubators, has increased the importance of such collaborations.

With the help of collaboration with external institutes like universities or research centers or other scientific institutions, companies can benefit from highly qualified people resources such as researchers or students; they can get access to technology and information; and they may utilize pricey research infrastructure.

According to some estimates, university research contributes up to 10% of all new goods or processes. Universities, in turn, benefit from greater financing, access to industrial equipment, and cash from licensing or patenting. Indeed, engagement with industry has become an unavoidable component of university finance, and money from international organizations and commercial firms for R&D in the higher education sector now represents a "significant source" in many nations (OECD 2015; (Rybnicek & Königsgruber, 2019)).

Collaborations are becoming increasingly significant, and their implementation is in the interests of governments, policymakers, researchers, and

practitioners. Therefore, improving or developing new relationships with external entities (other firms, universities, research centers, etc.), including consultancy services, is crucial when analyzing a company's technological level or enthusiasm for innovation.

3.4.9. Share of firms employing highly qualified personnel by the level of educational attainment or by fields of education/ Educational Attainment

Considering that innovation and technology are created by human beings, human resources appear as one of the most important tools that show the innovation capacity and potential of a company.

The makeup of the workforce by degrees of educational attainment is an important indicator of labor capabilities.

Educational attainment is considered as a workforce trait connected to education, knowledge, and skills, as stated in earlier human capital research (Alque`zar, Sabadie, & Johansen, 2010).

According to comparative studies, countries with the capacity to innovate have a high overall level of education/a high share of the population with tertiary level education, and there is widespread agreement that high levels of investment in education and a wide distribution have significant implications for human capital and economic growth, as well as possibly for social capital and social cohesion. The significance of learning in innovation processes is also emphasized in the literature on innovation (Ariff, 2007).

The importance of education and training, and, more broadly, learning for innovation, has been frequently emphasized at the EU level. Recent European Union policy papers advocate for education and training programs to foster "innovation

skills" and "innovation-friendly settings," such as through higher education system modernization and general education changes. The 2004 Joint Interim Report of the Council (Education) and the Commission, for example, emphasized that education and training are decisive factors in the capacity for excellence, innovation, and competitiveness, and advocated for urgent reforms of Europe's education and training systems (Ariff, 2007).

The Global Innovation Index (www.globalinnovationindex.org) which is published by Cornell University, INSEAD and the World Intellectual Property Organization (WIPO) also uses education statistics in addition to research and experimental development (R&D) and administrative data such as intellectual property (IP) statistics and selected indicators (OECD & Eurostat, 2018).

Workforce skills assumed to be one of potential or actual innovation capabilities by Oslo Manual and the Manual suggests to use share of firms employing highly qualified personnel, by level of educational attainment or by fields of education so as a computation result so as to measure innovation capacity (OECD & Eurostat, 2018).

The share of employed persons with tertiary education also seem to be a simple but informative measure bu the Manual anf it defines share of employed persons with tertiary education by field of education and training according to the ISCED-F 2013 classification (UNESCO/UIS, 2015), with a focus on; (OECD & Eurostat, 2018)

- natural sciences, mathematics and statistics
- engineering (including manufacturing and construction)
- health and medicine
- information and communication technology (ICT)
- media and design.

The education level of the staff; well; Whether he has a bachelor's / master's degree or doctorate, the field of education he received, the trainings he received within the scope of his job description and personal equipment can all be expressed as educational attainment, and all of them have a positive effect on the innovation potential of the person.

However, since there is no ready-made data set for all this information about the personnel in SOEs, only the education level of the employees will be analyzed in this study. The share of the number of employees with master's and doctorate degree working in the SOEs will be revealed.

3.4.10. Adapting advanced innovation management practices

When conducting indicators method to measure the level of technological development of a firm usually quantitative and statistal data are being gathered such as R&D expenditures or patent applications as mentioned above. However technological development covers many possible dimensions including a firm’s capacity of using advanced technologies as managerial tools is beside using them in professional fields and sometimes the mathematical data used as indicators may skip this dimension of the technological progress or innovation capacity.

Many quantitative outcome indicators for business process innovation are likely to be exceedingly difficult to estimate for respondents from large firms, or for specific types of business process innovations that are not directly used in production activities, such as administration and management. The indicators are better suited for small and medium-sized businesses, or for a query on business process innovations that are directly related to goods. Managerial innovations or using technology as a managerial tool should also be included when gathering data from firms.

Collecting data on the use of various digital technologies, such as computer infrastructure (server technologies), AI, Internet-connected devices, automation, mobile communication technologies, cloud computing, the use of digital technologies for collaboration, communication, and value exchange (e.g., through social media), and digital technologies for planning and management (e.g., enterprise resource planning), is a good starting point for capturing firms' digital capabilities (blockchain). The ability of digital technology to connect multiple business activities and functions, establishing an integrated system with structured data exchanges among different functions and units, is a common feature. Data on the digital integration of various business operations (production/delivery of services, logistics, marketing/sales, product development, administration) and digital links with suppliers and consumers can give useful information about a company's digital capabilities and usage (OECD & Eurostat, 2018).

Digital technologies enable businesses to create and retain massive volumes of data (sometimes in real time) about a wide range of company processes, both internally and in relation to suppliers and users. These data are becoming an increasingly crucial source for the creation of company strategies, models, products, and processes. Measures of these skills may be gathered by asking questions about the usage of data analytic methodologies and technologies, either in-house or by procuring data analytics services from outside sources: Database management systems, data mining tools, machine learning, data modeling, predictive analytics, user behavior analysis, and real-time data analysis are all examples of data analytics. (OECD & Eurostat, 2018).

Therefore, as the subject approach of the Oslo Manual suggests embodying questions related to a firm’s ability to design, develop and adopt technological tools

and data resources and the general management capabilities of a firm would be a complementary analysis measuring the firm's technological level. In that sense, the analysis of this study also searches for this managerial technological development by adding questions about the business process innovations and projects of SOEs.

3.4.11. Funds/incentives for Technology and R&D

In today's conditions, while technology is so important and contributes significantly to the development level and economy of the countries and shaping the future of the countries, the investments and expenditures made in most science and technology have become one of the most important policy tools of a country.

Many worldwide studies and statistics work on countries' innovation and technical capabilities, compare the countries' R&D and scientific technology investments and expenditures.

On the other hand, examining the science and technology investments and R&D expenditures made in a country alone does not always give accurate results, and it can give misleading information about the technology policies of the countries.

On the one hand, while these expenditures are suggestive, it is vital to assess the potential of making these investments in nations in order to examine the cause-effect connection and make sense of the findings. The existence of differentiating funding sources and incentives for R&D and other technological investment expenditures substantially guide countries' R&D and technical development potential.

The Oslo Manual Data emphasizes that financing sources may be used to evaluate the role of government investments and financial markets in the innovation process and it suggests several possible financing sources for innovation, including: (OECD & Eurostat, 2018)

own funds (retained profits or income from asset disposal)

- transfers from affiliated firms (holding, subsidiary or associated companies located in the domestic country or abroad)
- customer orders (including procurement contracts from domestic or foreign governments or international organizations)
- shareholder loans
- debt funding from commercial loans (banks, credit cards, etc.), overdraft facilities or suppliers' credit
- loans from governments
- loans from international organizations
- equity from private equity or venture capital firms, business angels or other individuals (family and friends)
- grants or subsidies from domestic or foreign governments, international organisations, non-governmental organizations, etc.
- bonds and obligations
- other sources (e.g., crowdfunding)

Frascati Manual suggests that the funds to pay the costs of performing R&D may come from inside the unit (internal) or outside the unit (external). Internal funds in the business enterprise sector include, for example, reserve or retained earnings (profits that have not been redistributed as dividends), sales of the unit's ordinary products (other than R&D), and raising capital in the form of equity, debt, or other hybrid instruments (e.g., funds raised on financial markets, bank loans, venture capital, etc.). Deductions from income tax obligations resulting from prior government subsidies for R&D are also internal funds because they do not have to be utilized to

pay R&D in the current reference year. Funds from grants, gifts and philanthropy, by a member of a business enterprise group from other members of the same business enterprise group or specific loans or credits should be reported as external funds (OECD, 2015).

Frascati Manual adds another category "international organizations," which includes supranational organizations, is included in funding from the "rest of the world." Various international organizations will be identified as appropriate funding sources by different countries. Members of the European Union, for example, may include a financing category such as "European Union institutions and other entities" (OECD, 2015) but these funds are going to be assumed as external funds in this study.

Besides funds, incentive mechanisms for technology and R&D is also an important tool for policy analysis.

Some governments, mostly at the central/federal level but also at the regional/local level, offer specific kinds of tax relief to encourage the funding or performance of R&D, notably in corporate companies. While such tax incentive is a kind of public financial assistance for R&D, it should not be quantified in the reported government source of funding for R&D performance totals (OECD, 2015).

3.5. Conclusion

In this chapter of the thesis, the indicators that can be used to measure the technological development levels of state-owned enterprises (SOEs) in Turkey were discussed. The indicators were chosen based on their relevance and applicability to the context of SOEs in Turkey, as well as their universal acceptance by international organizations like the OECD.

The selected indicators include Research&Development, patents, ICTs, scientific publications, number of researchers, high technology export, trademarks, design, collaborations, educational attainment and incentive funds. These indicators are crucial in assessing the level of technological development of SOEs in Turkey and can provide valuable insights into the organization's strengths and weaknesses.

Research&Development is an essential indicator that shows the extent to which SOEs are investing in research to develop new technologies or improve existing ones. Patents, on the other hand, demonstrate the number of innovative solutions that have been developed and protected by SOEs. This indicator can be used to track the growth of SOEs' intellectual property, which is a valuable asset for the organization and the country as a whole.

ICTs, scientific publications, and collaborations are also important indicators that can provide insights into the level of technology adoption and knowledge creation and dissemination by SOEs. The number of researchers and educational attainment can be used to assess SOEs' investment in human capital and talent development. High technology export, trademarks, design, and incentive funds are also crucial indicators that can provide valuable insights into the level of technological development of SOEs in Turkey.

By analyzing these indicators, it is possible to determine the strengths and weaknesses of SOEs in terms of their technological capabilities. This information can be used to inform policies and strategies that can help SOEs to improve their technological development and increase their contribution to the national economy.

Overall, the indicators method is an effective way of measuring the technological development levels of SOEs in Turkey. The indicators provide a comprehensive framework for assessing the level of technological development of

SOEs in Turkey and can help in identifying areas for improvement and development. The findings from this chapter can be used to inform policies and strategies that can help SOEs to improve their technological development and increase their contribution to the national economy.

In the next chapter of this thesis, the data on the selected indicators of SOEs and provide a commentary on their levels of technological development is discussed. By analyzing the data, the areas of strength and weakness in terms of the technological capabilities of SOEs is anaylzed.

Moreover, the regulatory framework and content analysis conducted within the previous section of this thesis is also taken into account. By analyzing the existing regulations and policy frameworks, as well as the content analysis of SOEs' technological development strategies, this thesis tries to provide recommendations and proposals that can trigger SOEs' adaptation of technology.

Based on the findings of this study, suggest some policy recommendations are suggested that can help SOEs to improve their technological development and increase their contribution to the national economy. These proposals can range from enhancing collaboration between SOEs and universities or research centers, to increasing investment in Research&Development and human capital development.

The proposed recommendations will be based on a thorough analysis of the data on the selected indicators, as well as the regulatory framework and content analysis conducted in the previous sections. By taking into account all of these factors, a comprehensive and actionable set of proposals that can help SOEs to improve their technological development and increase their competitiveness in the global market will be suggested.

CHAPTER 4

4. ANALYSIS AND RESULTS

4.1. The Purpose of Analysis

SOEs have attracted attention in recent years in international business and corporate governance in the context of international trade. Investments in state owned enterprises have played a substantial role in the development of Turkey for many years. Nevertheless, non-financial targets, corporate governance and institutional effects of SOEs are complicated and context-dependent. There is still no full understanding of what states aim to achieve through state owned enterprises and how these goals lead to different international strategies. Therefore, more work is needed to understand the ideas for the purposes of state-owned enterprises.

4.2. Data

In this thesis, the data analysis on the selected indicators is conducted using a quantitative approach. The indicators selected for this study include Research&Development, patents, ICTs, scientific publications, number of researchers, high technology export, trademarks, design, collaborations, educational attainment, and incentive funds. Most of the indicators are studied for the last 10 years, if data is available, to provide a long-term perspective on the technological development of SOEs in Turkey.

The quantitative analysis involves collecting and analyzing data from various sources such as official reports, statistical databases, and SOEs' financial statements. and also from the secondary data of the Ministry of Treasury and Finance. The data is then processed and analyzed to determine trends and patterns in the data.

The analysis includes comparing the trends and values of the selected indicators with available those of the private sector or the total numbers in Turkey. By doing so, we can gain insights into the technological capabilities of SOEs compared to their private sector counterparts and see whether they are left behind the other parties in Turkey.

The findings of the analysis are then used to come to a conclusion about the technological levels of SOEs in Turkey. By identifying the strengths and weaknesses of SOEs in terms of their technological capabilities, recommendations to improve their technological development and increase their competitiveness in the global market is provided.

Overall, the data analysis in this thesis provides a comprehensive and detailed understanding of the technological development of SOEs in Turkey. By analyzing the quantitative results of the selected indicators and comparing them with those of the private sector and the total Turkey data we can gain insights into the strengths and weaknesses of SOEs in terms of their technological capabilities. These insights can inform policies and strategies that can help SOEs to improve their technological development and increase their contribution to the national economy.

4.2.1. Averages of the ratio of the budget allocated to R&D within the total budget

One of the variables observed in 2012-2021 is the ratio of the budget allocated to R&D within the total budget. Some institutions do not have a budget allocated to R&D. The reason for this is the late start of R&D activities or the absence of R&D activities at all. For example, no budget was allocated for R&D in 7 institutions in the observed years. In 4 institutions, R&D activities started recently. Table 4 shows the averages of the ratios of the budget allocated to R&D by all institutions in the total budget (Table 4).

Table 4: Averages ratio of the budget allocated to R&D within the total budget

	Averages ratio of the budget allocated to R&D within the total budget
2012	0,00069
2013	0,00090
2014	0,00232
2015	0,00553
2016	0,00325
2017	0,00444
2018	0,00329
2019	0,00233
2020	0,00381
2021	0,00373

Source: Hazine ve Maliye Bakanlığı (2022)

As can be seen in Figure 5, an increase was observed in the average of the budget allocated to R&D until 2015, but after this year, it did not remain stagnant.

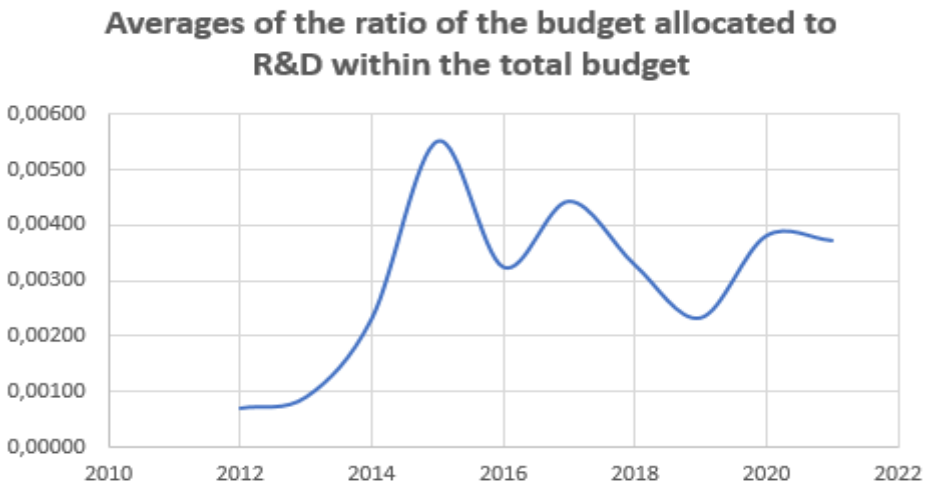

Figure 5:Averages of the ratio of the budget allocated to R&D within the total budget

4.2.2. Average ratio of R&D expenditures to total investments

In this section, before looking at the share of R&D expenditures of SOEs in their total investments, the R&D expenditures of SOEs realized by years, the position of these expenditures compared to the private sector, the share of the said expenditures in the general government R&D expenditures, and finally the share of the general R&D expenditures in Turkey will be examined.

As can be seen from the graph and table below, although R&D expenditures made by SOEs have tended to increase in the last three years, fluctuations are observed when looking at the data of the last 10 years. In the recent upward trend; the impact of TÜRASAŞ which was included in the SOE System in 2020, and the fact that four institutions have recently started to invest in R&D, has been great. When this effect is removed, it cannot be said that SOEs have an increasing trend in their R&D expenditures over the years.

As it can be understood from the data in the table, while the R&D expenditures of the private sector and the general government have increased regularly over the

years, SOEs have not been able to catch up with this increase. In parallel, the ratio of R&D expenditures of SOEs to general government R&D expenditures and total R&D expenditures in Turkey has tended to decrease rather than increase.

Table 5: R&D Expenditures of SOEs, General Government, Private Sector and Turkey

(Million TL)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SOEs	₺157,4	₺141,7	₺80,7	₺37.238	₺30.945	₺51.075	₺77.612	₺48.632	₺92.610	₺199.587
General Government	₺1.436.923	₺1.543.494	₺1.705.400	₺2.130.766	₺2.338.373	₺2.858.435	₺3.559.214	₺3.044.485	₺3.716.727	₺4.583.609
SOEs/General Government	***10,96%***	***9,18%***	***4,73%***	***1,75%***	***1,32%***	***1,79%***	***2,18%***	***1,60%***	***2,49%***	***4,35%***
Financial and Non-financial Corperations	₺5.891.215	₺7.031.519	₺8.760.020	₺11.207.003	₺14.580.949	₺18.415.556	₺25.326.868	₺31.940.687	₺38.505.513	₺62.400.170
Higher Education Sector	₺5.734.125	₺6.232.309	₺7.132.698	₺9.403.331	₺12.492.546	₺15.588.367	₺18.915.782	₺21.992.537	₺26.815.886	₺34.754.109
Total R&D Expenditure	₺13.062.263	₺14.807.322	₺17.598.117	₺22.741.101	₺29.411.867	₺36.862.358	₺47.801.863	₺56.977.709	₺69.038.126	₺101.737.888
SOEs/Total	***1,21%***	***0,96%***	***0,46%***	***0,16%***	***0,11%***	***0,14%***	***0,16%***	***0,09%***	***0,13%***	***0,20%***

Source: Hazine ve Maliye Bakanlığı (2022), TÜİK (2023)

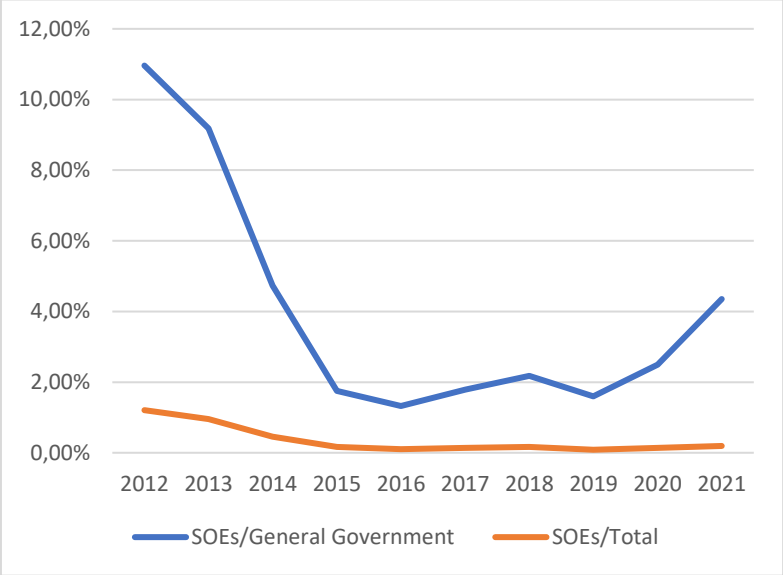

Figure 6: The Ratio of R&D Expenditures to General Government and Turkey

Table 6 shows the average ratio of R&D expenditures to total investments of SOEs by years. 6 institutions do not have any investment in R&D. In addition, four institutions have recently started to invest in R&D.

Table 6:Average ratio of R&D expenditures to total investments

	Average ratio of R&D expenditures to total investments
2012	0,0475
2013	0,0555
2014	0,0234
2015	0,0221
2016	0,0147
2017	0,0119
2018	0,0171
2019	0,0197
2020	0,1105
2021	0,1189

Source: Hazine ve Maliye Bakanlığı (2022)

As can be seen in Figure 7, the average of the ratios of R&D expenditures in investments remained close and low until 2020. However, this average has increased rapidly due to the fact that there are institutions that have started to invest in R&D in recent years. However, for the years observed this ratio have not raised up above %11 for the SOEs.

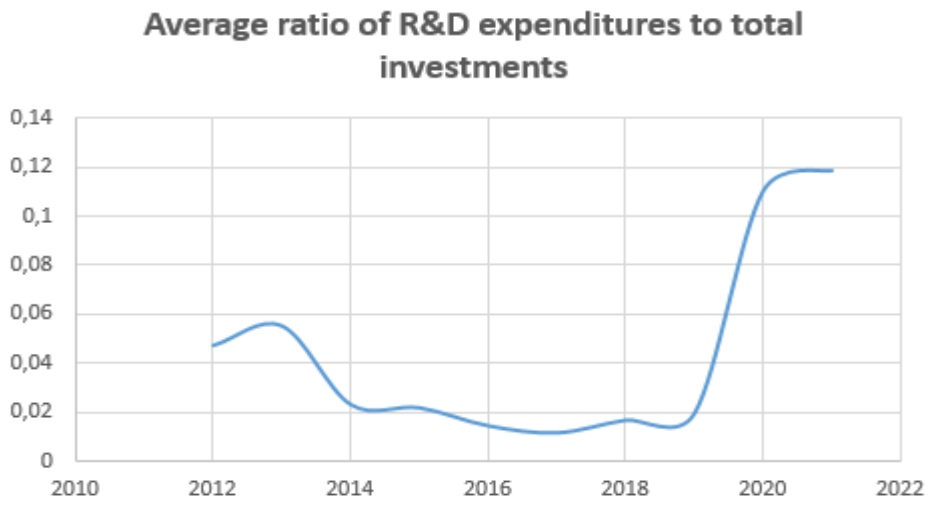

Figure 7: Average ratio of R&D expenditures to total investments

4.2.3. The total number of trademarks, patents and designs

When, the total trademark, patent and design applications made by SOEs are analyzed, it is seen that there are 11 institutions that do not have a trademark or patent application and 13 institutions that have no design applications. Thetotal numbers demonstrate thatamong patents, trademarks and designs, the SOEs in Turkey mostly apply for the trademarks and simultaneously have trademarks most. It is seen that most of the trademarks are owned by ÇAYKUR which has a substantial market share in Turkey in tea production. It is also seen from the data that, SOEs do not much designs despite that some of them operating in industry sectors.

The table below demonstrates the patent applications made by SOEs, domestic and foreign firms to the Turkish Patent and Trademark Office as well as the ratio of patent applications by SOEs to the total applications by 2012.

Table 7: Total Number of Patent Applications by SOEs, domestic and foreign firms

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total Number of Patent Applications to TürkPatent by SOEs in Turkey	4	3	2	0	9	0	3	2	0	5
Total Number of Patent Applications to TürkPatent by Domestic Firms	4.36	4.345	4.654	5.302	6.153	7.994	7.114	7.751	7.803	8.071
Total Number of Patent Applications to TürkPatent by Foreign Firms	78	95	149	251	407	202	137	63	90	85
Total Number of Patent Applications to TürkPatent	4.36	4.345	4.654	5.302	6.153	7.994	7.114	7.751	7.803	8.071
SOEs' Patent Applications/Total Patent Applications	**0,09%**	**0,07%**	**0,04%**	**0,00%**	**0,15%**	**0,00%**	**0,04%**	**0,03%**	**0,00%**	**0,06%**

Source: Hazine ve Maliye Bakanlığı (2022), Türk Patent ve Marka Kurumu (2022)

As can be seen from the table, the patent applications made by the SOEs to the Turkish Patent are very few compared to the number of applications made by domestic and foreign companies. Their ratio to the total number of applications confirms this situation. The fact that the total patent applications and the number of patents received are mostly made by only one SOE, Çaykur, shows that SOEs are actually behind many domestic and foreign companies in this field. In addition, while it is observed that the technology is gradually advancing and the total patent applications have increased over the years in parallel, when the patent application course of SOEs is examined, there has not been an increase. Considering that the sectors in which SOEs operate also need technology, it may be concluded that they are falling behind in terms of innovative activities.

The table below shows the design applications made by SOEs, domestic and foreign firms to the Turkish Patent and Trademark Office by 2012.

Table 8: Total Number of Design Applications by SOEs, domestic and foreign firms

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total Number of Design Applications to TürkPatent by SOEs in Turkey	1	2	3	0	22	0	0	1	6	9
Total Number of Design Applications to TürkPatent by Domestic Firms	7.864	8.209	8.393	8.291	8.371	8.533	7.63	8.529	9.948	13.91
Total Number of Design Applications to TürkPatent by Foreign Firms	559	573	635	605	469	476	422	451	365	402
Total Number of Design Applications to TürkPatent	8.423	8.782	9.028	8.896	8.84	9.009	8.052	8.98	10.313	14.312
SOEs' Design Applications/Total Patent Applications	**0,01%**	**0,02%**	**0,03%**	**0,00%**	**0,25%**	**0,00%**	**0,00%**	**0,01%**	**0,06%**	**0,06%**

Source: Hazine ve Maliye Bakanlığı (2022), Türk Patent ve Marka Kurumu (2022)

As can be seen from the table, SOEs lagged far behind domestic and foreign companies in design applications, just like in patent applications. The fact that these SOEs, most of which operate in the production sector, are lagging behind in design applications, which is an indicator of how much importance they attach to innovation activities and how successful they are, is an indicator that policy changes should be made quickly in this area.

The following table includes the trademark applications of SOEs and other companies. Looking at the data, there is no regular increase in trademark applications made by SOEs throughout the years from 2012. Although the trademark applications are higher than the patent and design applications made by SOEs, the total number of trademark applications made to the Turkish Patent and Trademark Office is also high,

and the trademark applications of SOEs have remained quite low compared to the applications of other domestic and foreign companies approximately about 0,01% of total applications. Here, too, only one SOE-ÇAYKUR- made up almost all of the total applications.

Table 9: Total Number of Trademark Applications by SOEs, domestic and foreign firms

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total Number of Trademark Applications to TürkPatent by SOEs in Turkey	8	27	28	15	14	10	17	2	22	10
Total Number of Trademark Applications to TürkPatent by Domestic Firms	97.311	93.32	97.145	95.962	94.575	106.099	105.55	119.412	155.913	176.493
Total Number of Trademark Applications to TürkPatent by Foreign Firms	9.101	10.419	9.463	9.684	7.816	10.395	9.682	10.139	10.115	10.291
Total Number of Trademark Applications to TürkPatent	106.412	103.739	106.608	105.646	102.391	116.494	115.232	129.551	166.028	186.784
SOEs' Trademark Applications/Total Patent Applications	**0,01%**	**0,03%**	**0,03%**	**0,01%**	**0,01%**	**0,01%**	**0,01%**	**0,00%**	**0,01%**	**0,01%**

Source: Hazine ve Maliye Bakanlığı (2022), Türk Patent ve Marka Kurumu (2022)

Data on patent, trademark and design applications among intellectual property rights, which is one of the most important indicators of a company's emphasis on innovation activities and its level of technological development, showed that SOEs in Turkey left behind by many local and foreign companies and have not been able to provide any momentum in this regard over the years.

4.2.4. Number of R&D and innovation projects started to cooperate

Institutions have collaborations or joint projects with various universities or scientific institutes. The frequency of TUBITAK among the collaborating institutions

draws attention. However, it is seen that cooperation or joint projects are carried out with many universities. There is no study that six institutions have started within the scope of cooperation. Table 10 shows the total number of R&D and innovation projects that all observed state-owned enterprises started within the scope of cooperation.

Table 10: The total number of R&D and innovation projects started to cooperate

	The total number of R&D and innovation projects started to cooperate
2012	26
2013	20
2014	30
2015	17
2016	16
2017	30
2018	16
2019	18
2020	18
2021	33

Source: Hazine ve Maliye Bakanlığı (2022)

As can be seen in Figure 8, the total number of R&D and innovation projects with which cooperation has been initiated does not remain stagnant over the years. However, the total number of projects does not change much over the years.

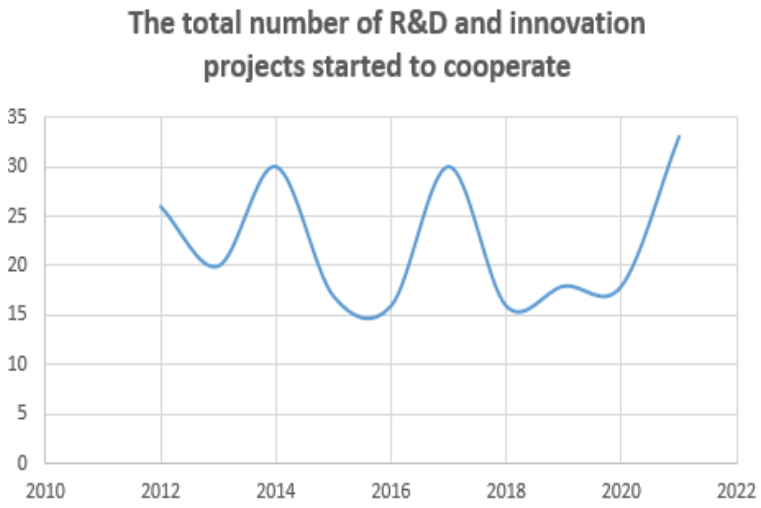

Figure 8: The total number of R&D and innovation projects started to cooperate

4.2.5. Number of completed R&D and innovation projects

Table 11 shows the change in the total number of completed R&D and innovation projects over the years. Figure 9 is included in order to see the change more clearly. Although there have been frequent increases and decreases over the years, the number of completed projects has not changed much over the years.

Table 11: The total number of completed R&D and innovation projects

	The total number of completed R&D and innovation projects
2012	12
2013	18
2014	21
2015	30
2016	20
2017	27
2018	23
2019	17
2020	20
2021	17

Source: Hazine ve Maliye Bakanlığı (2022)

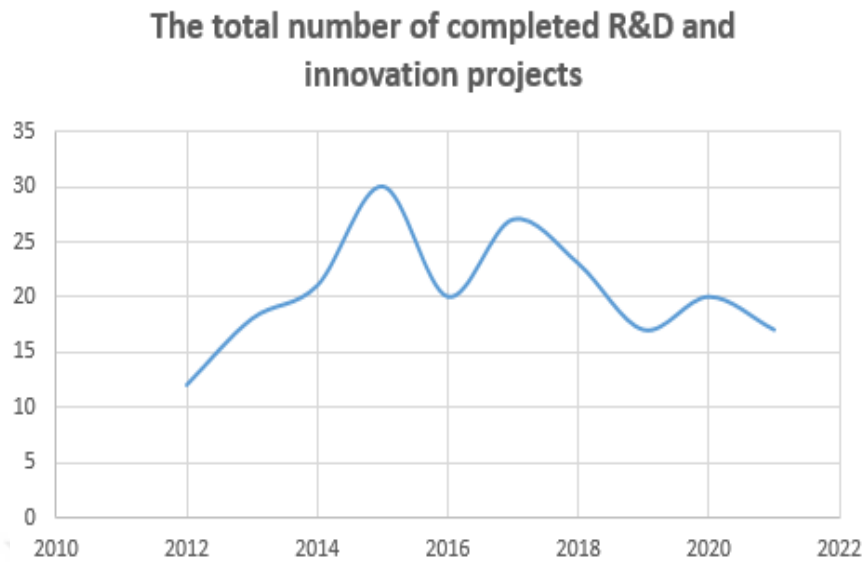

Figure 9: The total number of completed R&D and innovation projects

Table 12: Number of R&D Projects/Number of R&D Personnel

	Number of R&D Projects/Number of R&D Personnel
2012	0,48
2013	0,48
2014	0,47
2015	0,48
2016	0,47
2017	0,47
2018	0,48
2019	0,47
2020	0,46
2021	0,46

Considering the ratio of completed R&D projects to the total R&D personnel, it is an expected result that the ratio will not change much over the years.

4.2.6. Number of scientific/academic publications

Academic or scientific articles published by state-owned enterprises are shown in Table 13. However, there is no academic or scientific study published by eleven institutions in the observed years.

The change over the years is shown in figure 10. The lowest number of publications belongs to the years 2016 and 2020. There were no significant increases or decreases in the number of publications in the other years observed.

Considering the number of employees in all SOEs, it is observed from the figures that the number of publications is within a certain limit.

Table 13: The total number of scientific/academic publications

	The total number of scientific/academic publications
2012	19
2013	11
2014	13
2015	15
2016	6
2017	16
2018	13
2019	17
2020	10
2021	28

Source: Hazine ve Maliye Bakanlığı (2022)

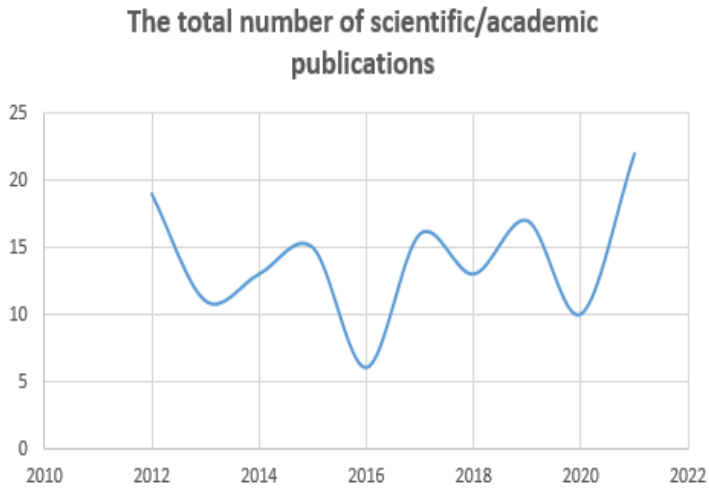

Figure 10: The total number of scientific/academic publications

Considering that there is no general increase trend in the number of academic publications, the table below has been prepared as it may give an idea to look at the ratio of the number of publications to the number of R&D personnel of the institutions.

Table 14: Academic Publications/Number of R&D Personnel

	Academic Publications/Number of R&D Personnel
2012	0,0045
2013	0,0026
2014	0,0030
2015	0,0035
2016	0,0014
2017	0,0037
2018	0,0030
2019	0,0039
2020	0,0023
2021	0,0063

Source: Hazine ve Maliye Bakanlığı (2022)

Looking at the table, it is observed that the fluctuations in the number of academic publications do not occur depending on the number of R&D personnel.

4.2.7. Average ratio of R&D personnel

Before looking at the distribution of the number of R&D personnel of SOEs within their total number of personnel, the situation of the total number of R&D personnel of SOEs in Turkey according to the general government, the private sector and the total number of R&D personnel in Turkey will be examined.

The table below gives the total number of R&D personnel employed by SOEs, the private sector, the general government, and finally in Turkey, and the share of SOEs in the government and total Turkey. Considering the data, the number of R&D personnel of SOEs in the last 10 years has constituted an average of 35% of the number of R&D personnel employed in the government, and this ratio has shown an increasing trend over the years. Although this seems as positive development but when it is analyzed it can be seen that one of the reason lying behind it that the number of R&D employee in government is decreasing by years. From that, there is a possibility that it may have occurred as a result of the high share of the number of personnel in SOEs in the total government employment. On the other hand, these figures are the total headcount figures and all personnel working in R&D units in SOEs are included in these figures. Not all included personnel are engaged in full-time R&D activities or research.

Table 15: R&D Employment (Headcount)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SOEs	4.22	4.27	4.29	4.287	4.306	4.32	4.295	4.313	4.44	4.413
Financial and Non-financial Corperations	61.378	69.018	73.737	77.551	83.873	101.404	118.867	129.798	144.674	166.914
Government	14.445	13.894	13.903	14.217	13.372	12.828	12.884	10.472	11.044	11.39
SOEs/Government	***29%***	***31%***	***31%***	***30%***	***32%***	***34%***	***33%***	***41%***	***40%***	***39%***
Higher Education	108.478	113.409	126.046	132.516	144.968	152.246	158.04	165.541	165.674	179.985
Total	184.301	196.321	213.686	224.284	242.213	266.478	289.791	305.811	321.392	358.289
SOEs/Total	***2%***	***2%***	***2%***	***2%***	***2%***	***2%***	***1%***	***1%***	***1%***	***1%***

Source: Hazine ve Maliye Bakanlığı (2022), TÜİK (2023)

Table 16 shows the averages of R&D personnel in state-owned enterprises. This rate has taken similar values every year at approximately 5%. In addition, five institutions do not have R&D personnel. The change in the average rate of R&D personnel by years is shown in Figure 19.

Table 16: Average ratio of R&D personnel

	Average ratio of R&D personnel
2012	0,0034
2013	0,0479
2014	0,0493
2015	0,0447
2016	0,0468
2017	0,0473
2018	0,0447
2019	0,0447
2020	0,0542
2021	0,0615

Source: Hazine ve Maliye Bakanlığı (2022)

As can be seen in Figure 11, the average R&D personnel ratio increased in the first years and then remained stable.

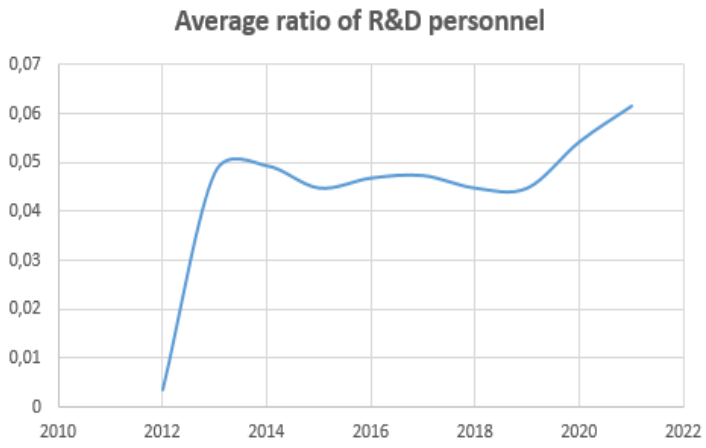

Figure 11: The Average ratio of R&D personnel

Under current policies and legal restrictions, the total number of personnel of SOEs has been decreasing over the years. On the other hand, with the regulations made in years 2015-2016, facilities and privileges were granted to SOEs in the employment of R&D personnel. Despite this, it is seen that this expectation did not realized, while an increase is expected in the number of R&D personnel of SOEs. Therefore, it is obvious that besides the legal regulations in this area, there is a need for changes in the management policies and traditional institutional structures of SOEs.

4.2.8. Average ratio of researchers

The averages for the rate of researchers are quite low, there are no researchers in most institutions (Table 17). As can be seen in Figure 12, the rate of researchers remained at a very low level until 2019. The reason why it has been in an increasing trend for the last two years is the institutions that have recently started R&D studies.

Table 17: Average ratio of researchers[8]

	Average ratio of researchers
2012	0,000072
2013	0,000067
2014	0,000078
2015	0,000061
2016	0,00000056
2017	0,000694444
2018	0,000705556
2019	0,002972222
2020	0,008422222
2021	0,008333333

Source: Hazine ve Maliye Bakanlığı (2022)

[8] Hazine ve Maliye Bakanlığı (2022)

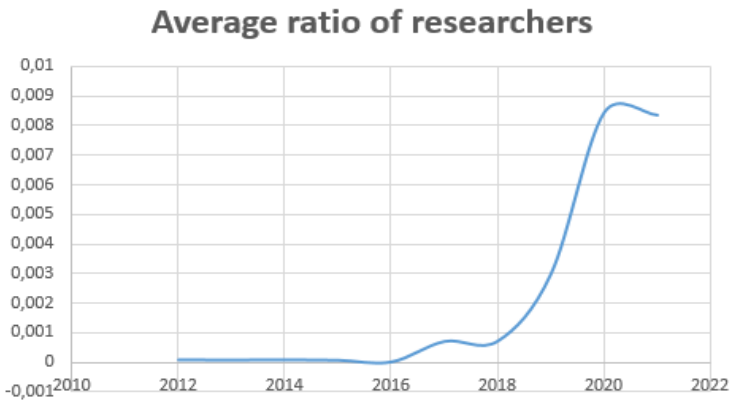

Figure 12: Average ratio of researchers[9]

4.2.9. Average ratio of employees with a master's degree

Table 18 shows the average rate of employees with postgraduate degrees in state-owned enterprises. In institutions, the highest rate is the rate of employees with a master's degree. This rate is quite high in some institutions and is increasing every year.

Table 18: Average ratio of employees with a master's degree

	Average ratio of employees with a master's degree
2012	0,102
2013	0,119
2014	0,121
2015	0,137
2016	0,143
2017	0,152
2018	0,161
2019	0,164
2020	0,168
2021	0,165

Source: Hazine ve Maliye Bakanlığı (2022)

[9] Hazine ve Maliye Bakanlığı (2022)

As can be seen in Figure 13, the rate of employees with graduate degrees is increasing every year.

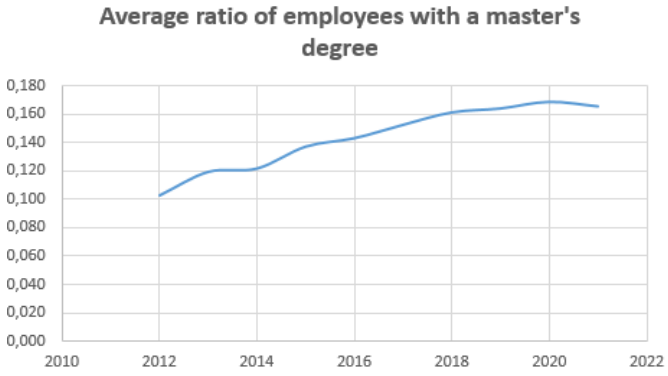

Figure 13: Average ratio of employees with a master's degree[10]

4.2.9. Average ratio of employees with a doctorate degree

Table 19 shows the average rate of employees with doctorate degrees over the years. Contrary to the rate of employees with a master's degree, the rate of employees with a doctorate degree is quite low and has been decreasing in recent years.

Table 19: Average ratio of employees with a doctorate degree

	Average ratio of employees with a doctorate degree
2012	0,0298
2013	0,0301
2014	0,0281
2015	0,0255
2016	0,0194
2017	0,0163
2018	0,0139
2019	0,0171
2020	0,0168
2021	0,0179

Source: Hazine ve Maliye Bakanlığı (2022)

[10] Source: Hazine ve Maliye Bakanlığı (2022)

In Figure 14, the annual change in the average rate of employees with doctoral degrees can be seen more clearly. The ratio of employees with a doctorate degree has decreased in recent years.

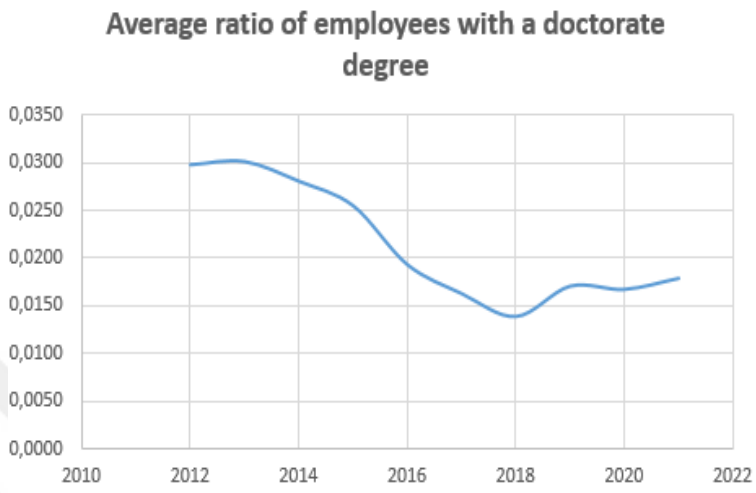

Figure 14: Average ratio of employees with a doctorate degree[11]

4.2.10. Average information technology and management information systems budget

Averages of budgets allocated by state-owned enterprises for information technology and management information systems are shown in Table 20. There is only one institution that does not allocate a budget for information technology and management information systems. One institution has allocated a budget for information technology and management information systems only for the last two years.

[11] Source: Hazine ve Maliye Bakanlığı (2022)

Table 20: Average information technology and management information systems budget

	Information technology and management information systems budget (TL)
2012	1.448.692,00
2013	2.619.630,23
2014	3.995.301,30
2015	5.607.516,22
2016	6.019.724,42
2017	6.897.763,84
2018	8.511.855,44
2019	1.410.6012,36
2020	1.320.4961,29
2021	2.275.0718,14

Source: Hazine ve Maliye Bakanlığı (2022)

Figure 15 shows the change in the average budget allocated to information technology and management information systems by years. It is observed that budget averages have increased in general.

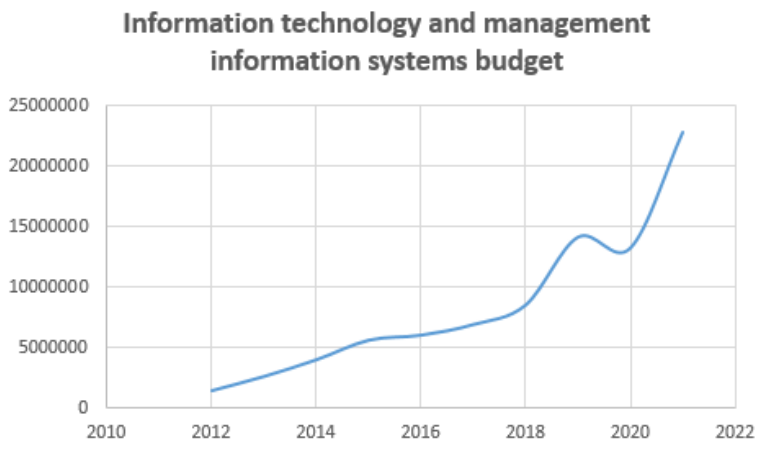

Figure 15: Average information technology and management information systems budget[12]

[12] Source: Hazine ve Maliye Bakanlığı (2022)

4.2.11. Average spending rate of information technologies and management information systems budget

Table 21 shows the average expenditure ratios of the information technologies and management information systems budget. Although a budget is allocated every year, not all of this budget is used. There is only one institution that uses the entire budget each year.

In Figure 16, the change over the years regarding the average expenditure ratios of the information technologies and management information systems budget can be seen more clearly. Although it decreased until 2016, it increased overall in the following years.

Table 21: Average spending rate of information technologies and management information systems budget

	Average spending rate of information technologies and management information systems budget
2012	0,788
2013	0,540
2014	0,424
2015	0,446
2016	0,587
2017	0,456
2018	0,576
2019	0,685
2020	0,714
2021	0,663

Source: Hazine ve Maliye Bakanlığı (2022)

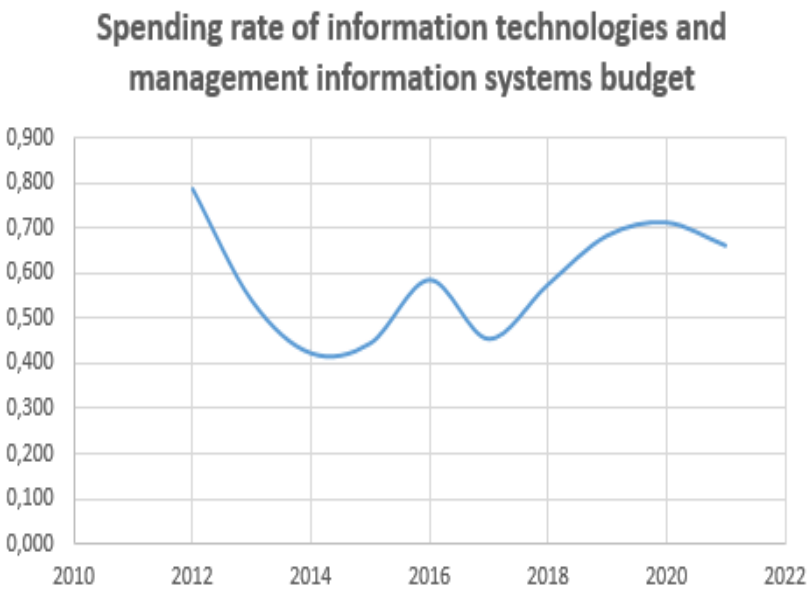

Figure 16: Average spending rate of information technologies and management information systems budget[13]

Quantitative data collected from state-owned enterprises; ratios related to R&D budget and expenditures, number of academic or scientific articles, number of jointly carried out projects, various rates of personnel, number of trademark/patent/design applications, budget and spending rates allocated to information technologies and management systems.

Qualitative data collected from state-owned enterprises, on the other hand, are the sources of funding for R&D activities and information technologies and innovation projects, the support/incentive mechanisms utilized, and the factors that are thought to hinder R&D and innovation activities.

The most commonly used fund in R&D activities and information technologies is equity. The biggest obstacles in front of R&D and innovation activities are the lack of qualified and talented personnel working in this field, the resistance to change and development, budget and finally the legislative obstacles.

[13] Source: Hazine ve Maliye Bakanlığı (2022)

The support and incentive mechanisms utilized are not available in most institutions. Some institutions can also benefit from public resources other than equity and can use the infrastructures of various universities. In addition, since high technology products are not exported, income related to this cannot be obtained.

4.3. Conclusion

In the analysis part of this study, it is primarily aimed to evaluate the quantitative data of 19 SOEs in Turkey. For this purpose, the data such as R&D budget, R&D expenditures, R&D and researcher rates, the ratio of employees with graduate education, number of scientific and academic publications, the budget rates allocated to information technologies and management were analyzed. In addition, which resources the SOEs use the most in funding R&D and innovation activities were presented and the factors seen as obstacles to R&D activities were also revealed for a complementary analysis.

From the analysis, it has been seen that some SOEs have recently started to budget R&D and innovation activities. It suggests that they can allocate a budget and invest in R&D and innovation activities with respect to legal arrangements and there is no legislation that prevents them doing so, but the fact that they do not actually bring these activities to the high levels when compared to the general government and Turkey as a whole and has not attained an increasing trend in the share of Turkey and general government in terms of R&D spending or some other indicators draw attention to the fact they do not attach much importance in these issues. Total R&D expenditures of government, the private sector and the total numbers in Turkey has increased continuously recent years but the share of SOEs in this increase remains very low.

That leaves a question that what factors hold SOEs back to increase their technology capabilities.

First of all, although SOEs have autonomous budgets, these budgets are not flexible enough in terms of how much they will allocate to which item. SOEs have to prepare their annual operating budgets in accordance with the medium-term programs prepared by the state and the basic financial targets prepared within the framework of the annual general investment and financing program prepared by the Ministry of Treasury and Finance. Although this situation is positive in terms of control of the government expenditures, it may limit the flexibility of SOEs. Namely, SOEs may prefer to allocate their limited budgets to items such as the cost of sales or general administrative expenses that are more urgent and inflexible in terms of production. Therefore, it can be said that one reason for holding the SOEs back in terms of technological capabilities is that SOEs are not flexible enough in creating their own budgets or spending. This is also confirmed when it is taken into account that SOEs cover most of their R&D and innovation activities with their own funds. In this regard, the inability to find resources other than equity for R&D and innovation activities and lack of incentive mechanisms may also have an impact because most state-owned enterprises can only fund their R&D and innovation activities with their own equity. In order to raise the levels of SOEs' capabilities in this area, it is considered that there is a need to create more funding sources for them in the fields of R&D and innovation.

There are collaborations or joint projects of state-owned enterprises with various scientific institutes and universities. TUBITAK is the most cooperated institution. It is seen that various joint projects are carried out with various universities. In addition, the infrastructure of universities is also used as a support/incentive mechanism. However, these collaborations and supports are limited to only a few

projects. Therefore, it is clear that SOEs need different mechanisms for their technological progress.

The ratios of R&D personnel, researchers and postgraduate personnel, who play the important role in R&D and innovation activities, were also evaluated within the analysis. Although the proportion of personnel with a master's degree increases every year, the proportion of personnel with a doctorate degree is gradually decreasing. In addition, the rate of researchers is very low and even there are no researchers in most institutions

As stated in the first part of the analysis, SOEs are subject to some strict regulatory restrictions in Turkey both in personnel assignment and in the determination of personnel wages and benefits. Especially until 2016, SOEs were recruiting personnel directly by central assignment without interviewing, and this was causing disruptions in recruiting suitable personnel for the task. For example, when a personnel with a certain experience and know-how was needed, an inexperienced person could be appointed to that position by central assignment mechanism. With the amendment made in the legislation in recent years, SOEs were given the right to select personnel by interview method after the written exam. This has enabled the SOEs to go one step further, at least in recruiting suitable personnel for the task In other words, with the regulations made facilities and privileges were granted to SOEs in the employment of R&D personnel. Despite this, it is seen from the data of SOEs, that, this expectation did not realized, while an increase is expected in the number of R&D personnel of SOEs. However, considering the data, the number of R&D personnel of SOEs in the last 10 years has constituted an average of 35% of the number of R&D personnel employed in the government, and this ratio has shown an increasing trend over the years. Although this seems as positive development but when it is analyzed it can be

seen that one of the reasons lying behind it that the number of R&D employees in the general government is decreasing by years.

As it is known, technology and innovation activities are carried out mostly by highly qualified personnel, as explained in the indicators section, personnel is an important pillar of technological development. It is considered that providing flexibility in the legislation for at least the personnel of SOEs working in the field of R&D or innovation and supporting existing personnel to increase personnel attainment for example with extra payment for master's and doctorate degree will contribute significantly to the technological progress of SOEs. It is clear thatthere is a need to provide flexibility in the legislation in terms of personnel rights and benefits in order to enable SOEs to compete with private companies in order to retain qualified personnel.

When institutions are evaluated in terms of trademark, patent and design applications, it is seen that some SOEs do not have a trademark, patent and design applications. When the total numbers are considered, it is seen that from patent, design and trademark applications made by SOEs, trademark applications constitute the biggest share. When descriptive statistics on trademark, patent and design applications made to the Turkish Patent and Trademark Office (TPTO) were evaluated, SOEs' trademark, patent and design applications remains very low within the total applications made to the TPTO. That is, the private counterparts of SOEs in Turkey are far ahead of the SOEs in terms of intellectual property rights.

It is observed that the budget allocated to information technologies and management information systems has increased in recent years. However, not all allocated budgets are used. In addition, there is no export of high-tech products.

Therefore, there is no income from the export of high-tech products for SOEs in Turkey

In this thesis, all the indicators discussed and examined regarding the technological development of SOEs show that SOEs may need an increase in their capabilities of technological development. Aside from the low indicator values in some SOEs, data on these indicators are not even available for some of them.

As mentioned in the first chapter of the thesis, SOEs are subject to many regulations and restrictions on financial resources, budget and personnel, which are perhaps the most important tools for technological development of a company. These restrictions constitute an important obstacle to the technological development of SOEs. For this reason, there is a need for a controlled stretching of the mechanisms that restrict SOEs, especially in these areas.

CHAPTER 5

5. FINDINGS AND POLICY PROPOSALS AS THE CONCLUSION

The key conclusions from the body of research, which utilized the private sector as a point of reference, were that public firms had inherent efficiency concerns because of managerial laxity, excessive government oversight, and insufficient incentives for innovation (Stiel, 2017). The New Public Management (NPM) movement demanded that market-based procedures be used in every aspect of public administration, including the provision of public services. In order to become more efficient, public businesses are urged to use subcontracting to concentrate on their core competencies, restructure their organizational structures for greater autonomy and less direct government control, and gain from the knowledge reverberations from partnerships with the private sector (Stiel, 2017). Around the world, attempts are being made to revive or restore SOEs. In the new Industrial strategy, the performance evaluation of the system has gained increased attention. When these companies' performance declines and they are unable to halt it, they must go through organizational turnaround, but they may also revitalize and recover with more work. For this type of organization, efficiency improvements are essential, and they may be attained through smart technology management. (Sinha, P.C.Jha, & Mesra, 2013).

For instance, many South African SOEs accept that the business environment is changing as a result of the development of digital technology and that the future is digital. The South African government places SOEs at the center of achieving a digital

society, and they have developed strategies to get ready for this future by utilizing new technologies and seizing opportunities provided by technologies like 5G, cloud computing, big data analytics, artificial intelligence, and machine learning (Venter, 2018).

In line with the results and findings that we encounter in the literature and in real life applications, the analysis of technological development levels of SOEs in Turkey conducted within this study has revealed that SOEs are subject to several legal limitations, which may have hindered their technological progress. To address these challenges, the policy suggestions are proposed aimed at increasing the capabilities of SOEs in Turkey to develop new technologies. The proposed suggestions are designed to address two key areas: employment policy and funding/budgeting policies.

Policy Proposals Aim:

The aim of the proposed suggestions is to improve the technological capabilities of SOEs in Turkey by addressing the barriers that may affect their flexibility to reach high levels of technological progress. The proposed suggestions aim to promote a more efficient and effective use of resources and promote a competitive environment that incentivizes innovation, productivity, and technological development.

1- Employment Policies

a. Increase the flexibility of SOEs to recruit merit-based R&D personel

Despite some recent amendments on recruiting personel, the current regulations governing employment in SOEs in Turkey limit their flexibility to hire and fire employees based on merit. This results in a workforce that may not be equipped with the necessary skills and qualifications to improve the technological capabilities

of SOEs. To address this challenge, a policy suggestion is recommended to increase the flexibility of SOEs to hire R&D employees based on merit. This will promote a more competitive technological environment that rewards high performance and incentivizes innovation and productivity and ensure the recruitment of personnel suitable for the desired criteria and duty.

Tools

To implement this suggestion, legislation should be introduced to allow SOEs to operate more flexibly in hiring R&D employees based on merit. This will require amendments to current regulations governing employment in SOEs in Turkey.

b. Increase and prioritise R&D and innovation activities within the institutions

One of the most important steps that will enable the SOEs to compete with the private sector and adapt to the new economic conditions is their R&D and innovation activities. Considering that these activities are carried out by R&D personnel within the institution, it will be one of the most important policies for organizations to support and encourage the personnel carrying out these activities in order to increase R&D and innovation activities within the institution.

The current remuneration packages in SOEs in Turkey may not be designed to promote innovation or R&D activities. To address this challenge, a suggestion is recommended to introduce performance-based remuneration packages for R&D employees. This will promote a culture of innovation that incentivizes high performance and technological development as well as retaining the recruited personnel within the SOE. It is considered that necessary arrangements can be made to provide the personnel working in the relevant fields with opportunities with personal rights in the competing private sector.

Tools:

To implement this suggestion, regulations should be introduced to introduce performance-based remuneration packages for employees. This will require the design of a new remuneration package that rewards high performance and incentivizes innovation and R&D productivity. Introduce performance-based remuneration packages for employees to support

c. Increase the the rate of employee with graduate degree especially in the fields such as R&D, innovation, technology, software and data science.

Increasing the number of personnel with post-graduate education will add a new vision to the institutions that will increase the number of projects and activities carried out in the fields of science, technology and innovation, and the number of academic and scientific publications. Therefore, it is important to support higher education using some tools in SOEs especially in fields such as R&D, innovation, technology, software and data science.

Tools

To implement this suggestion, regulations should be designed to introduce performance-incentive packages for employees. This would be a new incentive package that rewards and incentivizes graduate degrees in the related areas.

2- Budgeting and Funding Policies

a. Increase funding for R&D activities of SOEs to promote innovation and technological development.

The current budget allocation for R&D activities in SOEs in Turkey may not be sufficient to promote innovation and technological development. To address this

challenge, a policy suggestion is recommended to increase funding for R&D activities in SOEs. This will promote innovation and technological development, which will improve the technological capabilities of SOEs.

Tools

To implement this suggestion, the R&D funding allocation for SOEs in the national budget should be increased. This will require the allocation of additional funds for R&D activities in SOEs. For example, it is considered that SOEs may be included in the R&D incentive discount provided to the private sector by the Ministry of Industry and Trade in Turkey or that similar opportunities to SMEs by KOSGEB can be provided for SOEs. Under certain conditions, SOEs may also benefit from the incentives and discounts provided by Law No. 5746 for personnel and projects that are not public personnel and whose conditions are determined in the Law, which may support the technological development of SOEs.

b. Create a separate budget for SOEs to reduce dependence on government funding and increase their financial autonomy.

The current budgeting system for SOEs in Turkey may limit their financial autonomy and their ability to undertake R&D activities. To address this challenge, a suggestion is recommended to create a separate budget for SOEs. This will increase their financial autonomy and reduce their dependence on government funding.

Tools

To implement this suggestion, a new budgeting system should be designed for SOEs. This will require the allocation of separate funds for SOEs that will be managed independently.

In conclusion, the proposed policy suggestions aim to address the barriers and restrictions that limit the technological capabilities of SOEs in Turkey. The employment policy suggestions aim to promote merit-based R&D employment policies. The budgeting and funding suggestions on the other hand, aim to increase funding for R&D activities of SOEs and create a separate budget for them to reduce dependence on government funding. The proposed policy suggestion tools include introducing legislation and regulations to implement the policies effectively. By implementing these suggestions, SOEs in Turkey can improve their technological capabilities and become more competitive, innovative, and productive. The proposed suggestions can also contribute to the overall economic growth and development of Turkey by promoting the development of a technology-driven economy.

In the design and implementation of these proposed policies and other comprehensive policies that will provide the basis, important duties fall on other stakeholders such as the Ministry of Treasury and Finance, which carries out the shareholding mechanism, and the Strategy and Budget Presidency and relevant sector ministries.

It is important to note that the proposed suggestions are not exhaustive and may require further analysis and refinement to ensure their effectiveness. The suggestions should also be implemented in conjunction with other policies and strategies aimed at promoting the overall economic growth and development of Turkey.

Technological development on the other hand is a comprehensive subject and hard to measure and it is not possible to cover all dimensions regarding the technological development in details. The professional fields and sectors in which SOEs operate may also require some modifications with the policy suggestions provided with the proposed study. The main objective is to set the basis of a needed

policy that would broaden the visions of the state and SOEs. The findings of the thesis may illuminate next studies regarding the subject.

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APPENDICES

A. TURKISH SUMMARY / TÜRKÇE ÖZET

Kamu teşebbüsü veya diğer adıyla kamu iktisadi teşebbüsü kavramı ülkeden ülkeye farklılık göstermekle birlikte, bir kamu idaresinin çoğunluk hissesine sahip olduğu veya yönetimi bir kamu idaresi tarafından kontrol edilen teşebbüslere kamu teşebbüsü denilmektedir. Bu bağlamda kamu teşebbüsü kavramı, bir yandan pay sahipliği, diğer yandan yönetimde kontrol kavramı ile ilişkilendirilmektedir.

Uluslararası literatürde çeşitli bakış açılarına dayalı olarak farklı kamu işletmesi tanımları yapılmaktadır.

Türkiye'de ise sermayesinin tamamı devlete ait olan kuruluşlar 8/6/1984 tarihli ve 233 sayılı Kanun Hükmünde Kararname (KHK) ile Kamu İktisadi Teşebbüsleri (KİT) olarak tanımlanmakta olup KİT'ler, ulaşımdan haberleşmeye, enerjiden tarıma kadar farklı sektörlerde faaliyet göstermektedir.

Hissedarları kamu olsa dahi, kamu bankaları, özelleştirme portföyündeki kuruluşlar, mahalli idareler ve Tasarruf Mevduatı Sigorta Fonu (TMSF) iştirakleri ile Türk Ticaret Kanunu'na ve kendi özel kanunlarına tabi olarak faaliyet gösteren diğer kamu şirketleri 233 sayılı KHK kapsamında değildir ve bu KHK'deki KİT tanımına dahil değildir. Bu tez çalışmasında da yalnızca 233 sayılı KHK'ya tabi olan ve KİT tanımlamasına giren Türkiye'deki 19 KİT ele alınacaktır.

Türkiye'deki KİT'lerin sektörlere göre dağılımı aşağıdaki tabloda gösterilmektedir;

Energy	Agriculture	Transportation	Industry
Boru Hatları ile Petrol Taşıma A.Ş.	Toprak Mahsülleri Ofisi Genel Müdürlüğü	T.C. Devlet Demiryolları İşletmesi Genel Müdürlüğü	Devlet Malzeme Ofisi Genel Müdürlüğü
Elektrik Üretim A.Ş.	Çay İşletmeleri Genel Müdürlüğü	Devlet Hava Meydanları İşletmesi Genel Müdürlüğü	
Türkiye Elektrik İletim A.Ş.	Tarım İşletmeleri Genel Müdürlüğü	Kıyı Emniyeti Genel Müdürlüğü	
Türkiye Kömür İşletmeleri Kurumu	Et ve Süt Kurumu Genel Müdürlüğü	Türkiye Raylı Sistem Araçları A.Ş.	
Türkiye Taşkömürü Kurumu	Türkiye Şeker Fabrikaları A.Ş.		
Türkiye Petrolleri A.O.			
Eti Maden İşletmeleri Genel Müdürlüğü			
Türkiye Elektromekanik Sanayi A.Ş. Genel Müdürlüğü			
Türkiye Elektrik Dağıtım A.Ş.			

Source: Hazine ve Maliye Bakanlığı,2022

Yukarıdaki tablodan da görülebileceği gibi KİT'ler Türkiye'de halen önemli sektörlerde öncü olarak faaliyet göstermekte ve hatta bazı alanlarda tekel konumunda yer almaktadır. Özellikle, ülkemizin enerji sektörüne büyük ölçüde KİT'lerin hakim olduğu söylenebilir. BOTAŞ örnek olarak; ham petrol ve doğal gazın taşınması ve boru hattı işletmeciliği, doğal gaz ve LNG ithalatı, ihracatı, pazarlaması, depolanması ve satışından sorumlu olup, sektör rekabete açık ve serbestleşmiş olmasına rağmen halen hakim durumdadır. TEİAŞ ise elektrik arz güvenliğini üstlenmektedir. Ulaştırma sektörüne bakıldığında ana demiryolu altyapı işletmecisi olarak hareket eden ve ihmal edilebilir pazar payına sahip diğer işletmelere liderlik eden TCDD, ulusal demiryolu

altyapı ağında demiryolu trafiğini tekelleştirirken, iştiraki Taşımacılık A.Ş. yurt içinde sadece demiryolu yolcu taşımacılığı yapmaktadır.

KİT'ler Gayri Safi Yurtiçi Hasılaya (GSYİH), istihdama, bölgesel kalkınmaya veya gelişmekte olan ekonomilerin pazar ve sektör gelişimine önemli ölçüde katkıda bulunmakta ve önemli sektörlerde öncü olarak faaliyetlerini sürdürmektedirler. Türkiye'de KİT'ler, Covid-19 salgınına rağmen 2021 yılında yaklaşık 29,5 milyar TL katma değer yaratmıştır. Bu miktar GSYİH'nın %0,41'ine tekabül etmektedir. KİT'ler katma değer dışında temettü ve gelir payı ödeyerek genel bütçeye önemli katkı sağlamaktadır. KİT'ler tarafından son 10 yılda yaklaşık 31 milyar TL temettü ve yaklaşık 7,3 milyar TL gelir payı ödemesi yaparak bütçeye toplam 38 milyar TL katkı sağlanmıştır. KİT'ler Türkiye'de önemli istihdam yaratarak işsizlik oranlarının düşmesine de katkı sağlamaktadır. 2021 yılında 99 bin personel 17,3 milyar TL maliyetle KİT'lerde istihdam edilmiştir. Bu rakam Türkiye'deki 2,8 milyonluk toplam istihdamın %0,35'ini oluşturmuştur. Diğer taraftan, KİT'lerin ülke ekonomisine ve büyümesine sağladığı katkıların en önemlilerinden biri de yatırım harcamalarıdır. KİT'lerin yatırımları 2021 yılında 39 milyar TL'ye ulaşmış ve bu da Türkiye GSYİH'sının %0,54'ünü oluşturmuştur (Hazine ve Maliye Bakanlığı, 2022). KİT'ler, sosyal sorumluluk çerçevesinde devletin yapmakla yükümlü olduğu birçok yatırımı üstlenmekte, bu sayede hem halka hizmet sunmakta hem de yatırımlarını mümkün olduğunca karlı kılmakta ve ülke ekonomisine katkı sağlamaktadır. Ayrıca yaptıkları yatırımlarla ilgili sektörlerde özel şirketlerin önünü açarak örnek teşkil etmektedirler. KİT'lerin ekonomik büyüme ve kalkınmaya katkısı elbette sadece yukarıda belirtilen sayısal değerler değildir. KİT'ler faaliyet gösterdikleri sektörlerde uzun süre tekel yapılarını korumuşlar, kârlılık çerçevesinde hiçbir özel firmanın yapmayacağı sektörlerde yatırımlar yapmışlar ve böylece kamu hizmeti yükümlülüğünü

üstlenmişlerdir. Sektörlerin gelişmesine katkı sağlayan bu KİT'ler, daha sonra serbestleşme sonrasında birçok özel şirkete önemli know-how payları sağlamış ve öncülük etmiştir. Örneğin, 2013 yılında demiryolu sektörünün serbestleşmesinin önünü açan mevzuat düzenlemesinin ardından bugün sektöre adım atan veya girmek isteyen firmalar TCDD ve iştiraklerinden know-how almaktadır.

Tüm bu katkılar göz önünde bulundurulduğunda devletin önemli politika araçlarından biri olan KİT'lerin devamlılığının sağlanması ve mevcut yapılarının güçlendirilmesi önemlidir.

Türkiyede KİT'ler personel alımından ücretlendirmesine, yönetim kurullarının teşkilinden, ürettikeri ürün veya hizmetlerin fiyatlandırmasına kadar birçok mevzuat kısıtına tabi tutulmakta bu durum her ne kadar zaman zaman onlar için avantaj sağlasa da çoğu zaman hareket alanlarını kısıtlamaktadır. Bu yasal uygulama ve hükümet müdahaleleri KİT'ler için yalnızca doğrudan olanlardır. Bunların dışında dolaylı müdahaleler veya doğrudan müdahalelerin yarattığı baskı ve kısıtlamalar, yukarıda yayılma etkisi ile KİT'leri birçok yönden zorlamaktadır. Bazı kamu işletmeleri, kendilerine yüklenen bazı kamusal sorumluluklar nedeniyle basiretli tacirler gibi faaliyet gösterememektedir. Sadece toplumsal fayda yaratmak için faaliyet gösteren kuruluşlar olduğu gibi, toplumsal faydayı göz ardı etmeyen, ticari esaslara göre yönetilen kuruluşlar da vardır. Bu durumda özel sektörde faaliyet gösteren işletmelerin aksine kamu işletmelerinin özel bir durumu vardır. Bu durum örgütlerin kültürlerini ve pazardaki konumlarını etkilemektedir. Bu kamusal sorumluluklar nedeniyle, bazı kuruluşlar kararlarını alırken daha temkinli (riskten kaçınan) davranmak zorunda kalabilmektedir. Ancak fark yaratmak ve yenilik yapmak için risk almak gerektiği kaçınılmazdır.

Belloc'a (2014) göre, KİT'lerin verimsizliğinin sorumlusu devlet mülkiyetinden çok kültürel, yasal ve politik nedenlerdir. Buna ek olarak, Belloc (2014), devlet mülkiyetinin, kâr ve gelir beklentilerinden bağımsız araştırma finansmanı sağlayarak, risk ve belirsizliğe karşı özel oyunculara göre daha yüksek tolerans göstererek ve diğer kuruluşlarla işbirliğini kolaylaştırarak KİT inovasyonunu destekleyebileceğini savunmaktadır (Belloc, 2014). Bu şekilde, KİT'leri toptan yasaklamak veya kamu mülkiyetini ortadan kaldırmak yerine, KİT'leri faaliyetlerinde ve yönetiminde daha esnek hale getirecek, onları yeni gelişen dijital ortama uyum sağlayabilen daha dinamik ve işlevsel şirketler haline getirecek yeni politikalar getirilmelidir.

Kamu işletmelerinin etkinliği, 20. yüzyıl boyunca iktisat literatüründe çok fazla dikkat çekmiş olsa da, kamu kuruluşları içindeki teşvikleri, kontrolü ve devlet etkisini inceleyen çeşitli teorik katkılarla, şu anda mevcut literatürün en önemli bulgularından biridir. Özel sektörü bir karşılaştırma olarak kullananlar, kamu işletmelerinin yönetim gevşekliği, aşırı devlet kontrolü ve kamu firmaları içindeki inovasyon için yetersiz teşvikler nedeniyle içsel verimlilik sorunlarından muzdarip olduğunu belirtmektedir (Stiel, 2017). Yıllar boyunca küresel düzeyde birçok kamu sektörü işletmesinin tasfiye edilip kapanması bunu doğrular niteliktedir. Günümüzde KİT'leri canlandırmak veya restore etmek için tüm dünyada çaba gösterilmektedir. Gelinen noktada verimlilik kazanımları ve akıllı teknoloji yönetimi bu doğrultudaki en önemli adımlardan biridir (Sinha, P.C.Jha ve Mesra, 2013).

Sinha, PC Jhan ve Mesra yazılarında; KİT'lerle ilgili aşağıda belirtilen hususlarda ciddi sorunlar gözlemlenmekte olduğunu ifade etmiştir (Sinha, P.C.Jha ve Mesra, 2013);

1. Verimlilikte yetersiz büyüme

2. Kötü proje yönetimi

3. Fazla istihdam

4. Sürekli teknolojik ilerleme eksikliği

5. Ar-Ge ve insan kaynaklarının geliştirilmesine yeterince önem verilmemesi

6. Çok düşük sermaye yatırım getiri oranı

Teknolojik gelişmenin giderek önem kazandığı günümüzde KİT'lerin de çağa ayak uydurabilmeleri ve serbest piyasa koşullarında rekabet edebilmeleri için belki de en önemli adımlardan biri, KİT'lerin teknolojik ilerlemesinin sağlanmasıdır.

Bu gerekçeye göre Yeni Kamu İşletmeciliği (YKY) hareketi, kamu hizmetlerinin sunumu da dahil olmak üzere kamu yönetiminin tüm alanlarında piyasa odaklı uygulamaların hayata geçirilmesi çağrısında bulunmuştur. Kamu işletmeleri, verimliliği artırmak için taşeronluk kullanarak temel yetkinliklerine odaklanmaya, organizasyon yapılarını daha fazla özerkliğe ve daha az doğrudan hükümet etkisine doğru reforme etmeye ve özel sektörle ortak girişimlerden elde edilen bilgi yansımalarından yararlanmaya teşvik edilmektedir (Stiel, 2017).

Çok sayıda Güney Afrikalı KİT, geleceğin dijital olduğunu ve dijital teknolojinin gelişiminin iş ortamlarını değiştirdiğini kabul etmekte, yeni teknolojilerden yararlanarak ve 5G, bulut bilgi işlem, büyük veri analitiği, yapay zeka ve makine öğrenimi gibi teknolojilerin sağladığı fırsatları takip ederek bu geleceğe hazırlanmak için stratejiler geliştirmektedirler ve Güney Afrika Hükümeti KİT'leri dijital topluma ulaşmanın merkezine koymaktadır (Venter, 2018).

Günümüzde, KİT'lerle ilgili akademik çalışmalar bulunsa da, bu çalışmaların çoğu KİT'lerde inovasyonu ve teknolojik ilerlemeyi çoğunlukla dikkate almamakta veya göz ardı etmektedir. Kamu inovasyonunu araştırmak, diğerleri arasında Amerika Birleşik Devletleri, İtalya, Birleşik Krallık, Avustralya ve Brezilya'dan gelenler de

dahil olmak üzere bazı makalelerin konusu olmuştur ancak bahsedildiği gibi KİT'lerde inovasyonu inceleyen çok sayıda yayın yoktur. Bazıları KİT'lerin yapısını ve yoğunlaşmasını, KİT'lerdeki Ar-Ge ve inovasyon çalışmalarının sanayiye katkısını, doğrudan yabancı yatırımların KİT'lerin Ar-Ge'sindeki rolünü incelemekte, çok azı da KİT'lerin Ar-Ge ve yenilik politikalarındaki rolünü incelemektedir (Argothy & Álvarez, 2018).

Bilgi çağında ekonomik büyümeye önemli katkılar sağlayan araçlardan birinin teknolojik gelişmeler olduğu açıkça görülmektedir. Teknoloji üreten ve ihraç eden ülke ve kurumlar dünya ölçeğinde avantajlı bir konuma gelmektedir.

Teknolojik gelişmeler, ülkelerin beşeri ve fiziki sermaye yapılarına yapılan yatırımların gerçekleştirilmesi, üretim faktörlerinin etkinliğinin ve sayısının artırılması ve gerçekleştirilecek yenilikçi faaliyetler ile ekonomik büyümeyi hareketlendirecek temel unsurlar arasında yer alsa da yeterli olmamaktadır. Sürdürülebilir bir ekonomik büyüme sağlamak için tek başına bir faktördür (Berber, 2006). Sürdürülebilirliğin belki de en önemli adımı ise teknolojik ilerleme ve büyümedir. Modern çağın sürdürülebilir ekonomisi ve kurumların istikrarlı başarısı teknolojik gelişmelerle mümkün olacaktır. Bu bağlamda teknolojik gelişme ve değişimlerin takip edilmesi, anlaşılması ve ölçülmesi her geçen gün daha fazla önem kazanmaktadır.

Teknoloji düzeyi, en genel anlamda üretim süreci, ürün çıktısı, bu çıktının pazarlanması ve satış sonrası deneyimin toplamı olarak ifade edilebilir. Bu meblağın artması ise teknolojik gelişme yaratmaktadır. Ancak bu artışın ekonomik olarak kabul edilebilmesi için üretimi gerçekleştiren tarafların teknolojik gelişmeyi ticari bir ürüne yani inovasyona dönüştürmesi gerekmektedir (Kibritçioğlu, 1998).

KİT'lerin modern çağa ayak uydurabilmeleri ve teknolojik gelişimlerini büyütebilmeleri için KİT'lerin verimliliğini artırmanın en önemli görevlerinden biri,

devlet müdahalelerini, kısıtlamalarını ve engellerini en aza indirmek veya optimal düzeyde tutmaktır. İş gücünde, özlük hak ve ücretlerinde, yatırımlarda, bütçelerde ve harcamalarda yapılacak her türlü değişiklik, KİT'lerin teknolojik olarak ilerlemesini engelleyecektir. Dolayısıyla, bu kısıtlamaların gevşetilmesi ve KİT'lerin ekonomik ve idari açıdan bağımsız hale gelmesi, teknolojik ilerlemeleri ve yenilikçilikleri açısından avantajlı olacaktır. Dolayısıyla bu çalışma; KİT'lerin teknolojik gelişimlerinin önünde engel olarak karşılaştıkları zorluklar nelerdir ve daha yüksek teknolojilere uyum sağlama kapasitelerini artırmak ve teknolojik anlamda ilerlemelerini sağlayabilmek için için neler yapılmalı sorularına cevap bulmaya çalışmaktadır.

Ülkelerin ve kurumların gelişmişlik düzeyini belirleyen en önemli göstergelerden biri teknolojik gelişmişlik düzeyi olduğundan, literatürde teknoloji düzeyini ve teknolojideki değişimleri ölçmek için çeşitli yaklaşımlar önerilmektedir. Puanlama modelleri, veri analizleri, anketler, büyüme modelleri ve göstergeler bu yaklaşımlardan yalnızca bazılarıdır. Literatürde yer alan bu yaklaşımlar arasından KİT'lerin teknik yenilik ve gelişme potansiyellerini değerlendirmek ve tüm bu sorulara cevap verebilmek için bu tez çalışmasında göstergeler belirlenmiş ve sayısal göstergelerin özellikle son on yıldaki seyri izlenmiştir. Gösterge yönteminin belki de en önemli kısmı, göstergeleri kapsayıcı bir şekilde ve amaca uygun olarak seçmektir. Göstergeler sayısal verilerden oluşabileceği gibi sayılamayan, yorumlayıcı verilerden de oluşabilir. Anket ve mülakat gibi literatürde yer alan bazı tekniklerle göstergelere ilişkin veriler toplandıktan sonra, güvenilir sonuçlara ulaşmak için veri analizi yapılmaktadır.

Bu yöntemlerden bazılarını birleştirerek şirketlerin teknolojik gelişimini ölçmeye çalışmak her yöntemin eksikliklerini giderebilmektedir. Bu kapsamda, KİT'lerin teknolojik düzeyinin ölçülmesi söz konusu olduğunda, kapsamlı

göstergelerin belirlenmesi ve sonrasında veri analizinin yapılması toplanabilecek veriler dikkate alındığında karma bir yöntemin uygulanması daha sağlıklı olacağı değerlendirildiğinden bu tez çalışmasında bu şekilde karma bir yöntem uygunlanmıştır.

OECD, "Bilimsel, Teknolojik ve İnovasyon Faaliyetlerinin Ölçümü" başlığı altında bir dizi ölçüm kılavuzu yayınlamaktadır. Her belge, bilim, teknoloji ve inovasyonla ilgili dünya çapında kabul görmüş (STI) veri ve göstergelerin toplanması, raporlanması ve kullanılması için öneriler sunmaktadır. Frascati ve Oslo Kılavuzları inovasyon göstergelerinin temelini oluştururken, farklı göstergeler için de kılavuzlar bulunmaktadır. Bu tez çalışmasında da göstergeler belirlenirken Frascati ve Oslo Kılavuzları temel alınmış; tanımlanan göstergelerin Oslo Kılavuzu tarafından belirlenen aşağıdaki özelliklere sahip olması sağlanmıştır: (OECD & Eurostat, 2018)

- alaka,
- kesinlik,
- güvenilirlik,
- zaman çizelgeleri,
- tutarlılık,
- ulaşılabilirlik

Söz konusu göstergeler yine Oslo Kılavuzu ile belirlenen aşağıdaki inovasyon faaliyetlerini kapsayacak şekilde tasarlanmıştır; (OECD & Eurostat, 2018)

• Ar-Ge faaliyetleri

• mühendislik, tasarım ve diğer yaratıcı çalışma faaliyetleri

• pazarlama ve marka değeri faaliyetleri

• fikri mülkiyet (IP) ile ilgili faaliyetler

• çalışan eğitim faaliyetleri

• yazılım geliştirme ve veritabanı faaliyetleri

• maddi varlıkların satın alınması veya kiralanması ile ilgili faaliyetler

• yenilik yönetimi faaliyetleri

Ar-ge yatırımları, patent, marka ve tasarım başvuru sayıları, araştırmacı personel ve akademik yayın sayısı gibi bazı sayısal göstergelerin yanı sıra bazı sübjektif veriler de analiz edilerek bütüncül bir çalışma yapılmıştır. Çalışma, araştırma ve geliştirme yetenekleri ya da sadece inovasyon gibi sadece bir tanesine odaklanmak yerine, Türkiye'deki KİT'lerin etkin bir şekilde faaliyet göstermesini sağlayacak teknolojik ilerlemenin tüm yönlerini ele almayı amaçlamaktadır. Bunun örnekleri şunları içermektedir:

-mesleki alanlarda icat veya yenilik

-profesyonel alanlarda araştırma ve geliştirme

-profesyonel alanlarda ileri teknolojileri kullanmak

-ileri teknolojileri yönetim araçları olarak kullanmak

Gösterge verilerinin incelenmesi sonucunda, Türkiye'deki KİT'lerin teknolojik gelişme ve yenilikçilik açısından istenilen düzeyde olmadığı ve ilerlemeye yer olduğu tespit edilmiştir. Bunu takiben, göstergelerin analizi ışığında bazı politika önerilerinde bulunulmaktadır.

Bu tezde analiz edilen göstergeler; Ar-Ge'ye ayrılan bütçenin toplam bütçe içindeki oranı, Ar-Ge harcamalarının toplam yatırımlar içindeki oranı, marka/patent/tasarım başvuruları, üniversiteler veya bilimsel kuruluşlarla yapılan işbirlikleri veya ortak projeler, Ar-Ge personeli, araştırmacı ve lisansüstü eğitimli personelin toplam personele oranı, bilgi teknolojileri ve yönetim bilgi sistemleri harcamalarının bilgi teknolojileri ve yönetim bilgi sistemlerine ayrılan bütçe içindeki oranı, Ar-Ge faaliyetleri ile bilgi teknolojileri ve yenilik projelerine ayrılan fon

kaynakları, bu faaliyetlerde yararlanılan destek/teşvik mekanizmaları, yüksek teknolojili ürün ihracatından elde edilen gelirler ve son olarak teknolojik ilerleme/geliştirme kapasitesinin artırılmasının önündeki engellerdir.

Yapılan analizlerden her KİT'in Ar-Ge faaliyetlerine ayırdığı bir bütçenin olmadığı görülmüştür. Ar-Ge faaliyetlerine bütçe ayıran veya yatırım yapan KİT'lerin bu faaliyetleri yeni başlamış olup, ayrılan bütçe ve toplam yatırımlar içinde ihmal edilebilecek kadar küçük bir paya sahip olduğu ortaya çıkmıştır. Bu bağlamda, Ar-Ge ve yenilik faaliyetleri için özkaynaklar dışında başka fon kaynağı bulunamaması ve teşvik mekanizmalarının yeterli olmamasının etkili olabileceği değerlendirilmektedir çünkü çoğu kamu kuruluşu Ar-Ge ve yenilik faaliyetlerini yalnızca özkaynakları finanse etmektedir.

Ar-Ge ve yenilik faaliyetlerine bütçe ayırıp yatırım yapabilen ancak bu faaliyetlerini istenilen düzeye getiremeyen KİT'ler, bütçe kısıtları karşısında yetişmiş ve donanımlı personelin yeterli olmadığına dikkat çekmektedir. Ayrıca Kuruluşların Ar-Ge personelini iş değiştirmeleri nedeniyle elinde tutamaması da Ar-Ge faaliyetlerini engelleyen unsurlar olarak görülmektedir. Tüm bunlara ek olarak, yasal kısıtlamalar ve kurumların gelişmeye ve değişime karşı direnci, Ar-Ge ve yenilik faaliyetlerinin başarısını ve sürekliliğini zorlaştırmaktadır.

Ar-Ge ve yenilik faaliyetlerinde en önemli rolü oynayan Ar-Ge personeli, araştırmacı ve lisansüstü personel oranları da değerlendirilmiştir. Yüksek lisans derecesine sahip personel oranı her yıl artmakla birlikte doktora derecesine sahip personel oranının giderek azaldığı gözlenmiştir. Ayrıca araştırmacı oranı çok düşüktür ve hatta çoğu kurumda hiç araştırmacı bulunmamaktadır.

Analizin ilk bölümünde belirtildiği gibi, Türkiye'de KİT'ler hem personel atamalarında hem de personel ücret ve haklarının belirlenmesinde bazı katı

düzenleyici kısıtlamalara tabidir. Özellikle birkaç yıl öncesine kadar KİT'ler mülakat yapmadan doğrudan merkezi atama ile personel istihdam etmekte bu da göreve uygun personel alımında aksamalara neden olmaktaydı. Örneğin belli bir tecrübe ve bilgi birikimine sahip bir personele ihtiyaç duyulduğunda, merkezi atama mekanizması ile o pozisyona tecrübesiz bir kişi atanabilmektedydi. Son yıllarda mevzuatta yapılan değişiklikle KİT'lere yazılı sınav sonrasında mülakat yöntemiyle personel seçme hakkı tanınmıştır. Bu, KİT'lerin en azından göreve uygun personeli işe alma konusunda bir adım daha ileri gitmesini sağlamıştır. Ancak bu kez KİT'lerin kalifiye eleman bulundurmak için özel şirketlerle rekabet edebilmesi için özlük hak ve menfaatleri konusunda mevzuatta esneklik sağlanmasına ihtiyaç duyulmaktadır.

Bilindiği gibi teknoloji ve yenilik faaliyetleri çoğunlukla yüksek nitelikli personel tarafından yürütülmekte olup, göstergeler bölümünde de açıklandığı gibi personel, teknolojik gelişmenin önemli bir ayağıdır. KİT'lerin en azından Ar-Ge veya inovasyon alanında çalışan personeline mevzuatta esneklik sağlanması ve mevcut personelin personel kazanımını artıracak şekilde, örneğin; yüksek lisans ve doktoranın ek ödeme ile desteklenmesinin KİT'lerin teknolojik gelişimine önemli katkı sağlayacağı değerlendirilmektedir.

Kurumlar marka, patent ve tasarım başvuruları açısından değerlendirildiğinde bazı KİT'lerin marka, patent ve tasarım başvurularının bulunmadığı görülmektedir. Türk Patent ve Marka Kurumu'na (TPTO) yapılan marka, patent ve tasarım başvurularına ilişkin tanımlayıcı istatistikler değerlendirildiğinde, bunlardan yerli marka başvurularının yabancı marka başvurularına göre çok daha fazla olduğu dikkat çekmektedir. Kıyaslandığında, KİT'lerin marka, patent ve tasarım başvuruları, TPTO'ya yapılan toplam başvurular içinde yok denecek kadar azdır. Yani Türkiye'deki KİT'lerin özel muadilleri fikri mülkiyet hakları açısından KİT'lerin çok ilerisindedir.

KİT'lerin Ar-Ge ve inovasyon alanında fazla faaliyet göstermemesi ve bu alanlara fazla bütçe ayırmaması bunun bir sonucu olarak ortaya çıkmaktadır. KİT'lerin bu alandaki seviyelerinin yükseltilmesi için Ar-Ge ve yenilik alanlarında kendilerine daha fazla fon kaynağı yaratılması gerektiği değerlendirilmektedir.

Kamu iktisadi teşebbüslerinin çeşitli bilim enstitüleri ve üniversiteler ile işbirlikleri veya ortak projeleri bulunmaktadır. TÜBİTAK en çok işbirliği yapılan kurumdur. Çeşitli üniversitelerle çeşitli ortak projeler yürütüldüğü görülmektedir. Ayrıca üniversitelerin altyapısı da bir destek/teşvik mekanizması olarak kullanılmaktadır. Ancak bu işbirlikleri ve desteklerin birkaç proje ile sınırlı kaldığı gözlenmiştir. Dolayısıyla KİT'lerin teknolojik ilerlemeleri için farklı mekanizmalara ihtiyaç duydukları açıktır.

Son yıllarda bilgi teknolojileri ve yönetim bilgi sistemlerine KİT'ler tarafından ayrılan bütçenin arttığı görülmektedir. Ancak tahsis edilen bütçelerin tamamının kullanılmadığı da gözlenmiştir. Bu durum, Kuruluşların bu faaliyetleri önceliklendirmediği sonucunu ortaya koymaktadır. Ayrıca yine veriler incelendiğinde, herhangi bir KİT tarafından son 10 yılda yüksek teknolojili ürün ihracatı yapılmadığı görülmektedir. Dolayısıyla yüksek teknolojili ürünlerin ihracatından elde edilen gelir de yoktur.

Çalışma sonucunda, KİT'lerin teknik büyümesinin hedeflenen seviyelere getirilmesi için ağırlıklı olarak iki alanda yeni politikalar oluşturulabileceği tespit edilmiştir. Birincisi, KİT'lerin teknoloji ve yenilik düzeylerinin yararlanabileceği, Ar-Ge veya yenilik faaliyetleri için personel alımının serbestleştirilmesi gibi KİT'ler için yeni bir istihdam politikası tasarlamak, böylece ilgili nitelikleri karşılayan bireylerin işe alımını garanti altına almak için uygun hazırlıklar yapılmasını sağlamaktır. İlgili disiplinlerde çalışan personele rekabetçi özel sektördeki özlük haklarına sahip

olanaklar sağlanmasının önünün açılması ve istihdam edilen personelin elde tutulması da KİT'ler için gerekliliklerden biridir. Çalışanların daha yüksek eğitim almalarının desteklenmesi ve akademik yayın sayısının farklı destek mekanizmaları artırılıp yaygınleştırılması da KİT'lerin teknoloji ve inovasyonda ilerlemesine yardımcı olacaktır. Yeniden tasarlanması gereken ikinci politika ise, esnek bütçe sistemi ve teknolojik faaliyetler ve inovasyon aktiviteleri için fon çeşitliliğidir. Ar-Ge ve yenilik girişimlerini teşvik etmek ve desteklemek için KİT'lerin çeşitli teşvik mekanizmalarından yararlandırılması ve kendi kaynakları dışında alternatif finansman kaynakları geliştirmesi öncelikli olmalıdır. Örneğin, KİT'lerin Sanayi ve Ticaret Bakanlığının özel sektöre sunduğu Ar-Ge teşvik indiriminden faydalanmasının önünün açılması veya KOSGEB, KOBİ'lere sunduğu Arge teşvik mekanizmaları gibi KİT'lere de imkanlar sağlanması faydalı olacaktır. KİT'lere kendi bütçelerini tasarlama fırsatı verilmesi ve ciddi bütçe kısıtlamalarının gevşetilmesinin, KİT'lerin fon yaratma kapasitelerini artırabileceği ve Ar-Ge ve yenilik faaliyetlerine daha fazla kaynak ayırmalarına olanak sağlayacağı düşünülmektedir. Kamu kaynaklarının etkin kullanımının sağlanması için bütçe üzerindeki kontrol ve gözetimler kaldırılmadan, daha esnek ve serbest bir bütçeleme stratejisine geçilmesinin avantajlı olacağı düşünülmektedir.

Teknolojik gelişme, öte yandan kapsamlı ve ölçülmesi zor bir konudur. Bu çalışmada, tasarlanmak istenen politikanın, KİT'leri teknolojik gelişmeye yönlendirmeye yönelik genel bir politika olması planlanmıştır ancak teknolojik gelişmeye ilişkin tüm boyutları ayrıntılı olarak ele almak mümkün değildir. KİT'lerin faaliyet gösterdiği mesleki alanlar ve sektörler de önerilen çalışma ile sağlanan politika önerileri ile bazı değişiklikler gerektirebilir. Örneğin, Türkiye'deki KİT'ler arasında sektörel bir farklılaşma olmaması ve sektörlerin farklı dinamikleri ve talepleri

olabileceğinden, sektörel analizlerin bundan sonraki çalışmalarda uygulanabileceği düşünülmektedir. Bu çalışma ile tasarlanan temel amaç, devletin ve KİT'lerin vizyonunu genişletecek ihtiyaç duyulan bir politikanın temelini oluşturmaktır. Tezin bulguları konu ile ilgili bundan sonraki çalışmalara ışık tutabileceği değerlendirilmektedir.

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