

SCIENCE, TECHNOLOGY, AND INNOVATION IN TURKEY

2012



TÜBİTAK

THE SCIENTIFIC AND TECHNOLOGICAL RESEARCH COUNCIL OF TURKEY



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Contact:

TÜBİTAK – Department of Science, Technology, and Innovation Policy


Address: Atatürk Bulvarı No.221 06100 Kavaklıdere Ankara TURKEY

Web: www.tubitak.gov.tr/stipolicy

E-mail: politikalar@tubitak.gov.tr

Phone: +90 312 4673659

Fax: +90 312 4673659



Science, Technology and Innovation Vision of Turkey¹:
“To contribute to new knowledge and develop innovative technologies to improve the quality of life by transforming the former into products, processes and services for the benefit of the country and humanity”

¹ The vision statement intended to be achieved through the National Science, Technology and Innovation Strategy 2011-2016 as adopted in the 21st meeting of the Supreme Council for Science and Technology (SCST).

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1. National Innovation and Entrepreneurship System

Turkey targets to take place among the top 10 largest economies in the world, reaching 500 billion dollars of export volume and to be a country manufacturing and exporting national automobile, aircraft, ship and satellite by 2023. Towards this technological target, it is essential for Turkey to advance in the fields of science, technology, and innovation (STI). Accordingly, the Supreme Council for Science and Technology (SCST), which is the highest ranking STI policy-making body in Turkey, convenes regularly to take related decrees and place priorities. The SCST is chaired by the Prime Minister of Turkey and has convened regularly since the year 2004. With a maturing national innovation and entrepreneurship system, Turkey has recently engaged in a significant STI impetus. For this reason, the country attracts

increasing attention from other countries for effective policies and political determination.

In order to sustain the STI impetus in which Turkey is currently engaged and to achieve the targets for the year 2023, STI related institutions undertake initiatives to allow the climate in which innovativeness and entrepreneurship matures. The National Innovation and Entrepreneurship System generates technologies that create economic value-added and competent human resources. In this context, all the institutions from R&D performing to R&D funding actors operate in cooperation within the Turkish National Innovation and Entrepreneurship System. The major actors of this System with their systemic functions are given in Figure 1.1.

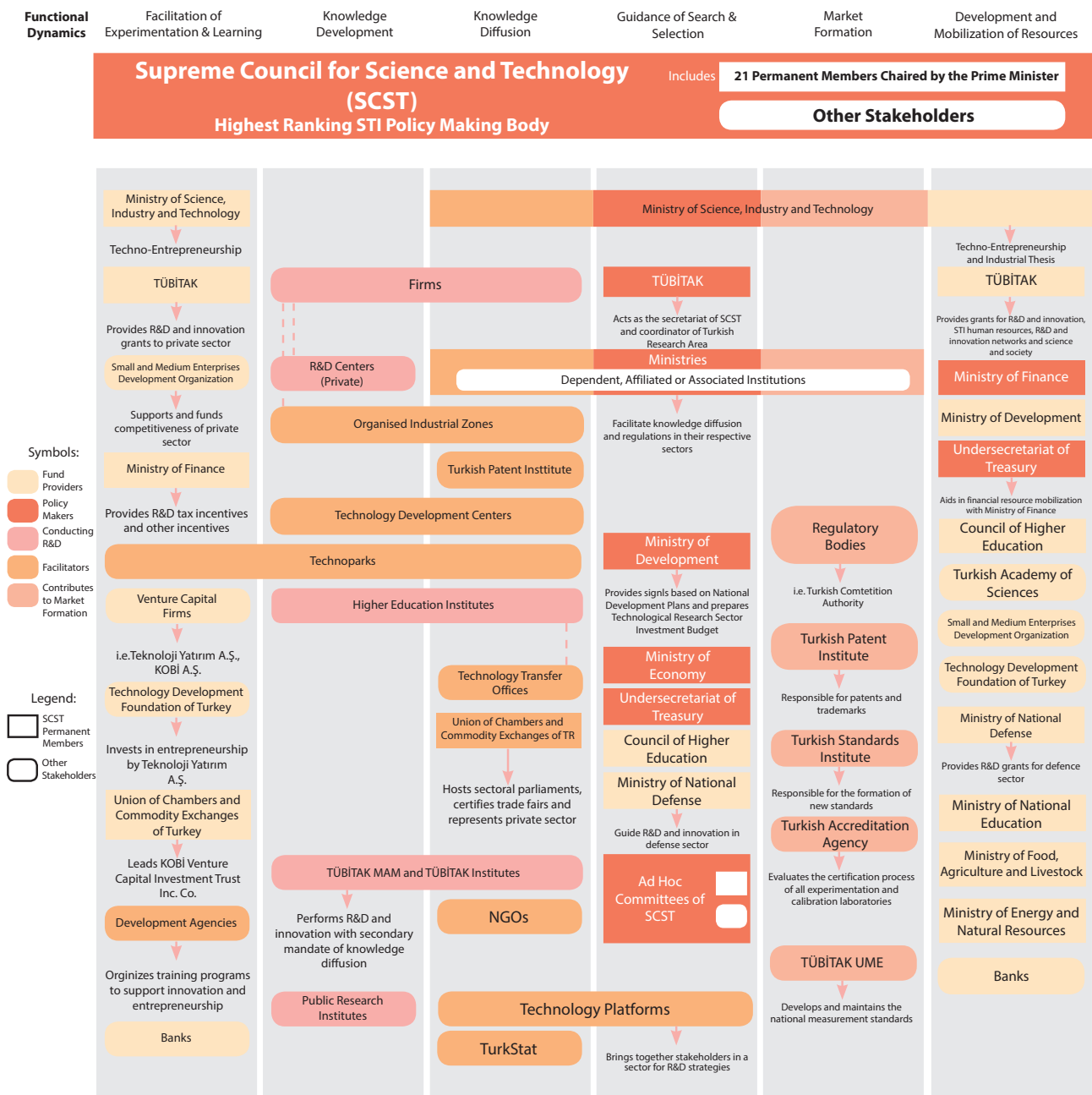


Figure 1.1: Major Actors in Turkish National Innovation and Entrepreneurship System²

² Functional dynamics approach describes the basic dynamics for effective functioning of the R&D and innovation system. Source: Bergeck, A. vd. "Analyzing the functional dynamics of technological innovation systems: A scheme of analysis." Research Policy 37 (2008) 407-429; M. Hekkert vd. "Functions of innovation systems: A new approach for analyzing technological change," Technological Forecasting and Social Change 74 (2007) 413-432; & "OECD Country Review of Innovation Policy: Current Status and Draft Synthesis Report," DSTI/STP (2009) 4/REV1, pp.10-11.

1.1 The Supreme Council for Science and Technology (SCST)

The Supreme Council for Science and Technology (SCST) is the highest ranking STI policy-making body in Turkey that was established on October 4, 1983 according to statutory decree 77. The SCST was established to fulfill the functions determined as:

- a) To assist the government in the determination of long-term S&T policies,
- b) To identify R&D targets related to S&T areas,
- c) To identify the priority areas in R&D and prepare related plans and programs,
- d) In accordance with these plans and programs, to assign tasks to public organs as well as to cooperate with the business enterprise sector as necessary to identify regulations and promotion schemes related to the business enterprise sector,
- e) To have bills and legislations prepared aiming to develop and increase the effectiveness of the S&T system,
- f) To identify the means for development and effective utilization of R&D human resources, and assure their implementation,
- g) To set the procedures for establishment of R&D centers of private institutions, and monitoring and evaluating their activities,
- h) To determine in which research fields and in what proportions the R&D investment is to be made,
- i) To provide coordination among sectors and institutions in programming and implementation stages.

As given in Figure 1.2, SCST is a vital aspect for STI governance.

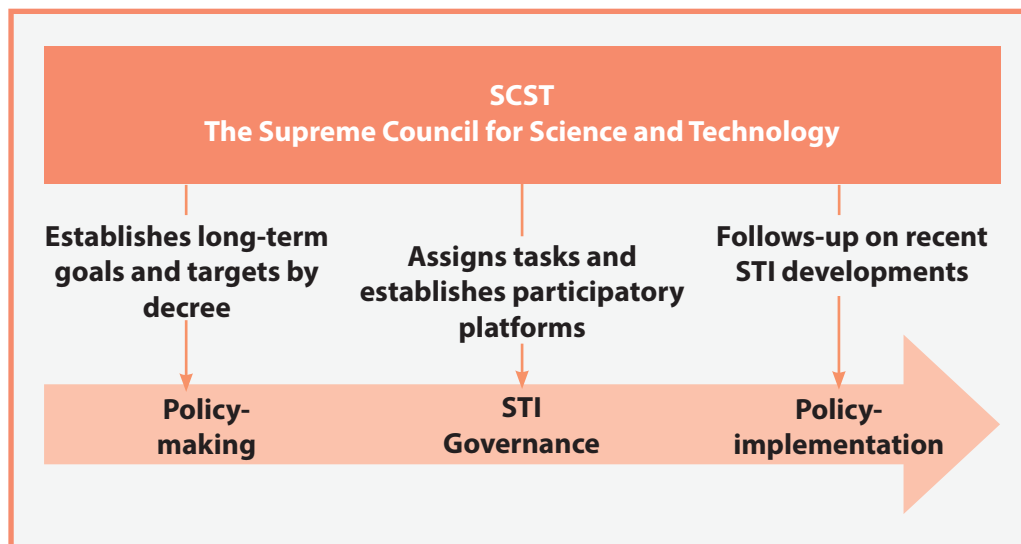


Figure 1.2: Functions of SCST

SCST is chaired by the Prime Minister and composed of its permanent council members:

- Minister of Science, Industry and Technology
- Minister of Energy and Natural Resources
- Minister of Food, Agriculture and Livestock
- Minister of Customs and Trade
- Minister of Finance
- Minister of National Education
- Minister of National Defense
- Minister of Health
- Minister of Forestry and Water Affairs
- Chairman of the Council of Higher Education
- Undersecretary of Treasury
- Undersecretary of the Ministry of Economy
- Undersecretary of the Ministry of Development
- Chairman of the Turkish Atomic Energy Authority

- President of TÜBİTAK and a Vice President
- General Director of Turkish Radio and Television
- Chairman of Union of Chambers and Commodity Exchanges of Turkey
- A member to be appointed by a university to be designated by the Council of Higher Education

Other relevant stakeholders are also invited to the meetings with advisory capacity.

While the SCST, which sustains robust interactions among the stakeholders and contributes to diffusing the developments on recent STI policies, convened only nine times between the years 1983-2004, it convened seventeen times between the years 2004-2013 (Figure 1.3). The regular and well-attended meetings of SCST since 2004 have further served to advance a culture within the participating institutions themselves, which holds promise to further the level of S&T governance to sustain the STI impetus in which Turkey is currently engaged.

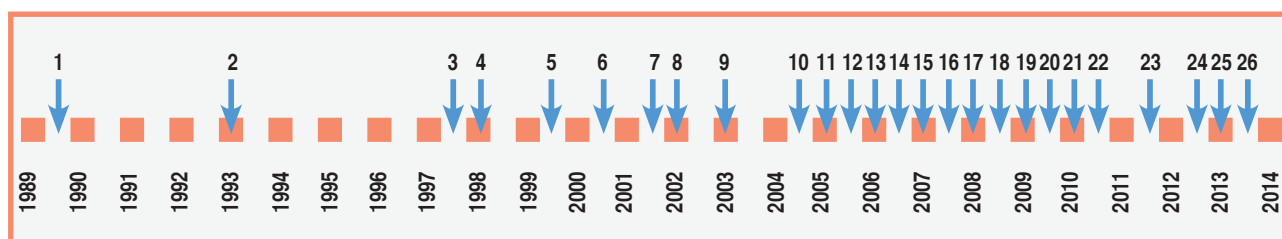


Figure 1.3: SCST Meetings between the Years 1989-2013³

Preparatory meetings prior to the meetings of SCST are held for discussions on the agenda and scope of the SCST meetings. These meetings host the participation of the high-level executives of the relevant institutions that participate in the SCST meetings. By this way, participation and information sharing among the actors of

the National Innovation and Entrepreneurship System is kept at the highest level.

SCST functions as a mutual learning platform as well as setting the STI policy direction of Turkey. In addition, it encourages in the development of policy proposals for the specified topics

³ As of November 2013

in a participatory environment. The National Science, Technology and Innovation Strategy 2011-2016, prepared in this context, has been approved in the 22nd meeting of SCST.

In recent years, the agenda of the SCST meetings are determined as issues that will affect the development of Turkey the fastest way. In this context, the 26th meeting of SCST was held on June 11, 2013, with the main theme "Energy". The following seven new decrees were adopted relevant to the theme at the meeting focusing on the enhanced usage of national energy sources in the energy mix and the development of national energy technologies through public-private partnerships:

- Development of National Design and Manufacturing Capability for Thermal Power Plants (MILTES)
- Development of Hydroelectric Energy Technologies (MILHES)
- Development of Wind Energy Power Plant Technologies (MILRES)
- Adaptation of Solar Energy Technologies (MILGES)
- Development of National Design and Manufacturing Capability for Thermal Power Plant Flue Gas Treatment Technologies (MILKAS)
- Development of Coal Gasification and Liquid Fuel Production Technologies
- Increasing Energy Efficiency

The 25th meeting of Supreme Council for Science and Technology was held on January 15, 2013 with the main theme "Turkey e-Government Assessment and High Talented (Gifted) Individuals". The following six new decrees were adopted at the meeting:

- Development of e-Government Organization Management Model

- Development of Firm Certification System for Procurement of e-Government Implementations
- Development of National Data Center
- Bulk Procurement of Package Programme Solutions that Governmental Agencies Need
- Inclusion of Health Sector within National Prioritized Areas
- Monitoring of Gifted Individuals Strategy

The 24th meeting of SCST was held on August 7, 2012. The main theme of the 24th meeting of SCST was "The Role of Education and Human Resources to Reach National Targets for the Year 2023". The following nine new decrees were adopted relevant to this theme at the meeting:

- Conducting Educational Assessment Studies for Evaluating and Improving the Quality of Education System
- Developing Digital Contents for Primary and Secondary Education Curriculum and Making Them Accessible
- Promoting Development of Digital Course Contents for Higher Education and Making Them Accessible
- Revising Teaching Programmes and Designing Educational Contents To Enable Students Acquire Core Competencies More Efficiently
- Developing Alternative Models for Foreign Language Teaching in Primary and Secondary Education
- Restructuring Scholarship Programs for Graduate Students to Study Abroad
- Organization of Science Fairs for the Primary and Secondary School Students
- Restructuring the System of Admission to Higher Education

- Conducting Preparatory Work for the Participation of Turkey to Horizon 2020- Framework Programme for Research and Innovation 2014-2020

The main theme of the 23rd meeting of SCST was “The National Innovation and Entrepreneurship System and Steps to be Taken to Foster this System”. The following eight new decrees were adopted at the meeting that was held on December 27, 2011:

- National Innovation System 2023 Targets
- Setting up a Coordination Board to Secure Integrity, Coherence and Target Oriented Approach in the R&D, Innovation and Entrepreneurship Support Mechanisms
- Developing Policy Tools to Activate and Increase the Number of R&D Intensive Start Ups
- Developing Policy Tools to Trigger Innovation and Entrepreneurship in the Universities
- Promotion of Entrepreneurship Culture
- Improving Public Procurement and Public Right of Use to Foster Innovation, Localization, and Technology Transfer
- Promotion of Science Centers
- Developing Policy Tools to Stimulate Domestic Patent Licensing

With implementation of the SCST decrees by the responsible organizations, positive effects are being observed. As an example, in the context of the decree “Developing Policy Tools to Trigger Innovation and Entrepreneurship in the Universities,” The Entrepreneurial and Innovative University Index has been prepared for the first time in Turkey in 2012 and the most innovative and entrepreneurial 50 universities were announced to public. The index study has been initiated by TÜBİTAK and The Council

of Higher Education. In addition, the Turkish Statistical Institute, Ministry of Science, Industry and Technology, Ministry of Development, Ministry of Finance, Turkish Patent Institute, Technology Development Foundation of Turkey, Turkish Academy of Sciences, and the Small and Medium Enterprises Development Organization have also contributed. The Index, which increases entrepreneurship and innovation, has focused competition between universities and hence contributes to the development of the entrepreneurship ecosystem by ranking the universities with respect to entrepreneurship and innovation performance. The index will be renewed and announced each year.

In addition to the Entrepreneurial and Innovative University Index, new mechanisms have been constituted by TÜBİTAK to support especially entrepreneurship as of 2012. In this respect, the *Multiphase Entrepreneurship Grant Program*, *Venture Capital Fund Program* and *Technology Transfer Offices (TTO) Support Program* have been launched for the benefits of the private sector. Furthermore, *Entrepreneurship and Innovation Contests* for high school and college students and the *Support Program for Education and Research Activities on Entrepreneurship and Innovation* have been launched together with including “Entrepreneurship and Innovation” in the priority areas identified under the *International PhD Scholarship Program* for the purpose of raising awareness of entrepreneurship and innovation.

1.2. National Science, Technology and Innovation Strategy (2011-2016)

The National STI Strategy (2011-2016) is the fundamental strategy document comprising of Turkey’s STI vision, priorities, and main objectives for a six year period. With this strategy document, it is aimed to ensure the sustainability of the momentum through the advance in STI for the year 2023. The National STI Strategy (2011-2016) was prepared in a

participatory platform and has been approved on December 15, 2010 at the 22nd meeting of SCST.

Created for the achievement of the national STI vision, the strategic framework of the National Science, Technology and Innovation Strategy (2011-2016) comprises of three vertical axes and six horizontal axes that serve the vertical ones (Figure 1.4). These axes form the

strategic objectives of the National STI Strategy (2011-2016).

Furthermore, the health sector was decided to be one of the need-oriented areas with a demand for gaining acceleration in the National STI Strategy (2011-2016). The health sector has been included within the national prioritized areas in the 25th meeting of SCST.

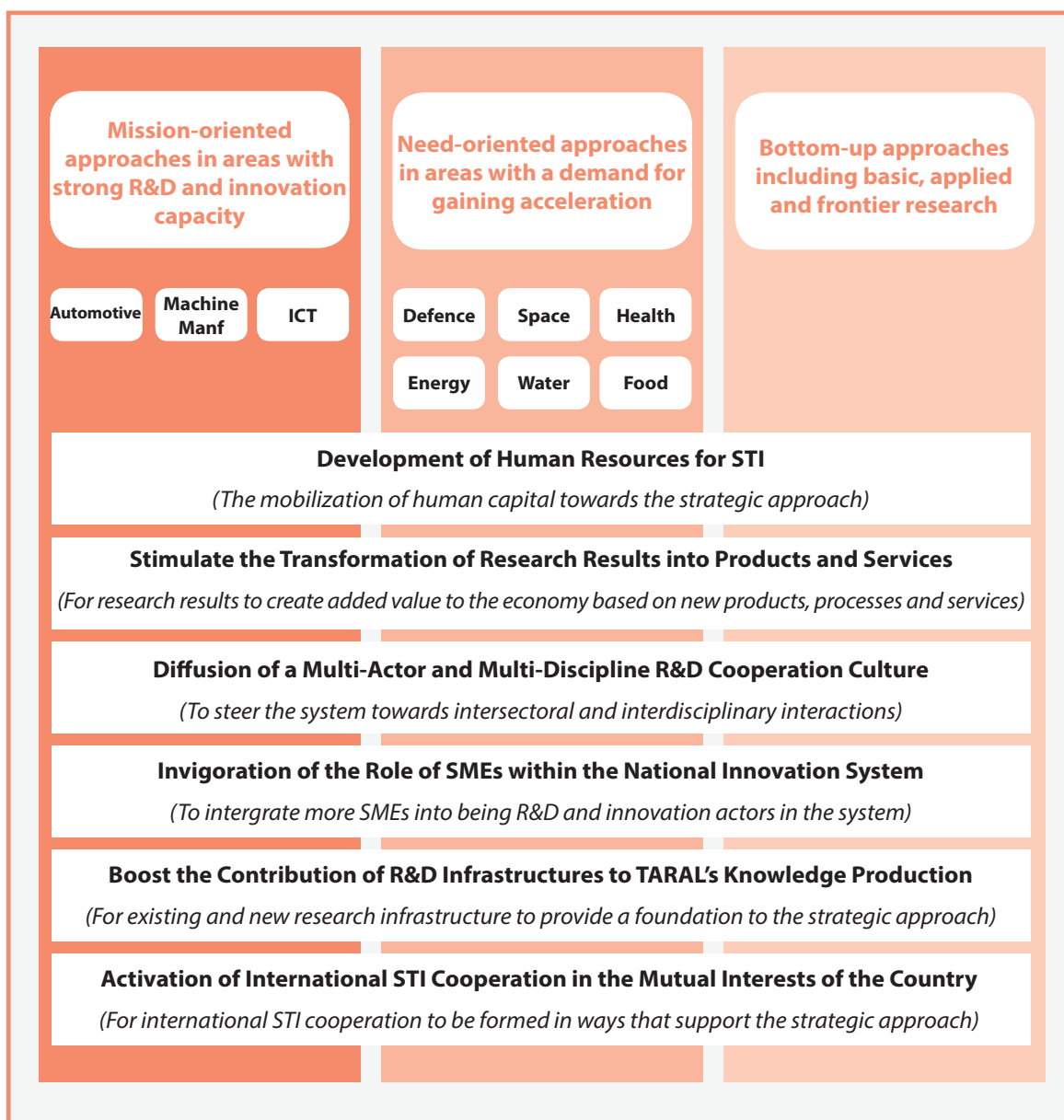


Figure 1.4 Strategic Framework of National STI Strategy (2011-2016)

As seen from Figure 1.4, developing STI human resources is one of the main pillars of Turkish STI policy. Accordingly, it is defined as one of the horizontal axis of National STI Strategy (2011-2016). In order to develop STI human resources, the *Science and Technology Human Resources Strategy and Action Plan 2011-2016* was prepared with the contribution of the related

institutions under the coordination of TÜBİTAK. This Strategy was adopted in the 22nd meeting of SCST and it was decided to be monitored under the National STI Strategy (2011-2016).

The general framework of the Science and Technology Human Resources Strategy and Action Plan (2011-2016) together with strategic objectives is given in Figure 1.5.



Figure 1.5: Strategic Framework of Science and Technology Human Resources Strategy and Action Plan 2011-2016

In another aspect, at the 21st meeting of SCST that was held on June 22, 2010, it was decided to form working groups in the areas of Energy, Water and Food in participation with the related experts from government, higher education, and business enterprise sectors. These stakeholders engaged in activities to prepare the national R&D and innovation strategies in these areas. Consequently, the work was completed and the R&D and Innovation Strategies in the areas of Energy, Water and Food, which were put under the auspices of the Prime Minister, were adopted at the SCST meeting with the decision of monitoring these strategies under the National STI Strategy (2011-2016).

With the National STI Strategy (2011-2016) being monitored by TÜBİTAK, each year, projects and activities that are planned to be carried out in order to fulfill the strategies of the Strategy are reported to the secretariat by the related institutions. The projects and activities are finalized with the contribution of the related institutions under the coordination of TÜBİTAK. Afterwards, the action plan is issued to the institutions for further action by the responsible Minister. Developments within the action plan are submitted to the secretariat biannually by the responsible institutions and reported at the SCST meeting.

1.3. Turkish Industrial Strategy Document (2011-2014)

The Turkish Industrial Strategy Document (2011-2014) was prepared by the Ministry of Science, Industry, and Technology in a participatory approach by consulting representatives of the public and private sectors. The long-term vision of Turkey's strategy is defined as "Becoming the production base of Eurasia in medium and high-tech products". Pursuant to this long-term vision, the overall objective of the Industrial Strategy for Turkey for the period of 2011-2014 is as follows: "Increasing the competitiveness and efficiency of Turkish Industry and expediting the transformation to an industry structure which has more share in world exports, where mainly high-tech products with high added value are produced, which has qualified labor and which at the same time, is sensitive to the environment and the society."

Eight horizontal industrial policy areas have been identified in the Turkish Industrial Strategy Document in which the public sector aims to remove obstacles to private sector's productivity. One of the horizontal industrial policy areas is *Technological Development of Companies*. In this framework, private sector's engagement in R&D, implementation of the Law on the Support of R&D, improvement of the activities of TÜBİTAK, the usage of information and communication technologies more efficiently, and the protection of industrial and intellectual property rights are targeted.





2. R&D Performance of Turkey: Highlights

Taking into account science, technology, and innovation as the basis for a highly competitive and sustainable economy, Turkey has recorded a fast-paced growth in this area in recent years. The consequences of these activities are traced by national STI indicators and Turkey has become a noteworthy and appreciated country in these areas.

Turkey's significant improvements in STI performance indicators are summarized below ⁴:

Investment in R&D

- Turkey has increased GERD to 12.5 billion PPP \$ in 2012, from 2.8 billion PPP \$ in 2000. Turkey exhibited more than three-fold growth rate, which is almost quadruple the rate for OECD and EU27.
- GERD as a percentage of GDP increased from 0.48% in 2000 to 0.92% in 2012 approximately twice the value of 2000. These rates are by far above the 8% for the OECD and 11% for the EU27 averages in the same period. Turkey has set a target to increase to share of R&D investment to 3% of GDP by 2023, which has been agreed by SCST in order to take part in the most developed countries in the field of STI in 2023⁵. This puts forth a significant catching-up

dynamic towards taking sustained strides to reach the 2023 target.

- The business enterprise sector has been the key driver behind the STI impetus of Turkey. The business enterprise sector's R&D expenditures reached to 5.6 billion PPP \$ in 2012, roughly six times its value in 2000. R&D expenditure of business enterprises sector has the biggest share in total R&D expenditures. Turkey targets to increase business enterprise R&D expenditures as a percentage of GDP to 2% by 2023⁵.
- Turkey has fostered a business enterprise sector that outspent the government to become the leading sector to fund R&D for the first time in 2005, reaching a share of funding at 47% of GERD in 2012.

STI Human Resources

- The total number of Full Time Equivalent (FTE)⁶ R&D personnel increased to 105 thousand and FTE researchers to 82 thousand in 2012, which are approximately four times the value of R&D personnel and researchers in 2000, respectively. Thus, significant progress was achieved to reach the target of researchers of 300 thousand by 2023⁵.

⁴ Sources: TurkStat, Thomson's ISI Web of Science, Turkish Patent Institute

⁵ Adopted in the 23rd meeting of SCST, decree number 2011/101

⁶ One FTE is one person-year. Thus, a person who normally spends 30% of his/her time on R&D and the rest on other activities should be considered as 0.3 FTE. Similarly, if a full-time R&D worker is employed at an R&D unit for only six months, this results in an FTE of 0.5.

- Turkey has increased the number of FTE R&D personnel and researchers per 10,000 total employment in 2012 to 42 and 33 from 13 and 11 in 2000, respectively. The presence of a relatively young population is considered as a future asset.
- Turkey has put forth noteworthy dynamics in the distribution of FTE R&D personnel by the main performing sectors of R&D activities, i.e. higher education, business enterprises, and governmental sectors. These dynamics strike the balance of 50% for the business enterprise, 39% for the higher education sector and 11% for the government sector as shares of the total stock in 2012. In contrast, it was 22% for the business enterprise, 63% for the higher education, and 15% for the government sector in 2000.
- The stock of FTE R&D personnel in each sector in which the business enterprise sector outpaced the higher education sector for the first time in 2009 increased more than eight-fold between 2000 and 2012, exceeding 52 thousand in 2012. This shows a parallelism with the dynamics of R&D investment. The number of researchers, which reached more than 35 thousand

in 2012 with nearly nine-fold increase compared to 2000, is targeted to be increased to 180 thousand by 2023⁷.

Scientific Publications and Patents

- The number of scientific publication increased to nearly 25 thousand in 2012. This is nearly a four-fold increase between 2000 and 2012 with an exponential rate.
- The number of domestic patent applications, the field in which more progress was required in the early 2000's, increased to 16-fold between the years 2000-2012. Turkey experienced a boom in the total number of domestic utility model and patent applications being filed to the Turkish Patent Institute, reaching approximately 5 thousand and 4 thousand, respectively.
- The number of international patent applications in terms of Patent Cooperation Treaty (PCT) and triadic patent has an increasing trend. The number of PCT patents originated from Turkey increased to 534, with more than a six-fold growth rate between 2000-2012. Turkey exhibited a five-fold increase in its triadic patent applications between 2000-2011.

⁷ Adopted in the 23rd meeting of SCST, decree number 2011/101



3. R&D and Innovation Investment

In parallel with the increase in R&D and innovation funds since 2004, Turkey put forth a fast-paced, rising trend in R&D expenditures. According to the results of the R&D Activities Survey 2012 conducted by TurkStat, Gross Domestic Expenditure on R&D (GERD) has risen from 2.8 billion in PPP\$ to about 12.5 billion in PPP\$, making more than three-fold increase between the years 2000-2012. The annual distribution of R&D expenditures is provided in Figure 3.1.

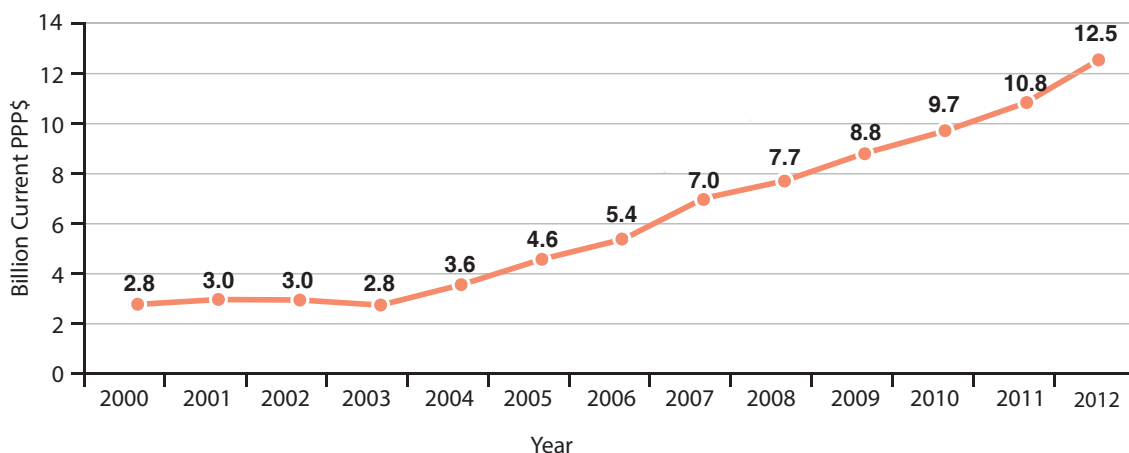


Figure 3.1: R&D expenditures of Turkey (Billion current PPP\$) (Source: TurkStat)

Regarding GERD as a percentage of Gross Domestic Product (GDP), annual increases have been observed. In 2012, the share of GERD in GDP increased to 0.92%, approximately twice the value of 2000 (Figure 3.2). Due to a high growth rate of GDP in Turkey, the resources that are allocated to R&D are required to increase at a rate above the growth rate of GDP in order to reach the 3% target in 2023.

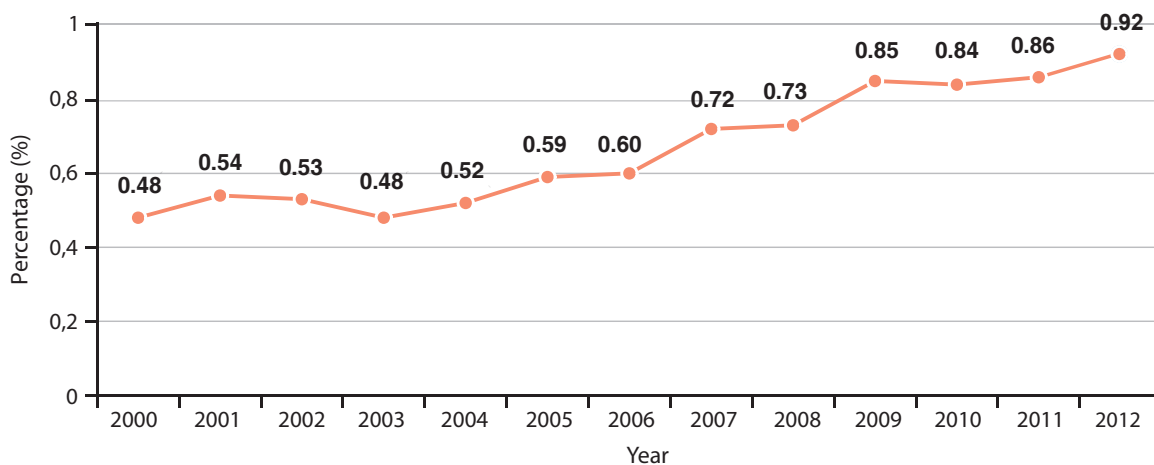


Figure 3.2: GERD as a Percentage of Turkey's GDP (Source: TurkStat)

3.1. GERD by Performing Sectors

GERD by performing sectors is provided in Figure 3.3. The business enterprise sector's R&D expenditures have been increasing substantially over the years as expected. 45.1% of GERD was performed by the business enterprise sector in 2012 and thus the business enterprise sector's R&D expenditure has exceeded the higher education R&D expenditure.

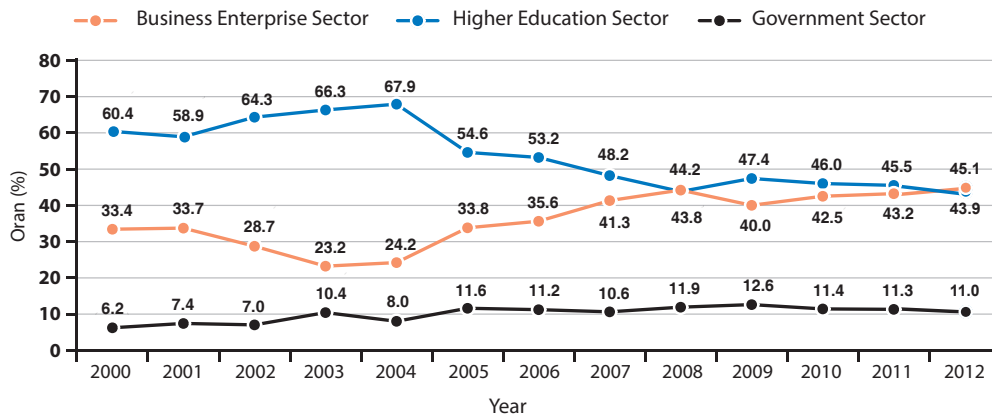


Figure 3.3: Percentage of GERD by Performing Sectors (Source: TurkStat)

3.2. GERD by Source of Funds

Regarding GERD by source of funds, the business enterprise became the leading sector to fund R&D at 41.5% of GERD, outperforming the government sector for the first time in 2005. This trend continued through the years so that the business enterprise funded 46.8% of GERD as the highest funder of R&D in 2012 (Figure 3.4)⁸.

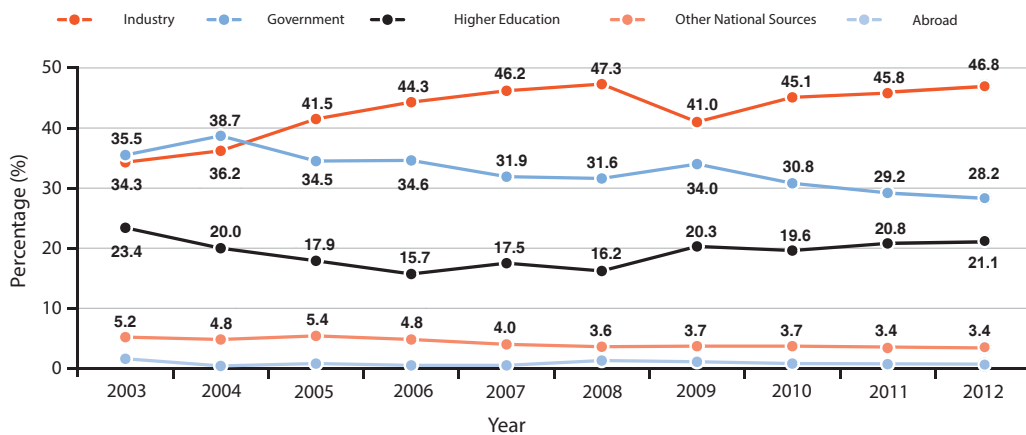


Figure 3.4: Percentage of GERD by Source of Funds (Source: TurkStat)

⁸ Based on a new classification scheme used by TurkStat, the higher education sector has been reported as a separate R&D funding sector.

3.3. Financial Flows for R&D

Table 3.1 gives the financial flows for R&D from source of fund to R&D performing sector in 2012 as a percentage of GERD. The greatest financial flow takes place from the business enterprise to be performed by the business enterprise sector, i.e. self-funding, which reached 40.4% in 2012. Such a profile indicates that

significant capabilities are being accumulated in the business enterprise sector. The business enterprise also provided funds for R&D to be performed in the governmental research institutes at 4.2%. The government self-funded its R&D activities at 10.7% of GERD while the higher education self-funded its R&D activities at 21% of GERD.

Table 3.1: R&D expenditures by sector and source of fund for Turkey (%) (2012)

Performing Sector	Source of Funds					Total
	Industry	Government	Higher Education	Other National	Abroad	
Business Enterprise	40.4	4.2	0.0	0.1	0.3	45.1
Government	0.2	10.7	0.0	0.0	0.1	11.0
Higher Education	6.1	13.3	21.0	3.3	0.2	43.9
Total	46.8	28.2	21.1	3.4	0.6	100.0

Source: TurkStat

3.4. Promoting R&D, Innovation and Entrepreneurship in Business Enterprise Sector

Promoting technological and innovation-driven research as well as innovative entrepreneurship is one of the vital aspects of improving the efficiency of the National Innovation and Entrepreneurship System. For this reason, the target is to increase the share of the business enterprise sector in R&D expenditures to 2/3 by 2023 and to stimulate the business enterprise sector in partaking even more actively in STI.⁹ With an aim to increase technology development capability, innovation culture, and competitiveness of Turkish companies, the Ministry of Science, Industry and Technology, TÜBİTAK, the Small and Medium Enterprises Development Organization (KOSGEB), and the Technology Development Foundation of Turkey (TTGV)

deployed policies that provide finance to the R&D activities of the business enterprise sector.

For example, TÜBİTAK Technology and Innovation Grant Programs Directorate (TEYDEB) funds project-based R&D activities in order to support research, technological development and innovation activities of Turkish firms. TÜBİTAK TEYDEB aims to contribute to enhance the ability of research, technological development, innovation culture and competitiveness of the Turkish industry. TÜBİTAK TEYDEB executes the *Industrial R&D Projects Grant Program*, *Project Brokerage Events Grant Program*, *University-Industry Collaboration Grant Program*, *SME RDI (Research, Development & Innovation) Grant Program* and *International Industrial R&D Projects Grant Program*.

In 2012, four new funding mechanisms were announced by TÜBİTAK TEYDEB. The purpose of these programs are utilizing existing capacity in different areas, developing unique technologies, and increasing technological

⁹ Adopted in the 23rd meeting of SCST, decree number 2011/101.

competence and knowledge accumulation in priority areas in accordance with the National STI Strategy (2011-2016) objectives.

The new support programs and their brief descriptions are as follows:

- *Multiphase Entrepreneurship Grant Program* encourages qualified entrepreneurship and supports the establishment of new, internationally competitive start-up firms who develop innovative and high-level technology products and processes by encouraging entrepreneurs who have an innovative business idea.
- As a part of a mission-oriented approach in R&D funding, *The Research, Technology Development and Innovation Projects in Priority Areas Grant Program* aims at increasing research-technology development capability and competitiveness of the companies in priority areas of Turkey. In this regard, call for proposals in the areas of energy, food, automotive, machine and manufacturing and ICT are announced initially.
- *Technology Transfer Offices (TTO) Support Program* aims at supporting TTO's with

the aim of commercializing knowledge and technology conducted at universities. The TTOs assist the transformation of these assets into implementations, formation of university-industry collaboration, and the production of knowledge and technology at universities according to the needs of the industry.

- *Venture Capital Fund Program* is another new program designated to fund venture capital firms.

The number of project proposals, total grants and applicant firms for all of the grant programs of TÜBİTAK TEYDEB between the years 2000-2012 are given in Figure 3.5 and 3.6. According to the recent dynamics, the number of project proposals has increased to 2,818 that is approximately a 10-fold increase in 2012 with reference to 2000. During the same period, the amount of the grants provided for the funded projects increased to more than 6-fold, reaching 288 million PPP\$ in 2012. The funded projects triggered to about 466 million PPP\$ in R&D expenditures in 2012. While the number of applicant firms was 176 in the year 2000, it reached to 1,822 in 2012. Similarly, the number of applicant firms for the first time was 99 in 2000 and increased to 946 in the year 2012.

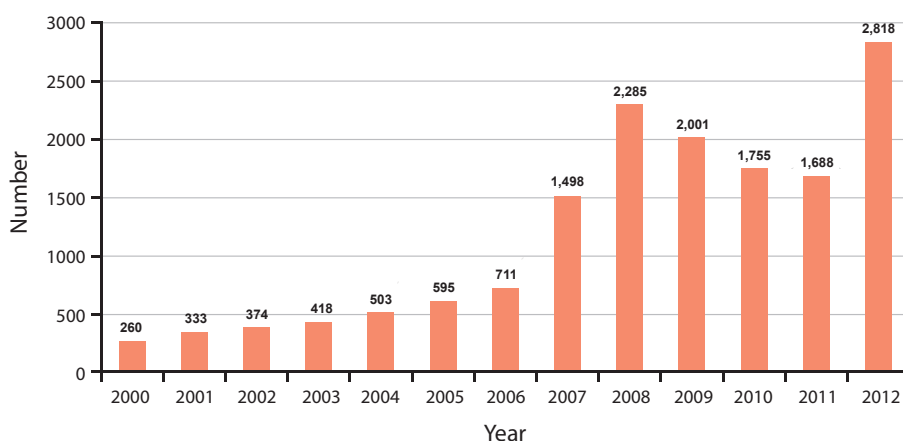


Figure 3.5: The Number of Project Proposals for the Grant Programs of TÜBİTAK TEYDEB

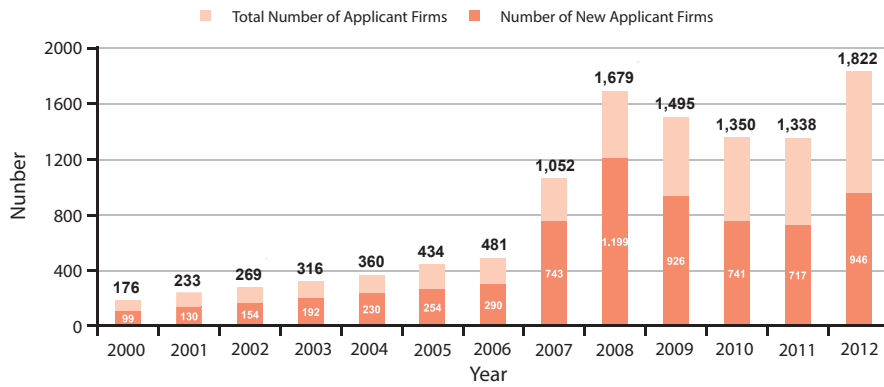


Figure 3.6: The Number of Applicant Firms for the Grant Programs of TÜBİTAK TEYDEB

The Ministry of Science, Industry and Technology implement the Industrial Graduate Thesis (SAN-TEZ) Program since 2007. SAN-TEZ projects stimulates co-operation between firms and universities by providing support to graduate students developing new, technology-based products and processes in their graduate (M.S. and PhD) theses. In particular, it seeks to

transform graduate research into innovative products and processes that engages in and addresses the needs and requirements of the industry. In this regard, the total number of project applications has been 1,675 and the number of supported projects has been 666 in total between 2006-2012 (Table 3.2).

Table 3.2: Number of Projects and Amount of Support within the Context of SAN-TEZ Program
(Source: Ministry of Science, Industry and Technology)

Year	2006	2007	2008	2009	2010	2011	2012	Total
Number of Project Applications	42	183	118	176	246	415	495	1675
Number of Supported Projects	17	68	45	76	111	192	157	666
Amount of Support*	5.9	11.5	16.8	21.8	23.1	29.1	58.5	166.7
Ministry Payment*	0.0	7.2	11.1	14.7	19.6	42.5	27.3	122.5

* Million PPP\$

The support for the establishment of Technology Parks (the Law on Technology Development Zones) of the Ministry of Science, Industry and Technology, which came into force in 2001, promotes the use of high/advanced technologies and the development/production of technology or software in Technology Development Zones through cooperation between universities, research institutions, and production sector. As of 2012, there are 49 Technology Development Zones in Turkey (in the provinces of Ankara

(6), İstanbul (5), Kocaeli (4), İzmir (2), Konya, Antalya, Kayseri, Trabzon, Adana, Erzurum, Mersin, Isparta, Gaziantep, Eskişehir, Bursa, Denizli, Edirne, Elazığ, Sivas, Diyarbakır, Tokat, Sakarya, Bolu, Kütahya, Samsun, Malatya, Şanlıurfa, Düzce, Çanakkale, Kahramanmaraş, Tekirdağ, Van, Manisa and Çorum). 34 of these Technology Development Zones are active and the remaining are in progress. The number of companies, personnel, and projects in the technology development zones are provided in Figures 3.7, 3.8, and 3.9.

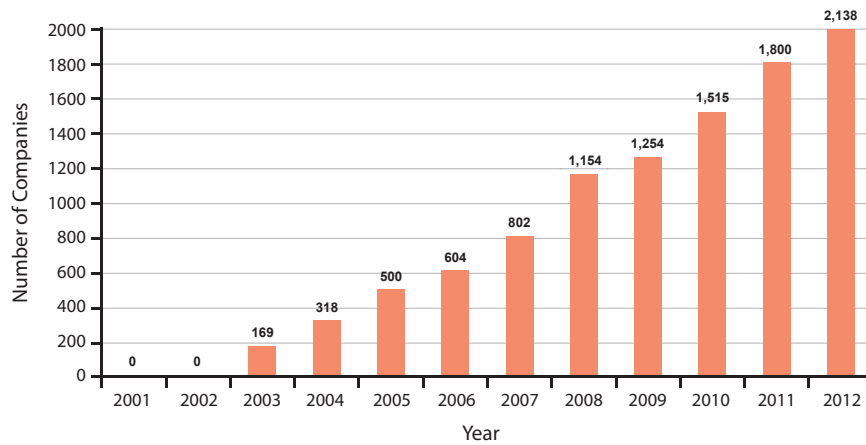


Figure 3.7: Number of Companies in Technology Development Zones
(Source: Ministry of Science, Industry and Technology)

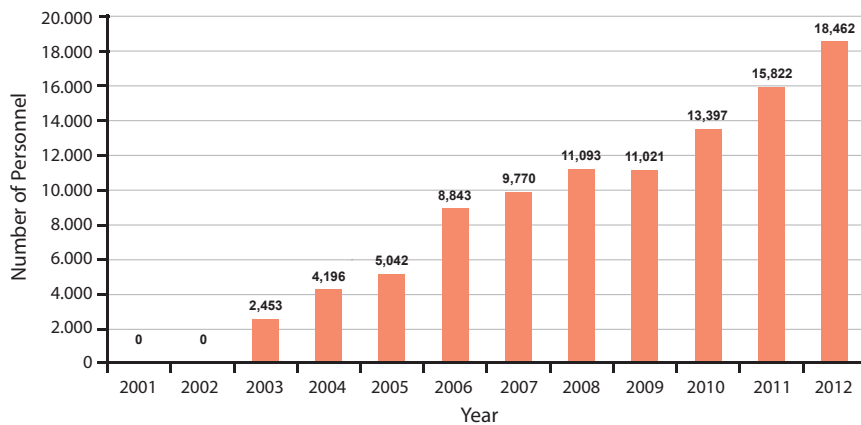


Figure 3.8: Number of Personnel Employed in Technology Development Zones
(Source: Ministry of Science, Industry and Technology)

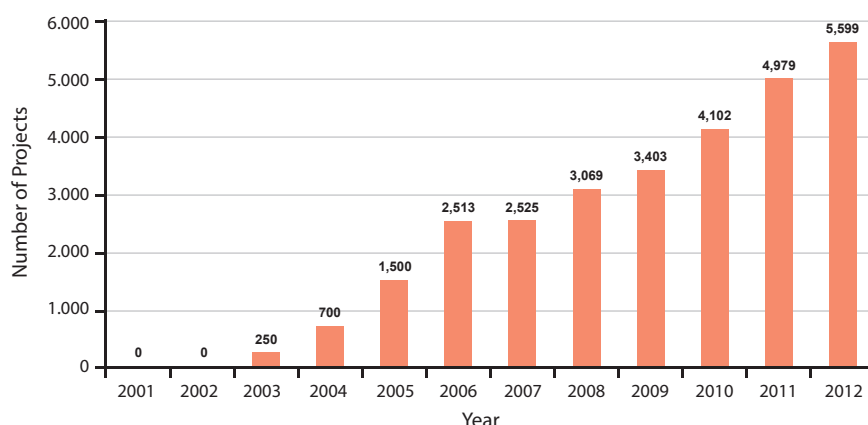


Figure 3.9: Number of Projects Implemented in Technology Development Zones
(Source: Ministry of Science, Industry and Technology)

There are various R&D tax incentive practices in world, especially in the OECD countries. In Turkey, the Law on Supporting Research and Development Activities (No. 5746) was issued in 2008 concerning R&D tax incentives. The incentives will be applied with this Law in all of the R&D and innovation expenditures mentioned below until the year 2023:

- R&D expenditures incurred in the R&D centers employing at least fifty full time equivalent R&D staff
- Public institutions, R&D and innovation projects supported by public enterprises

and establishments, foundations established pursuant to the Law or projects supported by international funds

- Pre-competition cooperation projects
- R&D expenditures incurred in the enterprises functioning as technology centers
- Enterprises benefit from the capital support provided to techno enterprises

Support and incentives provided under this law in the years of 2012 are given in Table 3.3.

Table 3.3: R&D Tax Allowance in terms of Income Tax Law, Corporate Tax Law and Law on Promoting Research and Development Activities (2012)

	R&D Tax Allowance	Number of Beneficiaries	Tax Allowance (Million Current PPP\$)
Income Tax	Income Tax Law	62	3.2
	Law on Promoting Research and Development Activities	58	13.9
Corporate Tax	Corporate Tax Law, Article 10/1-a	245	107.9
	Law on Promoting Research and Development Activities, Article 3	544	1848.8

Source: Ministry of Finance

By means of exemptions provided to enterprises by the Law on Supporting Research and Development Activities (No. 5746), R&D infrastructure in Turkey is constituted. In addition, this gives an opportunity for large enterprises that employ a large number of R&D personnel and contribute to the share of R&D expenditures in GDP to further develop these infrastructures and to produce their own technologies. During the period of 2008 (after the publication of the Regulation in July 2008) to 2012:

- 157 applications are submitted to establish R&D center.

- 131 enterprises were found eligible to establish R&D center.
- 136 R&D centers are in operation.

The Techno-Entrepreneurship Capital Support Program, which was initiated by TÜBİTAK in 2007 in order to encourage technology and innovation-based entrepreneurship, became more appealing after the Law No: 5746 was issued. The support program has been implemented by the Ministry of Science, Industry and Technology since 2009. The annual budget of the program has increased substantially as of 2011. The number of applications and supported projects are given in Table 3.4:

Table 3.4: Number of Applications and Supported Projects for Techno-Entrepreneurship Capital Support Program

Year	Number of Applications	Number of Entrepreneurs Found Eligible for Support	Number of Supported Entrepreneurs (who sign-up contract)
2009	159	83	78
2010	724	100	102
2011	859	288	272
2012	1,597	296	288

Source: Ministry of Science, Industry and Technology

The Regulation of KOSGEB Support Programs was promulgated in the Official Gazette on June, 15 2010 and shortly after, the *General Support Program*, *SME Project Support Program*, *Thematic Project Support Program*, *Entrepreneur Support Program*, *R&D, Innovation and Industrial Application Support Program* and *Cooperating-*

Leaguig Support Program were initiated in 2010. Together with *Emerging Enterprises Market SME Support Program*, which was launched in 2011, the number of support programs reached seven. The amount of support that is provided by KOSGEB is provided in Table 3.5:

Table 3.5: Amount of Support Provided by KOSGEB

Support Program	2010		2011		2012	
	Number of Enterprises	Amount of Support*	Number of Enterprises	Amount of Support*	Number of Enterprises	Amount of Support*
General Support Program	1,910	5.2	15,387	65.6	19,065	92.8
R&D, Innovation and Industrial Application Support Program	116	4.4	830	42.0	1,193	62.9
Entrepreneur Support Program	43	0.4	2,416	25.5	4,984	50.0
SME Project Support Program	3	0.3	630	19.9	1,814	54.8
Cooperating-Leaguig Support Program	3	1.4	46	12.1	84	20.2
Thematic Project Support Program	-	-	8	0.2	18	0.4
Emerging Enterprises Market SME Support Program	-	-	-	-	3	0.1

*Million current PPP\$

Source: KOSGEB

KOSGEB supports incubators, namely Technology Development Centers (TEKMERs) as well. There are 31 TEKMERs established in 22 provinces throughout the country as of 2012.

The Technology Development Foundation of Turkey (TTGV) supports R&D that will enable enterprises to make the best of their technological development potential so that the developed technologies serve Turkish Enterprises to achieve a competitive position in

the global market. In this context, the *Technology Development Project Support Program (TGP)* and *Advanced Technology Projects Support Program (İTEP)* are implemented. Moreover, with the *Environmental Supports Program*, financial support is supplied to the implementation of projects that are completed by industrial establishments in the fields of environmental technologies (cleaner production/sustainable production) and energy efficiency (Table 3.6).

Table 3.6: Amount of Support Provided by TTGV (Million current PPP\$)

Year	R&D Project Supports (TGP + İTEP)	Commercialization Project Supports	Environmental Project Supports
2000	46.3	-	4.2
2001	40.6	-	4.7
2002	21.9	-	12.7
2003	30.3	-	3.6
2004	33.2	-	1.7
2005	26.0	-	1.0
2006	37.0	-	2.1
2007	31.9	1.0	3.7
2008	40.2	1.8	4.3
2009	41.5	1.0	3.8
2010	27.0	-	2.7
2011	21.0	-	4.7
2012	7.1	-	3.1
Total	404.2	3.8	52.3

Source: TTGV

3.5. Promoting Academic R&D

Nowadays, universities and research institutions reinforce the role of transforming knowledge into innovation and boosting economy in addition to the role of developing qualified human resources through education and knowledge production through research. Universities, by this way, function as “knowledge hubs” that support the innovation and entrepreneurship ecosystem in the national innovation system¹⁰. Accordingly, the institutions like TÜBİTAK and the Ministry of

Development provide funds for high quality, result-oriented research, including those to promote curiosity-driven academic R&D to sustain innovation.

The Ministry of Development is responsible for preparing the *Technological Research Sector Investment Budget*, which includes resources allocated for TARAL under the coordination of TÜBİTAK programs. The Ministry of Development’s Technological Research Sector Budget between the years 2003-2012 is given in Figure 3.10.

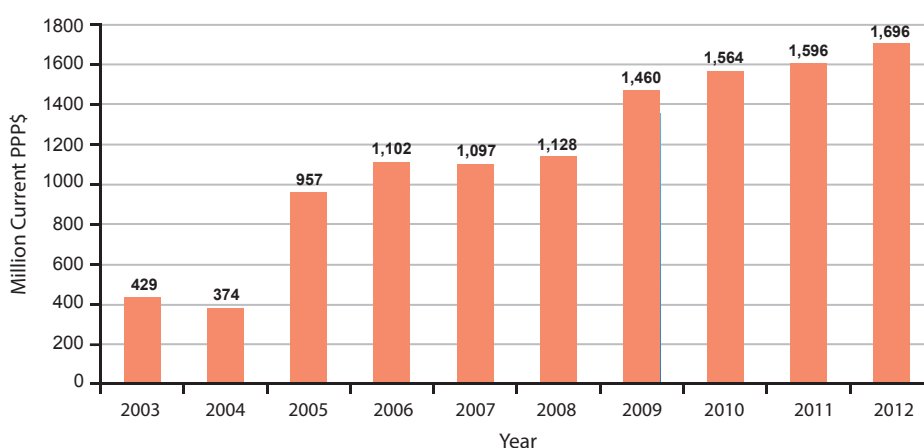


Figure 3.10: Technological Research Sector Investment Budget of Ministry of Development (Source: Ministry of Development)

TÜBİTAK Academic Research Funding Programs Directorate (ARDEB) funds R&D activities of researchers for knowledge and technology production and transforming the outputs into products and/or processes in accordance with global advances and national priorities. TÜBİTAK ARDEB executes the *Grant Program for Scientific and Technological Research Projects*, *Short-Term R&D Funding Program*, *Program for Participation in International Scientific Research Projects*, and *National Young Researchers Career Development Program*.

Along with the trend of moving towards a mission-oriented approach in R&D funding within the framework of the new vision of TÜBİTAK, the *Priority Areas R&D Funding Program* was established in 2012 in order to support R&D projects in the priority areas. In this respect, 944 project proposals were submitted to TÜBİTAK ARDEB in 2012. Within the scope of this program, result-oriented domestic projects with monitorable objectives in the priority areas that were determined in the National STI Strategy (2011-2016) are targeted

¹⁰ Youtiea, J. ve Shapira, P. (2008) “Building an innovation hub: A case study of the transformation of university roles in regional, technological and economic development.” *Research Policy* 37: 1188–1204

to be supported together with ensuring coordination between projects.

Figure 3.11 indicates the surge in the number of project proposals submitted to TÜBİTAK ARDEB between the years 2000-2012. As the number of project proposals was 946 in the year of

2000, the number of project proposals reached to 6,107 in 2012 with a six-fold increase. A total of 6 million PPP \$ in grants that were provided in 2000 increased to 160 million PPP \$ in 2012 parallel to the increase in R&D and innovation funds.

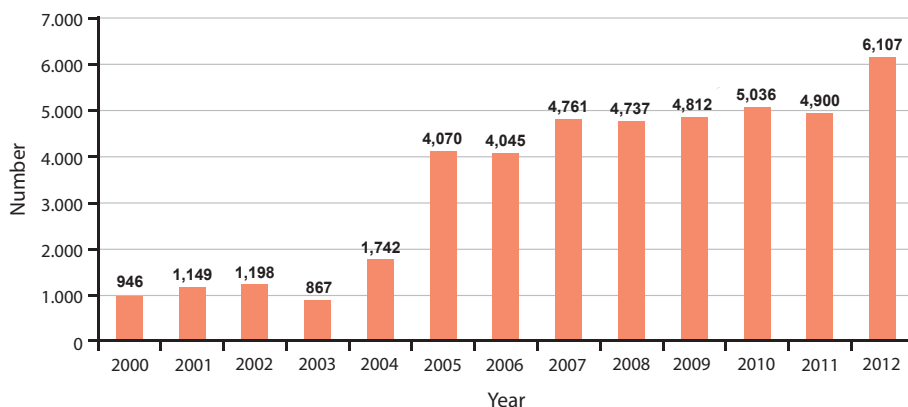


Figure 3.11: The Number of Project Proposals for the Grant Programs of TÜBİTAK ARDEB

At the institutional level funding, the Ministry of Finance diverts funds to public higher education institutes under the *Scientific Research Program* (BAP) with which each institute has their own mechanisms for allocating this fund to R&D projects. While the amount of scientific project funds of higher education institutes was 113 million PPP\$ in 2003, it reached to about 600 million PPP\$ in 2012.

Infrastructure is an essential element for promoting both academic and private R&D activities. Research infrastructures established in the public sector, private sector, universities, and research institutes serve as a tool to focus, organize, and direct processes of knowledge acquisition, learning, and transformation. In this respect, the Ministry of Development provides funds for the establishment of sustainable research infrastructures in line with national and regional priorities, responding to the needs of public and private sectors and building up the environment supporting qualified researchers

and their collaboration. The Ministry of Development provides supports under two schemes. The *Thematic Advanced Research Centers* supports, research centers in well-established universities and public research organizations having sufficient human power with expertise in a priority area and competence on the subject area on a national scale. There were 81 Thematic Advanced Research Centers projects in the Investment Program of 2012. Moreover, 7 projects in foundation universities are in progress. Through the *Central Research Laboratories* supports, research centers that are capable of carrying out advanced research projects in the universities are established. In this context, a total of 81 *Central Research Laboratories* were included in the Investment Program, namely 4 in 2012, 8 in 2011, 54 in 2010, 10 in 2009 and 5 in the previous years.

The “Cooperation Protocol About Performance Monitoring and Evaluation of Competence of Research Centers of Higher Education” was

signed between the Ministry of Development and TÜBİTAK on May 7, 2012. This Protocol provided for the classification, performance measurement, monitoring efficacy and assessment of current and future research centers, in conjunction with the universities, to ensure more efficient operation and sustainability. Thus, a system that provides state fund to the research centers based on their performance has been established and a structure, which provides a framework for the research centers to co-exist with the universities and to be partially independent from them and to have their own management model has been created.

3.6. Strengthening Demand for R&D and Innovation through Public Procurement

With the aim of satisfying R&D needs and solving the problems of public institutions by means of R&D projects, TÜBİTAK has launched the *Support Program for Research Projects of Public Institutions* by SCST decree on March 10, 2005. The funding program has been revised in the year of 2012 and transformed into a mission-

oriented mechanism. Accordingly, an analysis is conducted for the determination of R&D needs of public institutions with a contribution of experts from the related public institutions, the Ministry of Development, Ministry of Economy, and TÜBİTAK. In this process, a focus group identifies the needs of public institutions and accordingly, calls for proposals are prepared.

The projects proposed are assigned to one of the following units according to the subject of the project. These units are the *TÜBİTAK Public Research Grant Group (KAMAG)* and *TÜBİTAK Defense and Security Technologies Research Grant Group (SAVTAG)*. The number of project proposals submitted to TÜBİTAK KAMAG and SAVTAG are provided in Table 3.7.

Legislative changes have been made as mentioned above and the first call was announced in the second part of 2012 after the determination of R&D needs and prioritization of public institutions. It is expected that the number of project proposals is going to increase substantially in 2013 with the mission-oriented approach.

Table 3.7: Number of Project Proposals Submitted to TÜBİTAK KAMAG and SAVTAG

	2008	2009	2010	2011	2012
TÜBİTAK KAMAG	169	91	114	147	68
TÜBİTAK SAVTAG	8	7	4	9	4

3.7. Enhancing International S&T Cooperation

Science and technology have started taking an important role in international relations for all developed countries in the 21st century. Accordingly, conceiving policies, designing tools, and building collaborations within the perspective of international relations is an important strategy that aims to improve and highlight the STI capabilities of Turkey on a global scale.

Turkey attaches considerable importance to enhancing international cooperation and putting STI cooperation agreements into action. In 2012 TÜBİTAK had 26 bilateral S&T cooperation agreements with institutions from 22 different countries in which joint research projects are supported and monitored. There were approximately 400 international projects going on as of 2012.

Turkey participates actively in the European research programs or schemes, such as COST (European Cooperation in Science and Technology), EUREKA, ESA (European Space Agency), ESF (European Science Foundation), and EMBC (European Molecular Biology Conference), as well as regional organizations, such as BSEC (Black Sea Economic Cooperation), ECO (Economic Cooperation Organization) and international organizations, such as NATO, OECD, UNESCO etc.

TÜBİTAK also enhances relations with Turkish scientists living and working abroad for incorporating them into the Turkish Innovation and Entrepreneurship System. In this respect,

the first Congress for Turkish Scientists Living Abroad was held in 2012. Moreover, a study is being carried out for creation a database for Turkish scientists living abroad.

In an STI framework in which international cooperation in R&D gains increasing prominence, Turkey has been participating in the EU Framework Programs (FP) as an associate country since FP6. Within the scope of awareness-rising activities since FP6, many events are organized in Turkey including education for project preparation and project management. In addition, for increasing participation, specific support programs are initiated, and electronic newsletters and e-learning applications have been put into practice. The participation in not only EU Framework Programs, but also other international programs has increased both in quality and quantity and hence researchers have started benefiting from opportunities effectively. This has been a result of technical and financial support activities, award programs, European Research Area and Turkish Research Area analysis on calls, and lobbying activities directed to the European Commission and other EU bodies related to science and research developed for various needs and information levels of stakeholders.

Since the beginning of FP7 in 2007, the amount of support received by Turkey has reached to 370 million TL. Turkish SME's have received 88 million TL funded by FP7. 177 Turkish researchers have returned to Turkey by scholarship program on brain gain.

Turkey has been a member of EUREKA, which is a critical platform supporting international strategic partnerships formed by businesses, research centers, and universities carrying out market-oriented research projects since its outset in 1985 and is now considered to be the “Shining Star” of the EUREKA Program. Turkey has been holding EUREKA Program chairmanship between the dates July 2012 and June 2013. In the period 2010-2012, 120 Turkish

companies took part in 42 projects under the EUREKA Program coordinated by TÜBİTAK.

“Science and Research” is the only chapter which has been provisionally closed at the EU accession negotiations started in October 2005. This progress, which reflects the STI momentum of Turkey in recent years, advances Turkey in the EU accession process and it is believed that this achievement serves as the model for other chapters.



4. Human Resources in Science, Technology and Innovation

It is well known that societies in which science, technology and innovation become engines of development attach great importance to human resources for science and technology in the world. One of the most important goals of Turkey's R&D impetus is strengthening human capital. In parallel with increases in R&D expenditures, increases in the number of STI human resources exhibits that Turkey has boosted in this field. It is remarkable that this leap is driven mainly by the business enterprise sector.

According to the results of R&D Activities Survey 2012 conducted by TurkStat, the stock of full-time equivalent (FTE) R&D personnel and researchers have reached nearly 4-fold in quantitative terms between 2000 and 2012. Accordingly, the total number of FTE R&D personnel reached about 105 thousand and FTE researchers to 82 thousand in 2012 (Figure 4.1). A similar increase is also observed in the number of R&D personnel and researchers per 10,000 of total employment. The number of R&D personnel and researchers per 10,000 of total employment in 2012 has risen to 42 and 33, respectively (Figure 4.2).

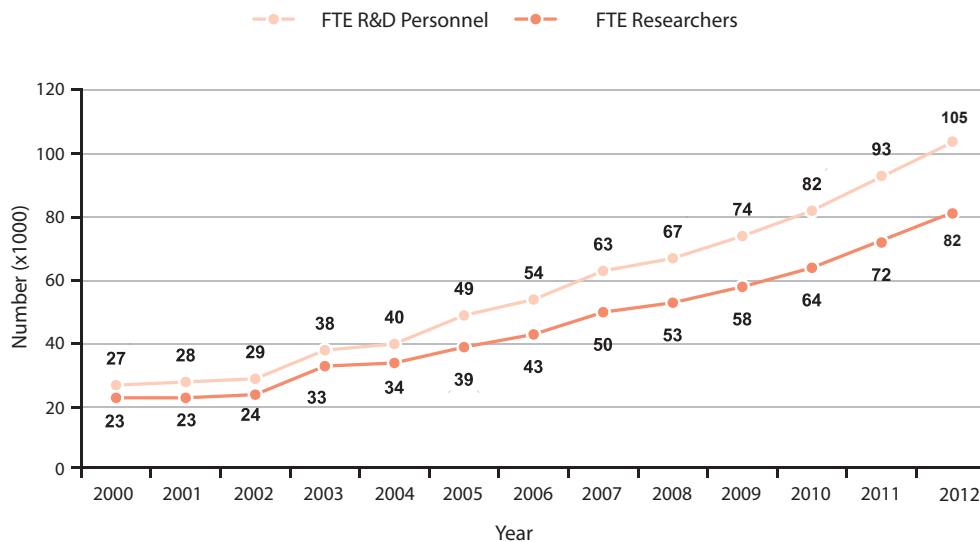


Figure 4.1: Number of FTE R&D Personnel and Researchers
(Source: TurkStat)

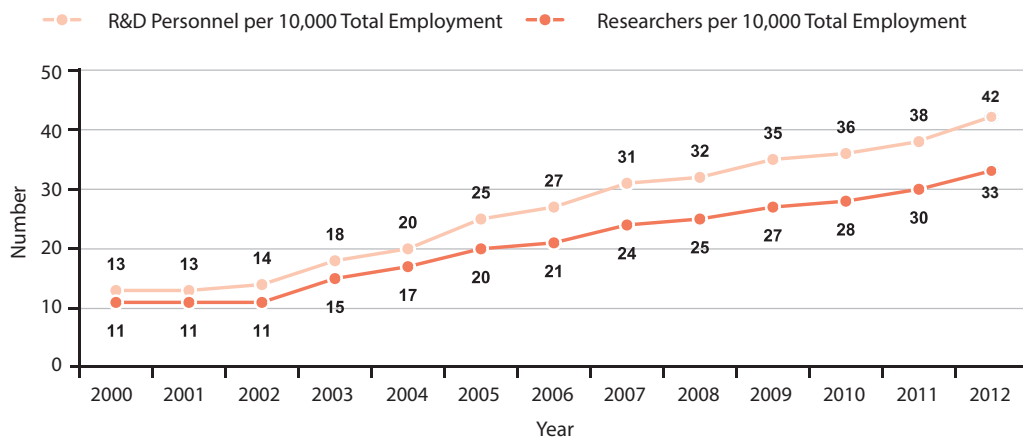


Figure 4.2: Number of FTE R&D Personnel and Researchers per 10,000 of Total Employment in Turkey (Source: TurkStat)

4.1. Distribution of STI Human Resources by Sectors and Occupation

The stock of FTE R&D personnel and researchers in each of the main performing sectors of R&D activities, i.e. higher education, business enterprise, and governmental sectors, increased remarkably (Figure 4.3). Most impressively, the highest increase was in the number of business enterprise sector's R&D

personnel, which has outformed the higher education sector since 2009. Between the years 2000-2012, FTE R&D personnel in the business enterprise sector exhibited nearly an 8-fold growth rate and reached over 52 thousand in 2012. In the total stock of FTE R&D personnel, these dynamics strike the balance of 50% for the business enterprise and 39% for the higher education sectors with 11% for the government sector in 2012 (Figure 4.4).

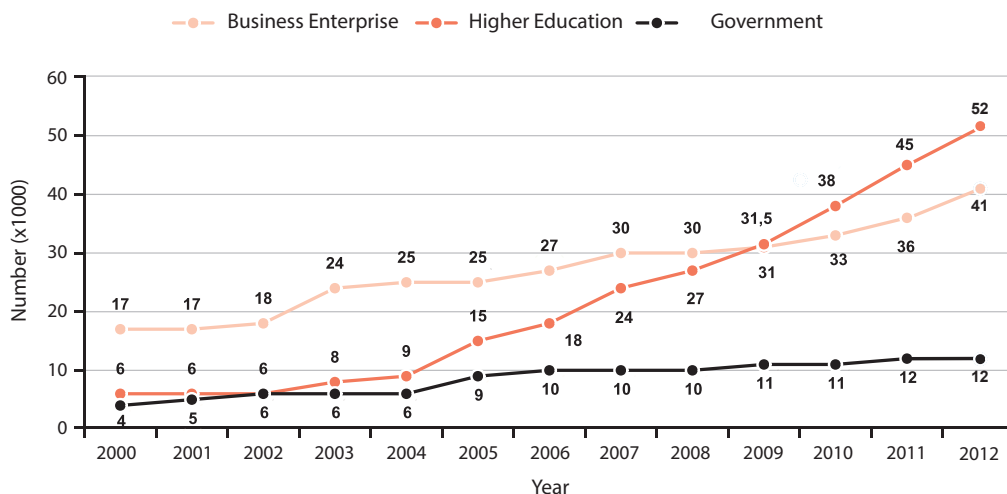


Figure 4.3: Number of FTE R&D Personnel by Sector of Employment (Source: TurkStat)

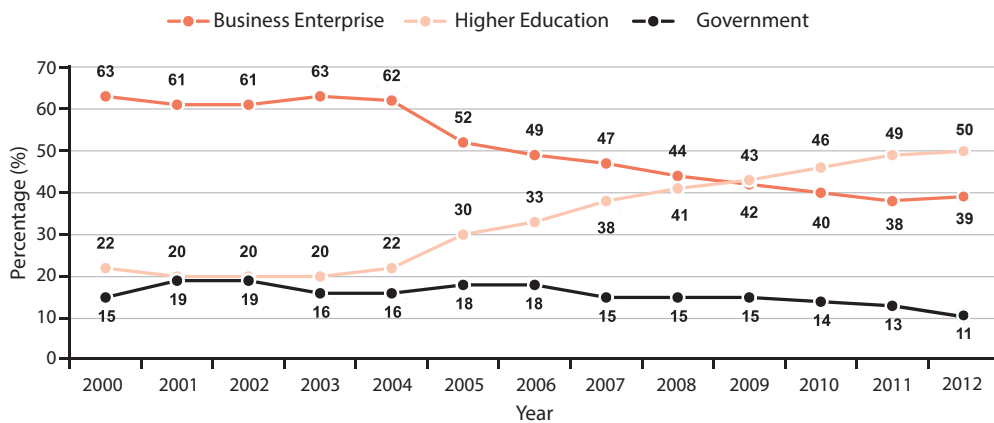


Figure 4.4: Share of FTE R&D Personnel by Sector of Employment (Source: TurkStat)

Considering the distribution of FTE R&D personnel by sector of employment, FTE researchers have maintained the largest share in the total stock of FTE R&D personnel in the period between 2000 and 2012. The number of FTE researchers has risen to 82 thousand in 2012

where it was 23 thousand in 2000. Although the stock of technicians and equivalent staff and other supporting staff increased over the years, the numbers are low compared to the number of researchers (Figure 4.5).

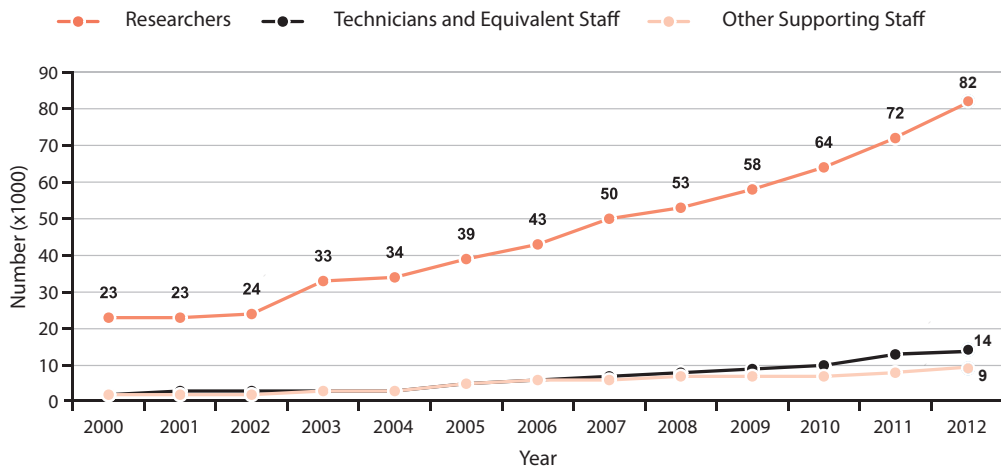


Figure 4.5: Number of FTE R&D Personnel by Occupation (Source: TurkStat)

4.2. Sustaining the Development of Human Resources for Science, Technology and Innovation

The development of human resources that meet the needs of the country has a vital importance to increase the number of R&D-oriented firms, entrepreneurship and commercialization of R&D and innovation activities. Accordingly,

new instruments and programs have been designed in this area. Currently, the diversity of programs for the development of STI human resources are implemented primarily by TÜBİTAK, Ministry of Science, Industry and Technology, Ministry of Development, the Council of Higher Education and Ministry of National Education. Implementation of support programs effectively and incremental budget

of these programs lie behind the increase in the number of STI human resources in recent years.

TÜBİTAK mainly supports STI human resources through the programs of its respective directorate, *Department of Science Fellowships and Grant Programs (BİDEB)*. On the one hand, TÜBİTAK BİDEB conducts programs for supporting scientist. On the other hand, TÜBİTAK BİDEB creates opportunities for improvement and development of the capacities of future scientists. TÜBİTAK BİDEB conducts more than 30 programs at various levels from elementary students to post-doctoral researchers.

In the year of 2012, TÜBİTAK BİDEB has announced new support programs, namely *Co-Funded Brain Circulation Scheme, Project Training Activities Support Program and Graduate Scholarship Program for The Least Developed Countries*. In the context of the Graduate Scholarship Program for The Least

Developed Countries, TÜBİTAK BİDEB aims to give scholarships for graduate students from Least Developed Countries (LDCs) in Turkish universities for improving science and technology capacity of LDCs and building scientific and socio-economic bridge between LDCs and Turkey. The Co-Funded Brain Circulation Scheme gives experienced international researchers the opportunity to carry out research and work especially in priority areas in academic or industrial institutions established in Turkey. In terms of the Project Training Activities Support Program, project writing, training and similar activities for PhD students and researchers are planned to be supported.

The amount of grants provided by TÜBİTAK BİDEB is provided in Figure 4.6. As can be clearly seen from Figure 4.6, the amount of support provided for scientists has increased significantly over the years and reached over 81 million PPP\$ in 2012.

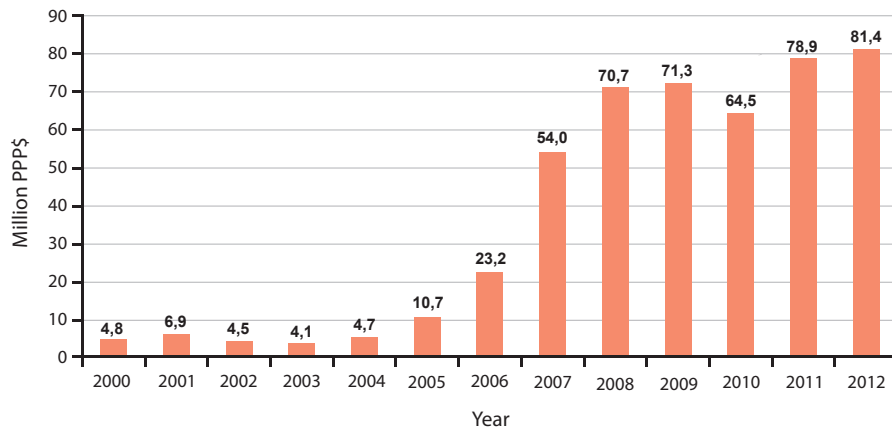


Figure 4.6: Amount of Grant Provided by TÜBİTAK BİDEB

Raising public awareness on science is an area under the auspices of the Prime Minister together with the development of STI human resources. In this respect, TÜBİTAK will establish science centers for children in all of the metropolitan cities of Turkey until 2016 and in every city in Turkey until 2023. Furthermore, both for encouraging creativity and entrepreneurship at the university level and bringing alternative energy sources to the agenda, Alternative Energy Vehicle Races are organized by TÜBİTAK. The support program that is titled Nature Education and Science Camps/Schools reaches approximately 40,000 people. The amount of sale of 497 popular

science books reached to 13.5 million. Every month, about 200,000 people purchase the magazines of *Science and Technology*, *Science and Kids* and *Curious Puppy* published by TÜBİTAK. All these initiatives and activities are ongoing under the *Department of Science and Society Programs* of TÜBİTAK.

The Council of Higher Education (YÖK) conducts the following programs: *Graduate/Postdoctoral Research Programs*, *PhD Scholarship Program*, *Research Program for Faculty Members*, *Scientific Human Resources Development Program (ÖYP)* and *Farabi Exchange Program*. Data on support programs carried out by YÖK are presented in Table 4.1, 4.2 and 4.3 as of 2012:

Table 4.1: Support Programs on Development of Scientist (Source: YÖK)

Research Support Programs	Year	Number of Applications	Number of Supported People
Master's Degree Research Support	2009	13	11
	2010	58	55
	2011	95	90
	2012	87	85
Doctoral Research Support	2009	187	164
	2010	195	177
	2011	171	154
	2012	109	101
Postdoctoral Research Support	2009	30	26
	2010	137	131
	2011	172	167
	2012	148	140
Research Support for Faculty Members	2009	-	-
	2010	95	88
	2011	1,623	1,588
	2012	1,315	1,307

Source: YÖK

Table 4.2: FARABI Exchange Program Support Data

Period	Number of Students	Number of Faculty Members
2009-2010 Autumn/ Autumn + Spring	302	19
2009-2010 Spring	235	2
2010-2011 Autumn / Autumn + Spring	1,605	26
2010-2011 Spring	425	-
2011-2012 Autumn / Autumn + Spring	2,300	-
2011-2012 B Spring	608	-
2012-2013 Autumn / Autumn + Spring (Approximately)	7,018	-
Total	12,493	47

Source: YÖK

Table 4.3: YÖK Support Data (Million PPP\$)

Year	Support Programs on Development of Scientist *	FARABI Exchange Program	Scientific Human Resources Development Program (ÖYP)
2009	4.4	0.9	0.0
2010	8.9	3.9	0.0
2011	30.3	6.8	14.3
2012	25.5	16.6	39.0

Source: YÖK

* Includes the total amount of support for Graduate/Postdoctoral Research Programs, and Research Program for Faculty Members.

In order to meet the need of professional human resources, the Ministry of National Education adopted the resolution of sending 5,000 students abroad for graduate studies in 5 years time starting from 2006. In the 24th meeting of SCST held on August 7, 2013, a decree was adopted for restructuring scholarship programs for graduate students to study abroad.

Similarly, the Ministry of National Education and TÜBİTAK conducts "This is my Achievement'

Project Study for Maths and Sciences Students in Primary School". Under these programs, whose pilot implementation was initiated in İstanbul in 2004, 2,794 project applications have been made and 133 projects were exhibited in the final. Afterwards, the coverage was extended to include 81 provinces in Turkey and 78,887 projects were proposed in the term of 2012-2013, 968 of which were invited in the exhibition and 100 of which were selected for the final.

The Center for Science and Arts is the independent special educational institution, which is designed with the aim of having gifted students gain awareness of their individual talents, improve their potential and make the most of it without interrupting their education in formal educational institutions. There are 67 Center for Science and Arts in 61 provinces in Turkey. As of the 2012-2013 year term, about 11 thousand students attend to Center for Science and Arts.

In previous years, the Ministry of Development has supported human resources development in terms of two programs, namely *Industrial Doctorate Program* and *Programs for Developing Human Resource*. Together with these programs, *Scientific Human Resources Development Program (ÖYP)* was conducted by the Ministry of Development in order to develop qualified academic staff. However, starting from 2010, this program is implemented by the Council of Higher Education (YÖK).

Programs for Developing Human Resources aim at supporting researchers in areas where the number of researchers are not sufficient in Turkey. Different from the Industrial Doctorate Program, this program focuses on areas on which researchers should be supported in light of recent developments in the world and Turkey's needs.

So far, capacity building in the relevant fields of universities has been the basic support provided by the Ministry of Development within the scope of developing human power in research programs.

Starting from 2012, new support programs were initiated in universities within the context of developing human resource in research. Benefiting from thematic advanced research centers that are established in universities, there has been more effective cooperation with the private sector. Increasing researchers'

employment in private sector is further intended by these programs. It is obligatory to provide scholarships or employment for students taking part in the projects in order for universities proposing projects to be supported. By this way, researcher candidate will not only be supported by public resources, but also the private sector will contribute to development of researchers. This will help private sector reaching qualified R&D personnel more easily.

4.3. The Role of Education in the National Innovation and Entrepreneurship System

The transition to a knowledge economy requires innovative, entrepreneurial, self-confident, adaptable human resources who have high analytical skills, are capable of self-expression, working as a team and learning by themselves. Starting from the restructuring Turkish education system, decrees to integrate Turkish national education system with science and technology policies are adopted at the 24th meeting of the SCST. In this respect, important activities started to shape future of Turkey are listed below:

- Taking a snapshot on Turkish education system for improving the quality of education system
- Revising education curriculum to develop human resources having skills of innovativeness, analytical thinking, questioning, self-confidence to rank Turkey among top 10 economies of the world
- Dissemination of science culture, spirit of research and project skills among all student groups by science fairs
- Restructuring the system of admission to higher education to measure the core competencies of students at high schools

- Promoting development of digital course contents to provide equal opportunities for all students.

Turkey has initiated FATİH Project coordinated by Ministry of National Education with the aim enabling equal opportunities in education and improving technology in schools for the efficient usage of ICT tools in the learning-teaching processes by appealing to more senses. In total, 570.000 classes of all schools that are in the preschool education, the primary education and the secondary education will be provided with tablets and LCD Interactive Boards. In-service trainings for teachers are going to be held in order to provide effective usage of the ICT equipment in the classrooms in the learning-teaching process. In this

transformation process, educational e-contents are going to be formed in accordance with the current teaching programs.

Furthermore, promoting development of digital course contents for higher education and making them accessible is decided at the 24th meeting of the SCST.

In order for creating and publishing web-based high quality educational materials in Turkish and hence to improve the quality of undergraduate education in Turkey, TÜBİTAK has launched the *Digital Content Open Source Resources Support Program*. In this respect, *Call for e-Books* involves content of academic resources with drawings, animations, simulations, and interactive applications, and *Call for e-Courses* involves enriched videos of courses.



5. Science, Technology and Innovation Productivity

Turkey's impetus in R&D spending and STI human resources is closely matched with an impetus in basic output indicators that contribute to technological dissemination, namely scientific publications and patents. This proves the positive effects of the increase in R&D input indicators on STI performance and output indicators.

5.1. Scientific Publications

Scientific publications are important output indicators of the National Innovation and Entrepreneurship System in terms of the dissemination of the knowledge created. Turkey increased the number of scientific publications in internationally recognized

Thomson Reuters Citation databases four-fold between 2000 and 2012 based on exponential rise reaching nearly 25 thousand publications in 2012 (Figure 5.1). This indicates that scientific publications are the driving force for Turkey in the catching up process. As a result, Turkey ranked 18th in the country rankings of scientific publications in 2012 which makes Turkey a remarkable country in this area (Figure 5.2). According to the report¹¹ published by Royal Society of UK in 2011, Turkey is among the countries standing out in terms of increase in scientific publications in the global scientific league where the traditional scientific leaders have gradually lost their shares.

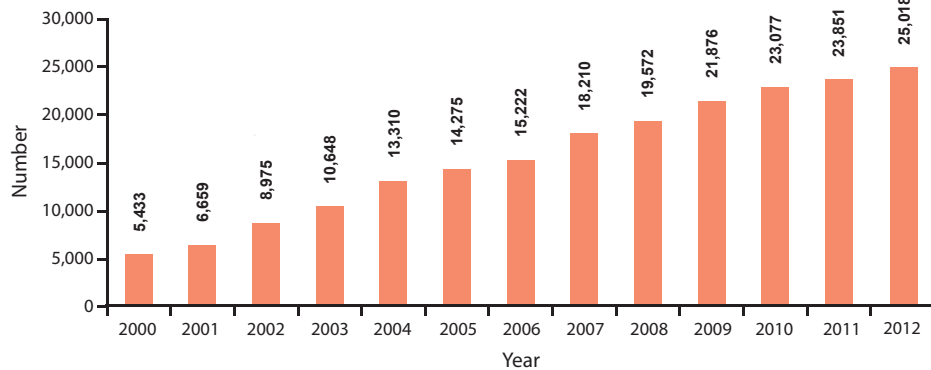


Figure 5.1: Number of Scientific Publications in Turkey

(Source: Thomson Reuters Citation Databases (WoS- InCites) /TÜBİTAK ULAKBİM – November 2013)

¹¹ The Royal Society (2011), Knowledge, networks and nations: Global scientific collaboration in the 21st century.

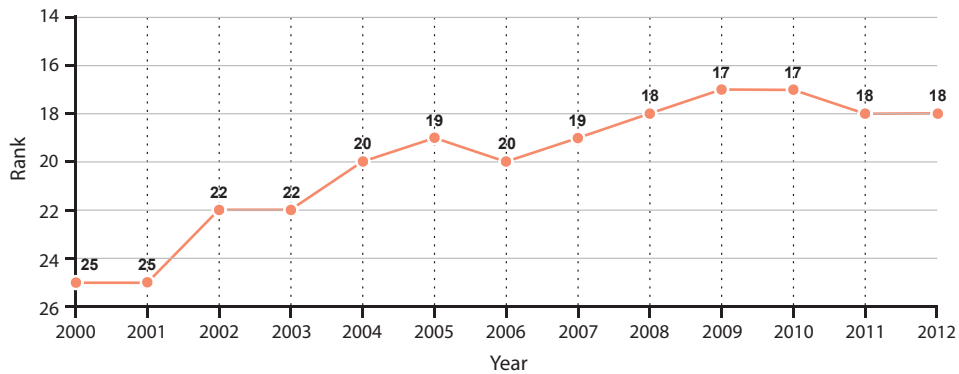


Figure 5.2: Rank of Turkey with respect to Scientific Publications
 (Source: Thomson Reuters Citation Databases (WoS-InCites) /TÜBİTAK ULAKBİM – November 2013)

Given the large population of Turkey, this puts the number of scientific publications per million population in 2012 at 331 publications as given in Figure 5.3, which represents nearly three-fold increase between 2000 and 2012.

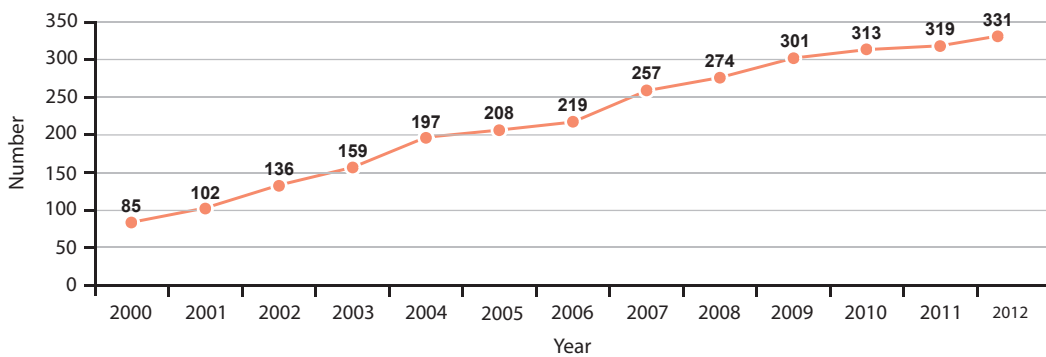


Figure 5.3: Number of Scientific Publications per Million Population in Turkey
 (Source: Thomson Reuters Citation Databases (WoS-InCites) /TÜBİTAK ULAKBİM – November 2013)

Figure 5.4 represents the number of Turkish addressed scientific journals in the internationally recognized databases of ISI. The first Turkish addressed scientific journal took place in the ISI databases in 1985. Until 2007, the number of journals increased to 8. In 2007, 31 new scientific journals took place in the databases and in 2012 this number reached to 68 in the databases of ISI SCI (Science Citation Index), SSCI (Social Science Citation Index) and A&HCI (Arts & Humanities Citation Index).

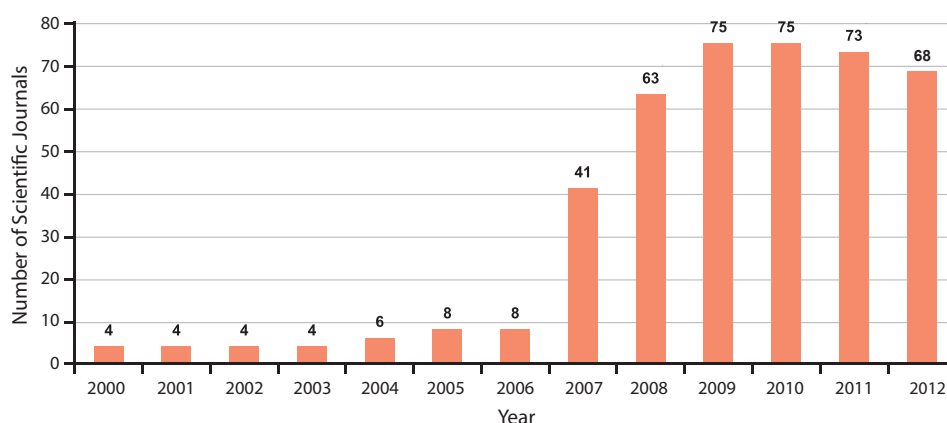


Figure 5.4: Number of Turkish Addressed Scientific Journals in the ISI Databases (SCI, SSCI and A&HCI)
(Source: TÜBİTAK ULAKBİM)

5.2. Patents and Utility Models

As another measure of the outputs from R&D, patents contribute to technology diffusion and provide incentives for further innovation, hence affecting economic performance¹². Since 2000, the patent applications to the Turkish Patent Institute have boomed with an exponential rate of increase, reaching a total of 8,268 patent and utility model applications being filed in 2012, which indicates more than ten-fold increase between 2000 and 2012 (Figure 5.4). Utility model applications, which were preferred by particularly SMEs because of being cheaper and easier than patent applications, fell behind patent applications for the first time in 2010. Sustaining this trend in the following years indicates that awareness of patenting has

been increasing. In particular, there were 4,543 patent and 3,725 utility model applications in 2012, representing a 55% and 45% of the total number of applications in 2012.

To increase the number of national and international patent applications originated from Turkey, to encourage patent applications, and to increase awareness of registering intellectual and industrial property rights, Patent Application Promotion and Funding Program was initiated by TÜBİTAK in 2007. Within the program, 7,889 proposals were submitted to TÜBİTAK and 7,400 were supported between the years 2007-2012. In 2013, TÜBİTAK Patent Support Program has been initiated replacing the previous program.

¹² OECD (2004), Patents and Innovation: Trends and Policy Challenges, Paris: <http://www.oecd.org/dataoecd/48/12/24508541.pdf>.

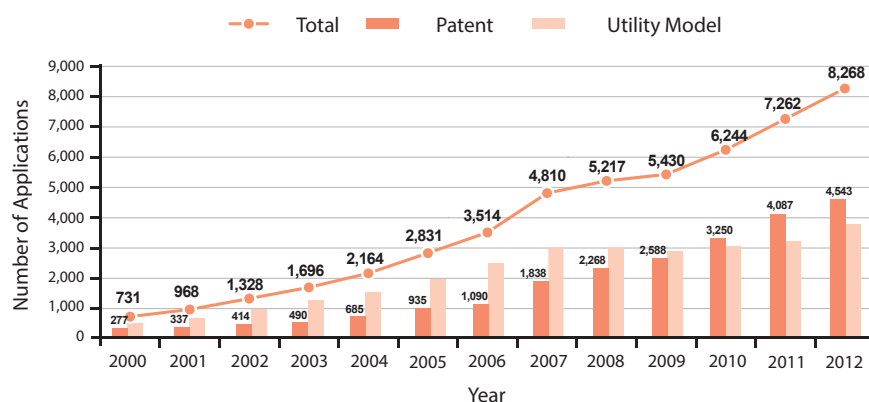


Figure 5.5: Domestic Patent and Utility Model Applications (Source: Turkish Patent Institute)

Due to the combined effect of intellectual property awareness and increasing R&D expenditures, Turkey has exhibited a rapid increase in the number of international patent applications being filed to the United States Patent and Trademark Office (USPTO), European Patent Office (EPO), and Japan Patent Office (JPO), either separately or simultaneously as triadic patent applications and Patent Cooperation Treaty (PCT) applications (Table

5.1). In PCT patent applications, Turkey exhibited more than six-fold increase from 72 applications in 2000 to 534 applications in 2012. In triadic patent applications, Turkey exhibited more than four-fold increase, reaching to 21 applications in 2011. Furthermore, as being among the 20 largest economies in the world, Turkey attracts increasing attention from other countries as a destination of patent applications.

Table 5.1: Number of International Patent Applications

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of Patent Applications to the PCT	72	76	85	112	116	174	269	359	392	389	480	539	534
Number of Triadic Patent Families	4	10	8	9	13	12	11	12	12	16	20	21	-

Source: OECD Main Science and Technology Indicators (MSTI) 2013/1, WIPO

Appendix: Major Actors of National Innovation and Entrepreneurship System

Actors	Web Page Address/Links
The Supreme Council for Science and Technology (SCST)	http://www.tubitak.gov.tr/en/about-us/content-scst
Ministry of Science, Industry and Technology	www.sanayi.gov.tr
The Scientific and Technological Research Council of Turkey (TÜBİTAK)	www.tubitak.gov.tr
Ministry of Energy and Natural Resources	www.enerji.gov.tr
Ministry of Economy	www.ekonomi.gov.tr
Ministry of Food, Agriculture and Livestock	www.tarim.gov.tr
Ministry of Development	www.kalkinma.gov.tr
Ministry of Finance	www.maliye.gov.tr
Ministry of National Education	www.meb.gov.tr
Ministry of National Defense	www.msb.gov.tr
The Council of Higher Education	www.yok.gov.tr
The Turkish Academy of Sciences (TÜBA)	www.tuba.gov.tr
Undersecretariat of Treasury	www.hazine.gov.tr
Turkish Statistical Institute (TurkStat)	www.tuik.gov.tr
Turkish Patent Institute	www.tpe.gov.tr
Turkish Standards Institution (TSE)	www.tse.org.tr
Small and Medium Enterprises Development Organization (KOSGEB)	www.kosgeb.gov.tr
Union of Chambers and Commodity Exchanges of Turkey (TOBB)	www.tobb.org.tr
Technology Development Foundation of Turkey (TTGV)	www.ttg.gov.tr
Turkish Accreditation Agency (TÜRKAK)	www.turkak.org.tr

Acronyms and Abbreviations

A&HCI	Arts & Humanities Citation Index
BAP	Scientific Research Program
BSEC	Black Sea Economic Cooperation
COST	European Cooperation in Science and Technology
ECO	Economic Cooperation Organization
EMBC	European Molecular Biology Conference
EPO	European Patent Office
ESA	European Space Agency
ESF	European Science Foundation
EU	European Union
EU27	27 Member Countries of the EU
EUROHORCS	European Heads of Research Councils
FP	Framework Programs
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
ICT	Information and Communication Technologies
ISI	Institute of Scientific Information
İTEP	Advanced Technology Projects Support Program
JPO	Japan Patent Office
KOSGEB	Small and Medium Enterprises Development Organization
LDCs	Least Developed Countries
MSTI	OECD Main Science and Technology Indicators
NATO	North Atlantic Treaty Organization
OECD	Organisation for Economic Co-operation and Development
ÖYP	Scientific Human Resources Development Program
PCT	Patent Cooperation Treaty
PPP	Purchasing Power Parity
R&D	Research and Experimental Development
RDI	Research, Development & Innovation
S&T	Science and Technology
SAN-TEZ	The Industrial Graduate Thesis Program
SCI	Science Citation Index

SCST	The Supreme Council for Science and Technology
SME	Small and Medium Enterprises
SSCI	Social Science Citation Index
STI	Science, Technology and Innovation
TARAL/TRA	Turkish Research Area
TEKMERs	Technology Development Centers
TGP	Technology Development Project Support Program
TTGV	Technology Development Foundation of Turkey
TTO	Technology Transfer Offices
TurkStat	Turkish Statistical Institute
TÜBİTAK	The Scientific and Technological Research Council of Turkey
TÜBİTAK ARDEB	TÜBİTAK Academic Research Funding Programs Directorate
TÜBİTAK BİDEB	TÜBİTAK Department of Science Fellowships and Grant Programs
TÜBİTAK KAMAG	TÜBİTAK Public Research Grant Group
TÜBİTAK SAVTAG	TÜBİTAK Defense and Security Technologies Research Grant Group
TÜBİTAK TEYDEB	TÜBİTAK Technology and Innovation Grant Programs Directorate
TÜBİTAK ULAKBİM	TÜBİTAK Turkish Academic Network and Information Center
UNESCO	United Nations Educational, Scientific and Cultural Organization
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization
YÖK	The Council of Higher Education