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Analysis of policy mixes to foster R&D investment and to contribute to the ERA

Turkey

Sirin Elci and Ihsan Karatayli

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Contact information
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

IPTS website: http://ipts.jrc.ec.europa.eu
JRC website: http://www.jrc.ec.europa.eu
DG RTD website: http://ec.europa.eu/research/

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ERAWATCH Network – Technopolis Group, Turkey

Sirin Elci and Ihsan Karatayli

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Executive Summary

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Hence, a central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of the efforts in increasing R&D investments and improving the performance of national research systems.

The main objective of the report is to characterise and assess the evolution of the national policy mixes in the perspective of the national goals for R&D investments, and for the contribution to the realisation of the European Research Area, as associate country. This report is building on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

Research plays an important role in Turkey's general policy agenda. It has been an integral part of the development plans for around five decades. Since early 2000s, the government has intensified the actions to increase R&D expenditures and to develop a sound research base. These efforts have led to a remarkable increase in R&D expenditures, which rose 2.7-fold during 2002-2007 period, from €1.24b in 2002 to €3.37b in 2007. GERD as a percentage of R&D has increased from 0.53% in 2002 to 0.71% in 2007.

The current target is to increase the share of GERD in GDP to 2% by 2013 (50% of this amount is to be funded by the private sector). Although still lower than the OECD average of 69%, the share of gross domestic expenditure on R&D performed by business sector (BERD) has also increased since early 2000, from 28.7% in 2002 to 41.3% in 2007. In order to develop the research capacity, the government targets to increase the number of full-time equivalent R&D personnel to 150,000 by 2013 (from 63,000 in 2007). Both of these targets were revised in 2008 in a way that they are aimed to be reached by 2013 instead of 2010. As also recognised by the government, the targets are ambitious considering the time frame and the challenges that Turkey face to rise R&D expenditure in the private sector, as explained below. For this reason, increased amount of public funding has been allocated for R&D since 2005.

With the increase in the public expenditures in R&D to meet the targets, Turkey has seen a great deal of new measures introduced into the policy mix. The existing policy mix mainly focuses on the development of human resources for research, increasing the private investments in R&D and intensifying the linkages between universities and the private sector. According to the policy mix route definitions used in this report, stimulating greater R&D investment in R&D performing firms, increasing extramural R&D carried out in cooperation with the public sector or other firms and increasing R&D in the public sector have been the main focus of the policy mix in Turkey. Routes of stimulating firms that do not perform R&D yet and promoting the establishment of new indigenous R&D performing firms are addressed only by a few measures. There are no direct measures towards attracting R&D performing firms from abroad. However, the new R&D Law providing fiscal incentives for R&D activities of the private sector, indirectly aims to attract R&D centres of multinationals.

In spite of these developments, there are certain barriers to R&D investments. The most important barrier is that SMEs with low to medium level technology profile are

the dominant segment of the economy and their R&D investments and capabilities remain limited.

The manufacturing industry was the largest contributor (68%) to total BERD in 2007. As regards the sectors engaged in R&D activities in manufacturing industry, the three best performing sectors are motor vehicles, trailers and semi-trailers (42%), radio, television and communication equipment and apparatus (14%) and machinery and equipment (12%) (TURKSTAT, 2007).

R&D is largely performed by universities and research organisations with public financing. However, in spite of the incentives, there are limited efforts to transfer the research results to the private sector and create new businesses through research commercialisation. Scarcity of human resources for R&D is another critical barrier. There are 2.0 researchers per thousand of total employed in Turkey, which is lower than the EU-27 average of 5.8. One of the main reasons for this scarcity is the brain drain that claims a significant share of Turkish researchers who reside abroad upon completion of their PhDs. The number of PhD students from Turkey that stays in the United States for five or more years is close to 60 percent, the fifth largest group after China, India, Iran and Argentina (World Bank, 2008). Finally, private funding (venture capital and business angel investments) for R&D and innovation is very limited which is a problem for the creation of new businesses through research commercialisation.

Barriers to R&D investment	**Opportunities and Risks generated by the policy mix**
Low level of research and innovation culture and investment in Turkey, particularly in the private sector	Increased amounts of public funding are available. Current economic crisis may result in lower level of GDP growth making it easier to reach the 2% target assuming that public funds for research will not diminish. Low levels of R&D awareness and capabilities in the private sector are not directly addressed by the policy mix. R&D funding is provided without any sectoral and regional focus which could lead to inefficient use of the R&D funding. No systematic evaluation exists for R&D programmes and policies.
Low levels of BERD over GERD ratio	Increase in public funding for business R&D is higher than academic and public R&D. Limited R&D capabilities and absorptive capacities in the private sector, and particularly in SMEs, can risk the increase in the BERD. Current policy instruments are complex and bureaucratic for SMEs in low and medium tech industries. However, a new scheme is adopted specifically for SMEs. Need to develop R&D capabilities and raise awareness on R&D and innovation among SMEs.
Limited number of human resources for R&D	The target for increasing the number of FTE researchers is set and measures initiated to reach the target. If this target is not achieved, the 2% target will not be reached either. The target requires almost all the S&E graduates to be employed as full-time researchers, which could hamper the competitiveness and absorption capacity of the business sector. Policy mix does not directly address the development of human capital for R&D and innovation at the private sector. Policy mix needs to target increasing the enrollment and attainment levels in tertiary education, and attracting Turkish PhD students abroad back to the country.
Low level of cooperation among different research actors, particularly between universities and the private sector	Several measures are implemented to stimulate collaboration between universities and the private sector as well as between public organisations and research performers. Intensified collaboration can be achieved if policy mix also addresses improvements in the regulatory framework for encouraging interactions between universities and the private sector.

Turkey is at the accession negotiations for EU membership and the process of the harmonisation of the EU *acquis* is still underway. Although not a Member State yet, all R&D targets of Turkey are set in parallel with the ERA targets. Among the 35 topics to be discussed at the negotiation stage, the first screening topic that was opened and the only one closed[1] has been the "Science and Research" chapter.

The ERA developments are closely followed by the policy makers and many of the newly introduced policy measures were inspired by their counterparts in the EU programmes. Most importantly, the Supreme Council of Science and Technology (BTYK)[2] launched the "Turkish Research Area" (TARAL) in 2004 with inspiration from the ERA. TARAL, a platform for public, private and NGO stakeholders to coordinate future R&D priorities and collaboration has been aimed to be integrated with the ERA. In this respect, Turkey has contributed to the common programmes and is determined to be involved in the programmes carried out at the European level.

Linked with this strategy, full association with the Sixth Framework Programme of the EU in 2003 has been an important step for Turkey, which also contributed to the remarkable progress in the field of research in this decade. Turkey paid approximately €250m as a contribution to the Sixth Framework Programme (the largest contribution among the candidate countries). Turkey's total contribution to the current Seventh Framework Programme is estimated to be €423.5m by the end of 2013. Turkey actively participates in the ERA-NET projects as they are seen as important tools for the integration of the TARAL and the ERA. As of 2009, 19 ERA-NET projects have been participated five of which have already been completed.

	Short assessment of its importance in the ERA policy mix	**Key characteristics of policies**
Labour market for researchers	• High on the policy agenda (however, no direct linkages are established with ERA as Turkey is not a member state)	• Increased scholarships funding for foreign students • Launching of a new international researcher support scheme • Participation in the EU research mobility programmes, such as EURAXESS and Marie Curie grants.
Governance of research infrastructures	• Mainly focused on more effective use of the current infrastructure instead of establishing new ones • Active participation in the European Strategy Forum on Research Infrastructures (ESFRI) and actions being taken to prepare the national Research Infrastructures Roadmap • Ten research infrastructures opened up to foreign access through the European Portal on Research Infrastructures Database	• Increased budget for research

[1] As of May 2009.

[2] The BTYK is the highest-level policy co-ordination body for science technology and innovation (STI) in Turkey. It is chaired by the Prime Minister and is composed of the related ministries, high level representatives of the government bodies, universities and NGOs. The Scientific and Technological Research Council (TUBITAK) acts as secretary to the BTYK.

	Short assessment of its importance in the ERA policy mix	**Key characteristics of policies**
Autonomy of research institutions	• Higher interest from the Turkish universities but explicit policies are not yet in place • Public research institutions are not autonomous • The research institutions have the flexibility to determine the R&D topics to be undertaken while they need to apply to the funding agencies where their projects are evaluated according to the criteria designed by these agencies	• Considerable progress achieved in the implementation of the Bologna process
Opening up of national research programmes	• Not mentioned in the policy documents or in the strategies developed so far • Active participation in the ERA-NET projects which are seen as tools for the integration of the TARAL with the ERA.	• Inclusion of international researchers is possible as long as they are affiliated to a Turkish research institute or a Turkish company. • Turkey is involved in FPs for research and partially in CIP.

TABLE OF CONTENTS

1 Introduction

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Hence, a central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of the efforts in increasing R&D investments and improving the performance of national research systems.

The main objective of the report is to characterise and assess the evolution of the national policy mixes in the perspective of the national goals for R&D investments, and for the contribution to the realisation of the European Research Area, as associate country. This report is building on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

In this report we characterise and assess the performance of the national research system and national research policies. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain is guided by a set of generic "challenges", common to all research systems, which unravel possible bottlenecks, system failures and market failures a research system has to cope with. The main elements of and results from this analysis are presented in Chapter 2, while in the Annex, the reader can find a more detailed account of this exercise.

The need for an effective research policy, appropriately co-ordinated with education, innovation, and other types of policies, is also widely recognised. Therefore, we focus on the following two analytical issues:

- The assessment of the national policy mixes for the achievement of national R&D investment goals set. Particular attention is paid to policies fostering private R&D and addressing barriers (Chapter 3).
- The assessment of national policies contributing to the realisation of the European Research Area, as associated state (Chapter 4).

2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

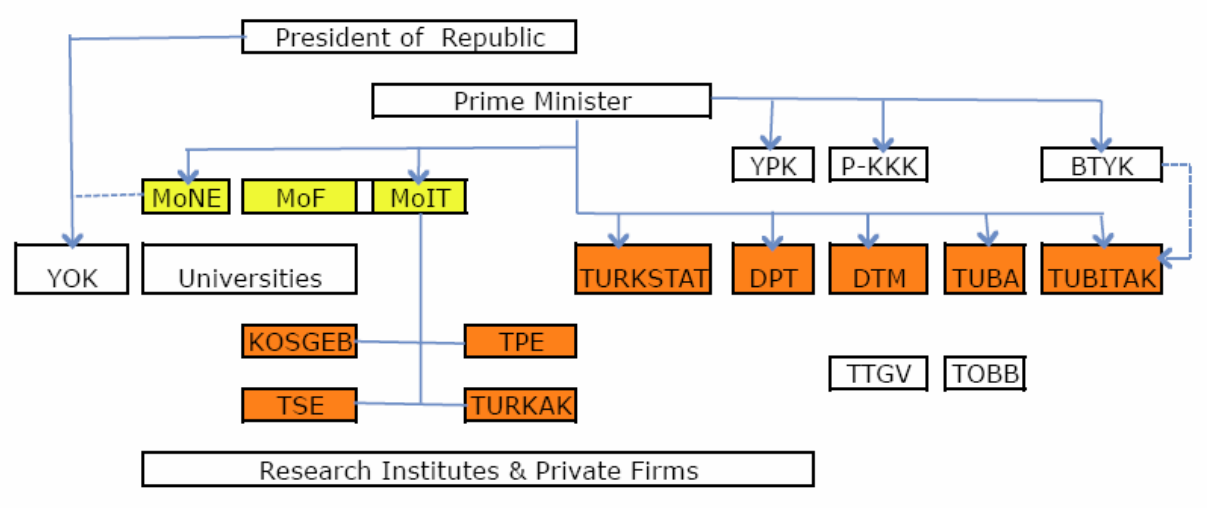
The Turkish economy is among the world's 20 largest and 64% of its 73 million population is below 34 years old. The country has the largest labour force of the 27 European Countries with over 24.7 million people in 2007[3]. With an average GDP growth of 4.2 percent between 1988-2007, Turkey ranked the fifth in OECD economies. The estimated growth for 2008 is 3.4 percent.

[3] Prime Ministry Investment Support and Promotion Agency (2008)

According to R&D survey conducted by TURKSTAT, GERD in Turkey was €2.69b and the share of GERD in GDP was 0.71% in 2007. GERD per capita population was PPP$93.2. Total number of R&D personnel (full time equivalent) was 63,377 and that of per ten thousand labour force was 29.9. (TURKSTAT, 2007)

Turkey has a well-developed national research system that encompasses most of the actors and institutions that exist in EU countries. Established in 1983, the Supreme Council for Science and Technology (BTYK) is the highest level legally formalised body, which determines, directs and coordinates research and innovation policies. The Scientific and Technological Research Council of Turkey (TUBITAK), which was created in 1963, is affiliated to the Prime Ministry and acts as the secretariat of the BTYK. The BTYK is headed by the Prime Minister and composed of relevant Ministers, heads of public and private bodies, universities and non-governmental organisations.

Figure 1: Overview of the governance structure of the Turkish research system



Source: ERAWATCH Network (2008)

The State Planning Organisation (DPT) and the High Planning Council (YPK) are two other important actors in the design and implementation of research and innovation policies. The Money-Credit and Coordination Council (P-KKK), an operational arm of the DPT, is responsible for the determination of monetary policies for state support programmes and the allocation of funds for this purpose.

The Ministry of National Education (MoNE) and the Higher Education Council (YOK) design and implement education and training policies and integrate them with research and innovation policies. Ministry of Finance (MoF) contributes to the design and implementation of fiscal incentives for R&D. The Under-Secretariat of the Treasury (HM) and Under-Secretariat of Foreign Trade (DTM) are actively involved in the formulation of policies and in policy implementation as they mainly provide finance to research and innovation programmes. The Turkish Statistical Institute (TURKSTAT) is responsible for conducting R&D and innovation surveys. The Turkish Academy of Sciences (TUBA) determines and recommends scientific priority areas and proposes legislation to the government on issues related to scientists and researchers. TUBA also designs and implements programmes to encourage scientific studies.

On the implementation side, TUBITAK itself is the main body managing research programmes. The Directorate-General of Industrial R&D of the Ministry of Industry

and Trade (MoIT), the Technology and Innovation Support Programmes Directorate of TUBITAK (TUBITAK-TEYDEB), the Technology Development Foundation of Turkey (TTGV) and the Small and Medium Industry Development Organisation (KOSGEB) are the main agencies implementing industrial R&D support programmes. Both TUBITAK-TEYDEB and TTGV use government resources for stimulating R&D and innovation in private sector companies (TUBITAK-TEYDEB provides grants, whereas, TTGV provides soft loans). MoIT, at the same time, stimulates the creation of technoparks to encourage university-business collaboration.

KOSGEB, affiliated to MoIT, deals with the design and implementation of small and medium-sized enterprise (SME) policies, which also cover aspects of research and innovation. In addition, KOSGEB helps to create an environment for university–industry cooperation in its technology development centres. The Turkish Patent Institute (TPE) is an autonomous body affiliated to the MoIT which is responsible for carrying out the procedures related to industrial and intellectual property rights (IPR) and for informing and guiding researchers, industrialists and R&D institutes on IPR related issues. The Turkish Accreditation Agency (TURKAK) is also affiliated to the MoIT and deals with increasing the competitiveness of industry by accrediting organisations and laboratories, and ensuring they operate in accordance with national and international standards. Established as one of the institutes of TUBITAK with an autonomous structure, the National Metrology Institute (UME) carries out scientific metrology activities and provides measurement, training, consultancy, information dissemination and infrastructure services. For nuclear research activities, the Turkish Atomic Energy Institute (TAEK) is the main body both for strategy preparation and for carrying out research activities. The Turkish Standards Institution (TSE) prepares, inspects and publishes standards in Turkey. TSE also conducts R&D about metrology and calibration. The Unions of Chambers and Commodity Exchanges of Turkey (TOBB) is a semi-public body, which represents the private sector in research and innovation policy-making and implementation process.

The institutional role of the regions in research governance

There has not been any regional approach on research and innovation policy-making and implementation in Turkey. However, the government puts strong emphasis on regional development. As an important step in that respect, a law on the establishment of regional development agencies (RDA) was issued in February 2006. Two pilot RDAs, namely Cukurova and Izmir, are in operation and as of 2009, they have started providing funding at their regions at NUTS II level. The support programmes of the two pilot RDAs focus on increasing production and employment levels in their regions. On the other hand, both RDAs have included stimulation of R&D and innovation in their regional development strategies.

There are 26 NUTSII level regions in Turkey and the government is in the process of establishing RDAs in the remaining 24 regions. Eight more RDAs were established as of May 2009 in Istanbul, Konya, Samsun, Erzurum, Van, Gaziantep, Diyarbakir and Mardin, and the rest are planned to be created by December 2009.

Apart from this development, some regions take steps to design and implement regional innovation strategies mainly as a result of the EU Research Framework Programmes. Currently, these programmes are one of the main driving forces for the regions to implement regional innovation projects. There are two projects recently completed this way: ‘Regional Innovation Strategies’ project in Mersin (RIS-Mersin) and ‘Supporting Potential and Existing Research Intensive SMEs’ in Adana. While the former aims at designing the innovation strategy for Mersin region with the

involvement of regional stakeholders, the latter deals with the question of the optimisation of the regional innovation system in Adana. Both Mersin and Adana are covered by one of the two pilot RDAs (Cukurova Development Agency). (Elci, 2008) In addition to these projects, a pilot RIS study has been completed in Izmir region under the Euromed Technology and Innovation Programme.

Main research performer groups

The main research performers in Turkey are the universities. They conduct a large portion of R&D (48.2% of GERD in 2007) and employ majority of the researchers (46.6% of full-time equivalent R&D personnel in 2007). The number of research publications, as the main output of the university research, has also been increasing depending on the increased research at the universities (from 15,403 in 2004 to 21,779 in 2007). According to TUBITAK, with 311 publications per million populations in 2007, Turkey ranked the 44th in the world. On the other hand, with an increase rate of 109% for the same indicator in the 2002-2009 period, Turkey ranks the sixth globally.

Traditionally, the older universities, which are located in Turkey's three major cities of Ankara, Istanbul and Izmir, and have better research infrastructure and human resources, are stronger in research. With respect to the number of research projects proposed by universities to TUBITAK and the amount of financial support provided by TUBITAK to these projects in 2008, the best performing five universities are Ege University, Ankara University, Istanbul Technical University, Hacettepe University and the Middle East Technical University. All of these universities are public universities.

In 2008, out of 4,400 project proposals submitted by universities to TUBITAK, 1015 were proposed by the best performing five universities. TUBITAK selected 930 projects (with a total budget of around €61m) out of 4,400 proposals. Nearly one-third of all projects supported both in terms of number and amount of funding are those proposed by these five universities.

Three out of five best performing universities in research projects (Hacettepe University, Ankara University and Ege University) are also among the top five universities in the number of publications in the Science Citation Index (SCI). The other two universities, which are also public universities, are Istanbul University and Gazi University. Among 17,786 publications in SCI by all Turkish universities in 2007, the number of publications produced by these universities was 4,756[4]. However, when the number of publications per researcher is taken into consideration, the best performing five universities are listed as TOBB University of Economics and Technology, Bozok University, Baskent University, Gebze Institute of Technology and Koc University. Three of these universities are private (TOBB University of Economics and Technology, Baskent University and Koc University) and the remaining two are public universities.

The Marmara Research Centre of TUBITAK (TUBITAK-MAM) is the biggest public research organisation which provides contractual research, testing, training, consultancy, analysis and certification services in its research centres, and creates an environment for the generation and growth of high-tech firms in its technopark. Other institutes of TUBITAK (Defence Industries R&D Institute, National Electronics and Cryptology Research Institute, Space Technologies Research Institute, National

[4] http://www.yok.gov.tr/index.php?option=com_docman&task=doc_download&gid=193

Metrology Institute, Basic Sciences Research Institute and Cukurova Advanced Agro-Technologies R&D Institute) are the most active organisations conducting research in their fields of specialisation.

With regard to private R&D performers in Turkey, there are six University–Industry Joint Research Centres (USAMs), established jointly by universities, TUBITAK and at least three companies or an umbrella organisation, with mixed funding. The USAMs' main activity is pre-competitive research although they can conduct contract research for a partner company. There are no private research centres carrying out contracted research, though some companies have established their R&D centres as separate entities in and out of the technoparks to benefit from the fiscal incentives provided by the Ministries of Industry and Trade, and Finance.

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the methodological approach of the ERAWATCH Analytical Country Reports 2008, which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The complete analysis of the research system can be found in the Annex.

Turkey has been implementing an economic policy agreed with the European Commission as a part of the EU membership negotiations and successfully completed the stand-by arrangement with the International Monetary Fund (IMF) in May 2008 (European Commission, 2008). The Turkish economy achieved an average GDP growth of 4.2 percent between 1988-2007 despite a severe economic crisis in 2001. In the process of recovering from the 2001 crisis and in line with the economic policy, Turkey adopted structural reforms which included exchange rate float, privatisation, revenue-administration strengthening, financial sector reform, energy sector reforms, investment climate improvements and social security reform. These reforms led to economic growth and put an end to chronic inflation. The structural reforms have also strengthened the regulatory and supervisory role of the state in the economy by increasing the share of private sector. As a result, since 2003, economic growth has been driven by the private sector. In line with these developments, positive trends were observed in some key indicators, such as foreign direct investment (FDI) inflows, which have surged from 1% of GDP in 2004 to 3% in 2007, and exports that grew from €55b in 2005 to €94b in 2008. On the other hand, this progress has not led to an increase in employment. The current global economic crisis hampers the development in the economy and worsens unemployment. The unemployment rate, which was up from 9.7% in 2007 to 10.9% in 2008, reached 16.1% in February 2009 alone over the same period the previous year.

Research started to play an increasingly important role in Turkey's general policy agenda since early 2000s. Through increased funding and new policy measures, particular attention has been paid to resource mobilisation and knowledge production. After the issuance of the new Science and Technology Strategies, the government took steps to increase R&D investment and to develop a sound research

base. As the first important action to implement the strategy, in 2005, the government allocated €733m for R&D activities in the public and private sectors. It was the first time that resources had been allocated in the national budget for research and is considered to be the largest R&D budget allocated by the government in any one year. This trend has continued and more than €1.1b was allocated to TUBITAK alone for the period 2005-08 to support research activities. As a result of these efforts GERD as a percentage of R&D has increased from 0.53% in 2002 to 0.71% in 2007.

It should be noted, however, that investment in research has always been an integral part of the development plans since issuance of the first plan in early 1960s. The 'Ninth Development Plan' (2007–2013) issued in the Official Gazette in July 2006 highlights the importance of R&D under the strategic objective of "increasing competitiveness" to contribute to the economic and social development of Turkey. The plan states that sectoral and thematic policies and priorities are considered and interrelated in a way that serves the same strategic objective. In the plan, the importance of R&D and innovation is highlighted for achieving increased competitiveness.

The most obvious weakness in the policy-making and implementation process is that the decisions are mainly taken centrally, and role of other stakeholders (e.g. the social partners, researchers, business sector and the general public) in the process is limited. Furthermore, the low levels of coordination and communication between the actors in the research system may hinder effective coordination between domains of resource mobilisation, knowledge demand, knowledge production and knowledge circulation.

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	• Increased budget for R&D activities as a result of increased government commitment in R&D
	Securing long term investment in research	• The science and technology strategy covers a period until 2010 and revised targets are set for 2013. Need to develop long-term strategies and secure long-term investments for R&D.
	Dealing with barriers to private R&D investment	• Increased funds for business R&D, and new measures in place to stimulate SMEs • Need to create awareness and build capacities on R&D among business, particularly SMEs • Need to establish early stage funding opportunities for start-ups and SMEs by stimulating private investments (particularly venture capital and business angel investments)
	Providing qualified human resources	• Increased funds and new policy measures launched for human resource development for research • Ambitious targets are in place to increase the number of researchers • Increase in the number of universities in various regions • Need to increase the number of tertiary education (S&T) graduates • Need to achieve increased collaboration between the education system and the business sector for the development of human capital • Need to develop and implement measures for brain gain

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge demand	Identifying the drivers of knowledge demand	• Actions to stimulate public demand for R&D procurement (a measure is in place and needs analysis was conducted in mid-2000s to identify areas of opportunity for R&D procurement) • Limited sectoral and regional focus on research policies and measures • Need to intensify communication among the stakeholders of the research system (in particular between universities and the business sector)
	Co-ordination and channelling knowledge demands	• Need to increase cooperation among actors of the research system to identify and address demand • Need to create a system for regular monitoring of demand • Need to conduct regular national technology foresight exercises, the first one of which was completed in early 2000s
	Monitoring of demand fulfilment	• Need to systematically evaluate the current policies and programmes
Knowledge production	Ensuring quality and excellence of knowledge production	• Need to design and implement measures to ensure quality and excellence of knowledge production • Measures are in place to intensify linkages between universities and business sector • Further efforts and measures are needed to increase the quantity and quality of research collaboration
	Ensuring exploitability of knowledge	• Measures are in place to encourage patenting • Technoparks and incubators aim to facilitate knowledge exploitation • Need to create awareness on IPR • Need to improve regulatory framework for university-business collaboration • Need to create intermediaries (such as technology transfer offices) to facilitate research commercialisation
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• Participation in the EU programmes inspires new measures in Turkey • More interest from the business sector for R&D cooperation • Need to create measures and assign roles to the system actors on knowledge dissemination
	Profiting from international knowledge	• Participation to the EU programmes is a major strength for the system • Bilateral research agreements in place with a large number of countries • Strong links of academics with colleagues and research institutions in other countries, particularly the USA • Need to create measures to attract back Turkish PhD students living abroad • Need to create measures to establish effective research links with the Turkish Diaspora
	Enhancing absorptive capacity of knowledge users	• Increased expenditures on education and the existence of a newly developed curricula • Increase in the life long learning opportunities • Need to design and implement measures to increase absorptive capacity of SMEs • Need to further stimulate the development of knowledge networks

As summarised in the table above, the Turkish research system mainly focuses on the resource mobilisation and knowledge production domains. The increased number of policy measures and increased funding from the state budget are the two major steps to address the challenges in these two domains.

In the knowledge production domain, there is a need to focus specifically on the exploitability of knowledge. This requires increased interaction between the producers and users of knowledge. Two important barriers in this respect are the unfavourable regulatory framework, which creates disincentives for university-industry collaborations[5], and the very low number of professional intermediaries to facilitate exploitation of knowledge.

The knowledge demand and knowledge circulation domains are not given sufficient priority in the research system. Particular attention is needed for the co-ordination and channelling knowledge demands, and for enhancing absorptive capacity of knowledge users.

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to national goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. It is therefore important to also analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

2.3.1 Resource mobilisation

In 2005, Turkey's National Science and Technology Strategy was determined by the BTYK for a period of five years. The research target for 2010 was identified as to increase GERD/GDP ratio to 2% and full-time equivalent (FTE) researchers to 40,000. However, in March 2008, TURKSTAT introduced a fourth revision to Turkey's GDP series and updated the base year to 1998 from 1987, and as a result, GERD was recalculated as 0.60% for 2006 and 0.71% for 2007. The main reason for the GDP revision was to reflect structural changes in the economy since 1987 in national accounts statistics. Another reason was to harmonize Turkey's GDP estimates with the European System of Accounts (ESA 95).[6] The goal for 40,000 full-time equivalent R&D personnel was already achieved due to the revision of the FTE ratios by TURKSTAT. Therefore, in 2008, the government revised the R&D targets. According to the new targets, GERD/GDP ratio is expected to reach 2% and FTE R&D personnel is foreseen to increase to 150,000 by 2013. It is also targeted to raise the share of privately realised R&D from 41% in 2007 to 50% of the total.

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[5] The main issues related to the regulatory framework for collaboration between the enterprise and research sectors include the following: (a) Some regulations (e.g., the university revolving fund regulations) create disincentives for researchers to provide services to the enterprise sector and thus reduce the mobility of researchers; (b) the current IP laws favour researchers in the allocation of royalties for commercialised research, hindering universities to commercialise R&D outputs; (c) incentives and support for universities and researchers to commercialise R&D are weak. (World Bank, 2008)

[6] http://siteresources.worldbank.org/TURKEYEXTN/Resources/361711-1209153236622/Volume_I_Final.pdf
Also see http://www.tuik.gov.tr/jsp/duyuru/upload/gsyh_8798fark.pdf

Overall, the targets set out for 2013 are ambitious and in line with the Lisbon Strategy. The government has taken the necessary steps in allocating the necessary funding and budgets required for reaching the targets through the use of national resources. It is expected that these trends will continue in the near future.

According to TUBITAK estimates of December 2008[7], GERD is expected to increase from TL 6b in 2007 to TL 25b in 2013. However, the basic assumption underlying this estimate, which is 7% GDP growth is to be achieved in 2008-2013 period, have changed due to global economic crisis. According to the Undersecretariat of Treasury, the economic growth expectations for Turkey are -3.6% in 2009, 3.3% in 2010 and 4.5% in 2011[8]. Therefore, these values need to be recalculated.

The main tool used for increasing the R&D investments, particularly for the private sector has been increasing the amount of financial support provided through the government sources. This trend has been continued in 2008-09 as well. In addition, a new measure was initiated in 2008 to provide easier access of SMEs to public funding. Another important step to increase the private investments in R&D has been the issuance of a new law in February 2008. The Law on Supporting Research and Development Activities (Law No. 5746), implemented by the DG Industrial R&D of the MoIT in cooperation with the MoF, provides a range of fiscal incentives for R&D activities of the private sector, (as well as for projects supported by public agencies and organisations). With this new law, the government aims to increase R&D activities that will realise gains from economies of scale and to attract R&D-intensive FDI.

TUBITAK and the MoNE provide scholarships for graduate studies. In 2006, MoNE has started a programme aiming to provide 5000 scholarships to the Turkish students to carry out their graduate studies abroad. Around 400 students in 2007 and 900 students in 2008 benefited from the programme. According to MoNE data, as of December 2008, there were 1,783 Turkish PhD students studying abroad and 183 of these students received scholarships from the Government. TUBITAK provided €6.6m funding for PhD scholarships to 1,468 students in 2007. TUBITAK also supports visiting scientists through its International Researcher Programme. Under this programme, 174 scientists were supported in 2007 with a total budget of around €0.3m.

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	• Increased state budget for R&D activities
Securing long term investments in research	• New measures put in place since 2005 • Targets aimed to be reached by 2013
Dealing with uncertain returns and other barriers	• Increased funds and new measures for increasing business R&D investments
Providing qualified human resources	• Increased funds and new policy measures for human resource development for research • Ambitious targets are in place to increase the number of researchers • Increase in the number of universities in various regions

[7] http://www.tubitak.gov.tr/tubitak_content_files//BTYPD/btyk/18/18btyk_nuketyetis.pdf

[8] http://www.hazine.gov.tr/irj/go/km/docs/documents/Treasury%20Web/Statistics/Economic%20Indicators/egosterge/Sunumlar/Ekonomi_Sunumu_ENG.pdf

TUBITAK foresees that the research budgets will continue to increase to achieve S&T targets. The target is to increase GOVERD to TL 11b in 2013[9]. The focus of the Government remains to be on increasing investments in R&D, intensifying university-business linkages, development of human capital for research, and more effective usage of the current infrastructure available instead of funding new infrastructures.

2.3.2 Knowledge demand

The Vision 2023 project, implemented between 2002 and 2004, is the first and only national technology foresight exercise of Turkey which aimed to provide input to the formulation of STI strategies for the next two decades. It has been the key tool used for observing the knowledge demand. Science and technology strategies hava mainly been structured according to the end results of this project. In addition to this study, TUBA implemented three pilot foresight projects over the same period, namely the 'Molecular Life Science and Technology Foresight' and the 'Basic Sciences Foresight' and 'Social Sciences Foresight' projects. As of 2009, there are not any plans for implementing similar activities in the near future.

On the other hand, in the process of initiating the 'Support Programme for Research Projects of Public Institutions' in 2005, a series of workshops were organised to identify the R&D needs of the public bodies. The objective of the programme implemented by TUBITAK is to support R&D projects aiming to develop new products and processes to meet the needs of public institutions.

Another scheme which facilitates the creation of technology platforms, inspired by the EU, aims *inter alia* to encourage the identification of knowledge demand. Under the so-called the 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms' (ISBAP) initiated in 2007, TUBITAK has established technology platforms in five sectors (textiles, electric/electronics, metal, automotive and marine sciences). The programme continues in 2009 and it is expected that new platforms will be created.

Finally, the national innovation system, key programmes and policies in Turkey are being assessed by the State Planning Organisation and the World Bank as per the request of the Government. It is expected that this assessment be finalised in 2009. In addition, OECD is carrying out the national innovation review with TUBITAK since 2008.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	• New technology platforms for identifying the knowledge demand are expected to be operational in 2009. • The measure for supporting technology platforms will be revised such that regional platforms can also be established.
Co-ordinating and channelling knowledge demands	• No major changes since 2008
Monitoring demand fulfilment	• An assessment study conducted by the State Planning Organisation and the World Bank started in 2008 and is expected to be completed in 2009. • OECD national innovation review started in 2008 is expected to be finalised in 2009.

[9] http://www.tubitak.gov.tr/tubitak_content_files//BTYPD/btyk/18/18btyk_nuketyetis.pdf

2.3.3 Knowledge production

Main policy of the Government regarding knowledge production is to support projects which maximise the effective use of current research infrastructure instead of funding the projects that require new investments for research. An important development in this domain is that increase in the government finance for research has led to an increase in the R&D funds used by universities and research institutes, resulting in new prospects for increased knowledge production by these organisations.

The increased number of measures to stimulate collaboration between universities and the private sector is expected to contribute to the exploitation of knowledge produced at universities. On the other hand, improvements in the regulatory framework are needed for the enhancement of the quality and quantity of collaboration projects. (also see 2.2 above)

IPR Regime in Turkey

The EC's Turkey Progress Report of 2008 found that the overall legislative framework for IPR in Turkey is largely aligned with the *acquis*, but administrative capacity remains insufficient to ensure effective enforcement, as required by the Customs Union Decision (European Commission, 2008). As noted in Section 2.1, the procedures related to IPR has been carried out by the TPE which is an autonomous body affiliated to the MoIT.

An analysis by the World Bank in 2008 reports three main findings related to IPR regime in Turkey:

- The legislative framework for intellectual property rights is broadly aligned with EU, notwithstanding certain divergences, most notably in the area of industrial property rights.
- The implementation and enforcement of IPR legislation in Turkey however has not reached EU levels, in terms of legislative changes, capacity of key institutions (IPR courts, TPE) and cooperation between public, private and non-profit sectors.
- The lack of autonomy of the TPE is affecting the quality of its services.

The Government is preparing four main pieces of IPR legislation in line with the EU requirements expected to be ratified in 2009.[10] There are still certain required legislative changes outstanding for which there is no clear implementation plan, including a new TPE Establishment Law to ensure its autonomy, a legislative framework for industrial property rights[11] and legislation to establish a professional society for patent and trademark attorneys.

In order to increase awareness on IPR and boost patent applications, TUBITAK and KOSGEB, in collaboration with the TPE, provide incentives for patent applications of companies and individuals. The MoIT is in the process of designing a new programme to support patent applications of enterprises.

[10] These pieces of legislation include adjustments to the Laws on Geographical indications, Industrial Design, and Trade Marks and a new Patent and Intellectual Property Law.

[11] The "Law Amending the Treaty on Granting European Patents", which regulates the procedures of European Patents within the Member States of the European Patent Organisation, entered into force and the Law on the accession of Turkey to the Protection of New Varieties of Plants (UPOV) Convention was ratified and published.

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	• Projects which aim at better use of the available research infrastructures will be prioritised.
Ensuring exploitability of knowledge production	• Increased funding will be available but policy changes are not foreseen.

2.3.4 Knowledge circulation

The performance of the Turkish research system needs to be improved in terms of the dissemination of research results for economic development purposes. As noted in above sections, betterment of regulatory framework is needed to encourage research circulation and exploitation from universities. Low level of awareness on IPR issues is also a barrier for knowledge circulation.

In order to address the challenge of knowledge circulation, ISBAP programme was introduced in 2007 and a nation wide awareness raising campaign for science is run for a number of years. The ISBAP programme will be extended so that local networks will also be supported in addition to the sectoral technology platforms. These networks are expected to be key tools for ensuring knowledge circulation by establishing links between the universities and the private sector. The Project Brokerage Events Funding Programme of TUBITAK is another measure encouraging the knowledge circulation from universities to the private sector.

Also in many of the existing policy measures implemented by KOSGEB, TTGV and TUBITAK, collaboration with academics is encouraged, for example by providing higher support levels to beneficiaries. Finally, the Support Programme for Research Projects of Public Institutions is another tool where collaborations between the public sector, academia and the private sector are encouraged.

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	• ISBAP programme, the Project Brokerage Events Funding Programme and the Support Programme for Research Projects of Public Institutions are in place to stimulate knowledge circulation.
Profiting from access to international knowledge	• Turkey participated in the 'Competitiveness and Innovation Framework Programme' in 2008. The aim is to increase involvement of Turkish research community in research FPs of the EU.
Absorptive capacity of knowledge users	• Starting from April 2009, hiring of at least one science and engineering graduate is mandatory to be able to apply to the industrial R&D support programmes of TUBITAK.

2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

As noted in previous sections, increased political commitment in research, higher level of funds allocated by the Government, and the existence of a well-developed

research system in Turkey are the main opportunities for the production of knowledge.

Existing research policies and policy measures heavily focus on resource mobilisation and knowledge production. They aim to address two key weaknesses: the low levels of R&D investments and the scarcity of human resources for research. However, there are various risks involved in the system. An important risk may be that since policy-making and programme design practices do not necessarily follow evidence-based and participatory approaches, they may fail to address the actual needs of the research community and the business sector. In addition, the relatively low levels of absorptive capacity of the private sector (particularly that of SMEs) may hinder the effective use of public finance as well as international funding available through programmes, such as the FPs. Finally, it should be noted that the R&D support programmes tend to be generic in nature, as opposed to thematic, with no focus on specific areas for capacity-building.

From the knowledge demand side, the main barriers include the limited number of measures to help identify and address knowledge demand by the private and public sectors, and the lack of mechanisms for systematic monitoring of demand to feed into the policy. The most important programme that has direct impact on identifying demand is the 'Support Programme to Build Scientific and Technological Cooperation Networks and Platforms (ISBAP)'. The measure has not yet been adequately taken up by the target groups since it is a relatively new scheme and requires a cultural change on sustainable partnerships between the stakeholders of the research system.

In order to increase R&D investment in the public sector, TUBITAK started a new programme for funding R&D projects of government organisations in 2006. In order to increase the number of applications to the programme, TUBITAK organised "joint consultation meetings" with the selected government agencies, related ministries and public institutions in 2007. In these meetings, which were organised as one-off events, short and mid-term research areas were identified and research projects in these areas were identified.

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	• Increased funds for R&D • Political commitment for investing in knowledge intensive sectors • Well developed research system	• The risk of failing to address the actual needs of the research community and the business sector as policy-making and programme design practices do not necessarily follow participatory approaches. • The low levels of absorptive capacity of the business sector, particularly that of SMEs • General policies towards increasing R&D input without sectoral and regional focus • The lack of systematic evaluations
Knowledge demand	• Creation of sectoral platforms • Existence of a measure to support R&D projects to develop new products and processes for meeting the needs of public organisations	• Low levels of evidence-based policy-making practices may block the efforts towards identifying and addressing knowledge demand • The lack of systematic monitoring of demand

Domain	Main policy related opportunities	Main policy-related risks
Knowledge production	• Cooperation with the international community especially the EU • Increase of National funding	• Need to achieve coordination among the different institutions which runs different programmes • Need to invest in building capacities in the research community and the business sector to benefit from the programmes
Knowledge circulation	• Increased interest by the business sector to benefit from the increased amounts of R&D funding • Increase in the number of intermediaries easing up the cooperation between university and industry	• Need to improve regulatory framework for universities to encourage collaboration with the business sector and facilitate spin-off formation • Need to create sustainable professional institutions to facilitate research commercialisation • Need to increase capacities of intermediaries assisting university-industry cooperation

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above-mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

The low levels of R&D investment in general is the dominant research policy issue in Turkey and the objective is to increase the GERD as a percentage of GDP to 2% by 2013 (raising the share of privately realised R&D from 41% to 50% of the total) to

approach to the 3% target of the EU. The increase in the government finance in R&D aims to make sure that this target is met.

A major barrier to achieve this ambitious target relates to the absorptive capacity of the private sector (particularly that of SMEs). SMEs constitute 99.9% of the total enterprises and 81.5% of employment in Turkey, according to KOSGEB. However, SME ratios for capital investment (38% of the total), value added (26.5%), exports (10%) and bank credit (5%) point to low labour productivity, insufficient access to finance and barriers to entering foreign markets (European Commission, 2008). Only 14.5% of SMEs operate in manufacturing sector. 90.27% of manufacturing industry companies is micro enterprises having less than 10 employees. The majority of manufacturing sector firms is active in traditional, low-tech sectors, such as furniture (12%, food (11%), garments (12%), wood products (10%) and textile (8%). As noted by KOSGEB, main weaknesses of manufacturing SMEs related, inter alia, to the use and development of technology, qualified human resources, value-added manufacturing capabilities and access to knowledge.[12]

The share of agriculture in GDP is 7.7% in 2007. Agricultural enterprises are small scale, and their fragmented structure cause productivity to remain at low levels. R&D carried out by the private sector in agriculture is very small: FTE R&D personnel is only 91 and total R&D spending is €2.7m (0.02% of BERD), according to the 2007 data of the TURKSTAT.

The services sector accounts for the highest share in the economy with about 60% of GDP in 2007. According to the 2007 R&D statistics, the number of FTE R&D personnel is 9,396 in the sector. R&D expenditure is 30.7% of total BERD (€429m in 2007).

The low number of FTE equivalent R&D personnel, which again negatively affects the capacity for absorbing resources and R&D performance, is another issue for the achievement of R&D investment objectives. In order to address this challenge, the number of FTE R&D personnel is aimed to reach 150,000 by 2013, from 63,000 in 2007. This target requires a dramatic increase in the science and engineering (S&E) graduates in the country. The number of S&E graduates is low (34,774 in 2006) and the rate of increase since 2001 is around 13%.

According to the MoNE data, total number of PhD students for the term 2006-2007 in the Turkish universities was 33,711. As of November 2008, there were 1,731 PhD students studying abroad. A significant share of Turkish researchers resides abroad upon completion of their PhDs. The number of PhD students from Turkey that remains in the United States for five or more years is close to 60 percent, the fifth largest after China, India, Iran and Argentina (World Bank, 2008).

Another barrier in the system for the achievement of objectives is the low levels of collaboration between research performers and the private sector, and insufficient capacities for research commercialisation. As noted before, the majority of research activities are carried out in universities in Turkey and due to the increase in the R&D funding, the number of research publications continues to rise (from 15,403 in 2004 to 21,779 in 2007). On the other hand, mainly due to the weak regulatory framework for collaboration between the enterprise and research sectors, as explained in Section 2.2, the potential remains untapped.

[12] http://www.kosgeb.gov.tr/dosyalar/StratejikPlan/KOSGEB_STRATEJIK_PLANI_2008-2012.pdf

The 2007 R&D statistics of TURKSTAT indicate that both public and private investments in R&D had increased sizably (by 2.7-fold in the period 2002-2007 period). The current economic crisis may facilitate making progress towards the target, both through stagnation or negative growth in GDP, and in creating opportunities for shifting the economy towards more R&D intensive activities.

3.2 Policy objectives addressing R&D investment and barriers

The 'Ninth Development Plan' (2007–2013) issued in 2006 identifies five strategic objectives as development axes sustain economic growth and social development in a stable structure during the Plan period:

- increasing competitiveness;
- increasing employment;
- strengthening human development and social solidarity;
- ensuring regional development;
- increasing the quality and effectiveness in public services.

Sectoral and thematic policies and priorities have been considered under these axes and were made interrelated in a way to serve the same strategic objective (DPT, 2006). R&D policies are covered under the strategic objective of "increasing competitiveness".

The policy objectives specifically addressing R&D investment and barriers were outlined in the Implementation Plan of the Science and Technology Strategies issued by the BYTK in 2005 covering the period 2005-2010. The main objectives, basic principles and targets outlined in the document include the following[13]:

a. Main Objectives:
   - To increase the quality of life in Turkey
   - To find solutions to social problems
   - To increase the competitiveness of Turkey
   - To socialise and disseminate the science and technology culture

b. Basic principles:
   - Strategic approach
   - Result-oriented research
   - Public-private sector cooperation
   - Efficiency
   - Increased participation of all stakeholders
   - Accountability
   - Achievement of better coordination between the authorities and tasks
   - Flexibility

[13] http://www.tubitak.gov.tr/home.do?ot=1&sid=1004&pid=547

c. Major Targets:

- To increase the demand for R&D
- To increase the number and the quality of R&D personnel
- To increase the share of R&D expenditures in GDP

As noted in previous sections, quantitative targets were also set, such as to increase the share of R&D expenditures in GDP to 2%. These targets were revised in 2008 in a way that they are aimed to be reached by 2013 instead of 2010 (also see Section 2.3.1)

Starting with 2005 a rapid increase in the public R&D funds is observed to reach the targets and new policy measures have been introduced for the use of funds in line with the policy goals.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

In general, the funding mechanisms in Turkey aim to increase R&D investments, enhance human capital for research and intensify linkages between the private sector and universities/research institutes.

The organisations funding R&D activities are the MoIT, TUBITAK, KOSGEB and TTGV. Apart from TUBITAK, all three organisations provide finance to the R&D activities of the private sector with the main objectives of encouraging investments in R&D for increased competitiveness, and stimulating collaboration between universities and the private sector. The total funding provided by these organisations for supporting R&D activities in 2008 was €15.6m through MoIT, €10m through TTGV, €3.5m through KOSGEB and €354m through TUBITAK.

Another important organisation in the R&D system is DPT. DPT is the main coordinating organisation in the determination of the investment budgets of the public organisations, including universities. The planned investment budgets of all public bodies, including R&D investments, are submitted to DPT for approval. DPT evaluates these budgets with regards to strategic plans and, if necessary, consults with expert organisations (in the case of R&D investments, they collaborate with TUBITAK). Once the investment projects are approved, the required funding is added by the MoF to the annual budgets of the proponent organisations. In 2008, total R&D investment was €141m for universities, €214m for the institutes of TUBITAK and €22m for the investment projects of other public bodies.

TUBITAK is the main body designing a wide range of funding mechanisms and disbursing the majority of funds allocated for research by the government. Overall characteristics of the TUBITAK's funding schemes based upon three mainstreams depending on the organisation applying for R&D support, namely government, universities or the private sector companies. In addition to the funding provided to organisations, TUBITAK provides scholarships at undergraduate and graduate

levels. Funding provided through these main lines in 2008 were €28m under the Science Fellowships and Grant Programmes Department (BIDEB) and €65m under the Academic Research Funding Programme Directorate (ARDEB). ARDEB also provided €81m under the Support Programme for Research Projects of Public Institutions. The total number of projects selected for support by ARDEB in 2008 was 946. Average budget per project was approximately €67,000. According to TUBITAK, projected budget of ARDEB programmes is €186.5m for 2010.

In addition, the Technology and Innovation Funding Programmes Directorate (TEYDEB) of TUBITAK provided €180m to the private sector R&D in 2008.

The implementation procedures and processes of these programmes are very similar. Experts are assigned for each project proposal and a panel decides whether the project should be supported. Once the project is selected for funding, academics and public institutions receive payments in advance, whereas the private sector companies are, in general, disbursed upon the submission of the documents for expenditures actually made for the project. As a result of a change in the by-laws of TUBITAK in 2007, private sector companies have also started receiving payments in advance for their projects from TUBITAK upon the submission of collaterals.

The public support for R&D activities, particularly for those of the private sector, are generic and do not involve any thematic focus. The only thematic programmes financed through the R&D budget by TUBITAK are those implemented for defence and space sectors.

3.3.2 Policy Mix Routes

The “Policy Mix Project” identified the following six ‘routes’ to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one ‘route’, the policy portfolio varies from country to country and region to region depending on policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

The policies and policy measures in Turkey do not address the need for promoting new indigenous R&D performing firms. However, as part of the broader industrial and innovation policy framework, there are four programmes aiming to encourage creation of new technology-based firms.

One of these programmes (the 'Support Programme for Technology- and Innovation-focused Entrepreneurship') is implemented by TUBITAK to stimulate technology-based entrepreneurship. Although there are not any evaluation results on the effectiveness of the programme, it is known that demand is not high as it is implemented in a very similar way to the private sector R&D support schemes of TUBITAK. Since the launching of the programme in March 2007, 23 entrepreneurs have been selected for support. The funding amount provided to each venture is about €56,000. To be able to receive funding from TUBITAK, the beneficiary has to pay first and then claim reimbursement. If advance payment is to be requested by the beneficiary, collaterals need to be provided. The new Law on Supporting Research and Development Activities issued in 2008 aiming to provide fiscal incentives for R&D includes a special clause for the support of technology-based entrepreneurship. According to that clause, grants could be provided for the creation of new technology-based firms without requiring collaterals. In addition, any government agency with an R&D budget can support the establishment technology-based firms under the same measure.

Entrepreneurs who would like to start up their technology-based businesses by developing a prototype are also supported through the 'R&D and Technological Innovation Support Programme' of KOSGEB. Other two major initiatives to support the creation of new technology-based firms are the technology development centre (incubators) of KOSGEB and technoparks. KOSGEB's incubators provide facilities for the creation of high-tech start-ups whereas technoparks aim to ease the process of establishment of new companies through the tax incentives provided. KOSGEB also supports renting costs of such companies in technoparks. As of 2008, there are 18 active technoparks in the country housing 890 companies (of which 32 are foreign) that employ 7,437 R&D staff and 2,308 technical support personnel. The technopark companies implement 2,671 R&D projects in ICT, electronics, defence, telecommunications, medical/bio-medical research, new materials, industrial design ad environmental technologies. They accounted for €178m of export revenue in 2008, up from €109m in 2006, according to the MoIT.

Route 2: Stimulating greater R&D investment in R&D performing firms

As underlined before, the main focus of the new measures developed in Turkey has been on increasing the R&D investments of companies in general. The key tools used for this purpose have been increasing the amount of funding for R&D investments of firms, providing tax incentives and awareness raising on R&D.

Tax incentives were available for R&D investments of companies since 1980s. These included

- Decree on Tax Postponement to Support R&D (1986)
- Law of Technology Development Zones (2001)
- R&D Tax Exemption (2005)

The first scheme has not been found beneficial by the Turkish firms due to the low incentives involved as opposed to high bureaucracy, and therefore, the uptake of it was low. Under the second scheme, companies located in technoparks (the so-called Technology Development Zones (TDZs)) are exempt from income tax for their R&D personnel and from corporate tax for the products they develop. The third scheme provides companies with the possibility of deducting 40% of their R&D costs from the revenues used for tax calculation.

As mentioned in previous sections, the new 'Law on Supporting Research and Development Activities' provide tax benefits to R&D personnel of companies located outside the TDZs and employing at least 50 researchers, if they have been entitled as "R&D Centre" by the government. In addition, the 40% deduction level of the R&D Tax Exemption scheme was increased to 100% with this law.

The most important measure to stimulate private R&D investments is the 'Support Programme for Industrial R&D Projects' which provides grants to R&D activities of the private sector and is implemented by the TEYDEB of TUBITAK. The programme has been implemented since 1995 and is co-financed by the DTM. 75% of the funding is provided through TUBITAK's resources and 25% is financed by the DTM. In 2008, the total budget for the programme was €180m.

Another measure used for R&D support and again co-financed by the DTM resources is the 'Support Programme for Technology Development Projects' implemented by the TTGV. TTGV's scheme is in operation since 1991 and initiated with the funding provided from the World Bank resources. The scheme supports the same type of industrial R&D projects that TUBITAK does, but provides soft loans instead of grants. Total support provided by TTGV through this programme was around €10m in 2008.

KOSGEB provides funds to the R&D projects of SMEs through the 'R&D and Technological Innovation Support Programme'. A mixture of grants and soft loans is provided to SMEs. A total amount of €3.5m was provided through the programme in 2008.

Route 3: Stimulating firms that do not perform R&D yet

Apart from the above-mentioned KOSGEB support for SMEs, the only scheme available to stimulate firms that do not perform R&D yet is the 'SME Funding Programme' implemented by TUBITAK. The programme was initiated in 2007. It aims to increase the number of R&D projects carried out by SMEs by offering a much faster and easier access for funding. The aim of the programme is to support SMEs to develop new products, cost minimizing techniques, production technologies and to enhance the existing products qualifications, standards and quality. The SMEs are expected first to gain the capacity to develop new R&D projects and then apply to the main R&D supporting programme. The support also includes the procurement of consultancy for the preparation of project proposal as well as administrative issues throughout the project. As of November 2008, the total number of projects selected for support was 678 and total budget allocated for these projects was around €6m since the programme was first introduced in March 2007.

Route 4: Attracting R&D-performing firms from abroad

Attracting FDI is one of the priorities of the Government. However, there are no direct measures for attracting research intensive FDI. The new R&D tax law ('Law on Supporting Research and Development Activities') which provides generous fiscal incentives for R&D activities of firms employing at least 50 researchers is expected to be used as a stimuli to attract foreign firms which would like to locate their R&D branches outside their home countries.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The topic has been on the political agenda for a very long time and there are support measures implemented by support agencies. One of the programmes implemented for this purpose is the 'Industrial Thesis (San-Tez) Projects' support programme by the MoIT. The programme was designed to bridge the gap between the industry and the academic community. It aims to stimulate co-operation between firms and universities by supporting MS and PhD thesis which are carried out by graduate level students in order to develop new technology-based products and processes, and to transform the university research into innovative products and processes in line with the needs and requirements of the industry. Universities can apply to the programme with the participation of at least one private sector enterprise. The private sector enterprise should provide a statement regarding how the results will be used in the industry and that they will be financing 25% of the whole project budget.

Another measure introduced in this area by TUBITAK is the ISBAP programme. The aim of the programme is to assist the establishment of sector or technology specific networks/platforms by national and international enterprises, public research institutes and scientific communities. The programme has been inspired from the technology platforms developed under the 6th Framework Programme of the European Union. The networks/platforms established are expected to carry out technological road mapping activities and conduct research in order to meet the needs of network/platform members. The programme was developed to replace the "University-Industry Joint Research Centres (USAMs) Programme". The USAMs established under this programme, if apply for support, are funded through the ISBAP.

As a part of the 'Support Programme for Research Projects of Public Institutions', it is possible for public organisations to create consortiums with the private sector, universities or public research institutes to conduct joint R&D activities. Since this programme is more related to the increasing R&D in the public sector (and since R&D collaboration with third parties is not obligatory for public organisations) it is covered under the Route 6 below.

Route 6: Increasing R&D in the public sector

Involvement of the public sector in R&D activities is another topic that has been debated over the last ten years. In 2005, TUBITAK introduced a new programme called the 'Support Programme for Research Projects of Public Institutions' (KAMAG). The R&D needs of public organisations are addressed through TUBITAK funding under this programme. Defence and space programmes are managed separately in accordance with another decision taken by the BTYK.

As part of the programme, the public administrations need to identify their needs, which could be solved through R&D projects. If required by the public administration, these projects can be implemented in collaboration with the private sector or universities/public research institutes. TUBITAK undertook the task of moderating the workshops for the identification of research needs, primarily with the ministries and with other public institutions. In the preparation period of the programmes, related ministries and public bodies organised "joint consultation meetings", as one-off events, with the participation of related universities and research institutions. In these meetings, the short and mid-term research areas were defined and plausible research projects in these areas were discussed. The final list of objectives and

research priorities, resulting from these meetings, were transformed into research programmes by core groups, which were composed of experts from various sectors (such as universities, public institutions, non-governmental organisations). The research programmes were approved by the BTYK.

As of October 2007, the following programs were prepared by public bodies in corporation with TUBITAK and approved by the BTYK:

- Defence Research Programme and Space Research Programme
- National Earthquake Research Programme
- National Health Research Programme
- National Agriculture Research Programme
- National Energy and National Resources Research Programme
- National Law Research Programme
- National Family and Social Research Programme
- National Internal Security Research Programme
- National Environmental and Forestry Research Programme
- National Foundations Research Programme
- National Transportation Research Programme
- National Population and Citizenship Affairs Research Programme
- National Cultural and Tourism Research Programme
- National Education Research Programme

Related public bodies announce these national programmes to all organisations that will conduct R&D activities.

The importance of education and innovation policies

Public funding for human resource development has been increasing in line with the research strategy. YOK, MoNE and TUBITAK are the three major public organisations that provide scholarships. For years, YOK has been providing teaching assistants with scholarships to encourage them to conduct graduate studies abroad. MoNE introduced in 2006 a scholarship programme that targets to send 5000 students abroad in 5 years for their graduate studies. Finally, TUBITAK has tripled the number of scholars since 2005 and by the end of the year 2007, 6800 scholarships were provided.

There is an increased focus on science, technology and innovation in the new curricula designed and implemented by the MoNE since 2005, at the primary and secondary levels of education. As an important step, innovation has been integrated in the national education curricula as a topic under the course ‘Technology and Design’. In addition, TUBITAK, in cooperation with the MoNE, organises various schemes (such as science olympiads) to promote science and research in schools. Incentives and support have also been provided for university researchers by TUBITAK in the form of project support, scholarships and awards to increase the number of R&D personnel. In 2007, TUBITAK started a new support programme called the "Science and Society Support Programme" enabling teachers and academics to develop and implement projects to promote science in schools and universities.

There are 27 different scholarships and S&T awareness raising programmes implemented by the BIDEB department of TUBITAK from primary school level to graduate level. In 2008, approximately €28m funding was provided to around 15,500 beneficiaries through these programmes. The amount of scholarships provided by TUBITAK-BIDEB has increased almost 20 times from 2003 to 2007.

Assessment of the importance of policy mix routes and their balance

Route 1 has been attached particular importance by policy-makers since late 1990s. However, existing incentives are insufficient to stimulate the creation of new indigenous R&D performing firms, and therefore, there is a need to increase the number and diversity of policy measures.

Route 2 is the most important route in the Turkish research policy. The Government has been stimulating greater R&D investment in R&D performing firms through direct funding and fiscal incentives for more than two decades.

Importance attached to Routes 3 and 6 are increasing and there are new policy measures in place to stimulate R&D in both routes.

Route 4 has not been a priority topic of debate in policy circles. Therefore, there exist no policy measures specifically designed to attract R&D-performing firms from abroad.

Table 7: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	No specific policies exist for new indigenous R&D performing firms however there are four measures available to encourage the creation of new technology-based firms	The collateral requirements for the funding provided by TUBITAK will be removed in 2009
2	This route is the most important one in the policy mix. There are various schemes in place, which have been implemented for more than two decades.	Amount of funding increases
3	This route has been one of the main concerns of the strategy but the number and diversification of measures are limited.	Some minor changes are planned starting form April 2009 regarding the application times of research projects and employment of S&E engineering graduates in companies
4	No direct measures to attract R&D-performing firms from abroad. However, the R&D law indirectly aims to attract R&D branches of multinationals through generous fiscal incentives.	No major policy change
5	There is interest on this route at the policy level and there are some measures in place. However interest from the business sector is very low mainly because of the limited incentives provided by the measures.	The current ISBAP programme will be extended such that local networks will also be supported
6	There is interest at the policy level and a measure is in place.	No major policy change

Although given priority by the policy-makers, uptake of the policy measures under Route 5 by the target groups is limited. The number of projects supported under San-Tez is approximately 120 since the launching of the programme in 2006. ISBAP supported seven projects since it was initiated in 2007. Two of these seven projects are the university-industry research centres established under the programme preceding ISBAP (USAM), and four projects do not have private sector participation.

3.4 Progress towards national R&D investment targets

The progress towards the national R&D investment targets has been satisfactory so far. Since the 2% target has been set in 2005, GERD as a percentage of GDP has increased from 0.52% in 2004 to 0.71% in 2007. Total GERD in 2007 was around €2.69b, according to R&D survey results of TURKSTAT. Business sector R&D expenditures have also increased remarkably from 24.2% in 2004 to 41.3% in 2007.

Although largely achieved by the revision of the FTE ratios by TURKSTAT, the target 40,000 FTE R&D personnel was reached in 2007. Now the focus of the government is to achieve the revised target of 150,000 FTE R&D personnel by 2013. The current policy mix has been shaped in line with the targets, and therefore, mainly focuses on stimulating greater R&D investment in R&D performing firms, increasing extramural R&D carried out in cooperation with the public sector, and increasing R&D in the public sector. Apart from these routes, higher importance is attached to the development of researchers.

The S&T targets are very ambitious in nature. In order to achieve the 2% target by 2013, the funding should increase almost 5 times as compared to the GERD in 2007. The private sector R&D spending should increase almost 7-fold by 2013 in order to reach 50% BERD/GERD ratio, and the government should finance 1/3 of business R&D investment. The number of FTE R&D personnel should increase almost 3.5-fold in the same time interval. According to EUROSTAT, total number of FTE R&D personnel in EU27 increased by 10% in five years, from 1,202,824 in 2003 to 1,349,808 in 2007. Considering this fact, one can judge that reaching the FTE R&D personnel target is a major challenge for Turkey.

As also noted in Section 2.3.1, these increases were calculated by TUBITAK with a GDP growth assumption of 7% per year, which was the average rate of growth for the period 2002-07. However, the current economic crisis has shown that the GDP growth will be lower than forecasted, and as a result, the 2% target might be approached.

Table 8: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Low level of research and innovation culture and investment in Turkey, particularly in the private sector	Increased amounts of public funding available Current economic crisis may result in lower level of GDP growth making it easier to reach the 2% target, assuming that public funds for research will not diminish Low levels of R&D awareness and capabilities in the private sector are not directly addressed by the policy mix R&D funding is provided without any sectoral and regional focus which could lead to inefficient use of the R&D funding No systematic evaluation exists for R&D programmes and policies

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Low levels of BERD over GERD ratio	Increase in funding for business R&D is much higher than academic and public R&D Limited R&D capabilities and absorptive capacities in the private sector and particularly in SMEs can risk the increase in the BERD Current policy instruments are complex and bureaucratic for SMEs. However, a new scheme is adopted specifically to encourage SMEs to invest in R&D. Need to develop R&D capabilities and raise awareness on R&D and innovation among SMEs.
Limited number of human resources for R&D	The target for increasing the amount of FTE researchers is set and measures initiated to reach the target If this target is not achieved the 2% target will not be reached either The target requires almost all the S&E graduates to be employed as full-time researchers, which could hamper the competitiveness and absorption capacity of the business sector (as noted in section 3.1, the number of S&E graduates was approximately 35,000 in 2006. The number of FTE researchers was around 40,000 in the same year. Increasing this number to 150,000 by 2013 means that 110,000 new FTE researchers should be recruited over seven years. This means almost every S&E graduate needs to be employed as a FTE researcher while the private sector would also need S&E graduates for other positions, such as innovation and production.) Policy mix does not directly address the development of human capital for R&D and innovation at the private sector Policy mix needs to target increasing the enrolment and attainments in tertiary education and attracting back Turkish PhD students living abroad
Low level of cooperation among different research actors, particularly between universities and the private sector	Several measures have been designed and in place to stimulate collaboration between universities and the private sector as well the public organisations and research performers Intensified collaboration can be achieved if policy mix also addresses improvements in the regulatory framework that currently creates disincentives for researchers to offer services to commercialise research results

4 Contributions of national policies to the European Research Area

This Chapter provides a thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA[14] which

[14] Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final
(see http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers
- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

According to 2008 TURKSTAT population statistics, 0.1% of Turkish population have PhD degrees, 0.4% holds masters degrees and 5.9% holds university degrees including the vocational high schools.

As noted in previous sections, the number of researchers and R&D personnel increases with the increase in public funding and policy measures for the development of human capital for research. Despite this progress, the number of researchers is still far behind compared to the OECD and EU averages.

When the educational levels of FTE R&D personnel is considered, 24% of them holds a PhD or a higher degree, 18% holds a masters degree, and 39% holds a bachelors degree (TURKSTAT, 2007). The rest has either a post-secondary non-tertiary or a lower degree. While the holders of a PhD or a higher degree constitute almost half of the FTE R&D personnel employed in the higher education institutes, in the private sector, they make up for only 3% of the total R&D workforce.

Regarding the tertiary education, the number of bachelor's degrees awarded has grown approximately by 20% since 2001. The shares of science and engineering degrees as a percentage of all bachelors' degrees were 8.1% and 9%, respectively, in 2006. Although the shares remained the same, the number of graduates has continued to increase. The number of science and engineering graduates has increased since 2001 by 11% and 15%, and reached to 16,450 and 18,324 in 2006, respectively.

4.1.1 Policies for opening up the national labour market for researchers

There are no barriers for recruiting foreign researchers for both permanent and temporary positions in the Turkish universities. However, employing researchers in public organisations and private sector is not that easy because of the bureaucratic and time-consuming regulations regarding the employment of foreigners. No distinction exists between researchers and regular workers for the private sector.

Scholarship programmes exist in particular for the third countries at the tertiary education level, which sometimes result in longer-term residence and work permits.

The 'Implementation Plan for the International Science, Technology and Innovation Strategies (2008-2010)' issued by the BTYK in 2007 mainly focuses on the issue of attracting foreign researchers.

There is a programme implemented by TUBITAK-ARDEB (the so-called 'International Researcher Programme') for the inclusion of international researchers in R&D projects of both universities and business enterprises. If an international researcher is employed in a project, separate application is filed stating the excellence of the researcher in the project topic. Other than this scheme, R&D support programmes usually allow the inclusion of service procurement from the international research community up to a certain percentage of the total project budget as long as the applicant proves that necessary knowledge is not available in Turkey.

The Visiting Scientists Fellowships Programme implemented by TUBITAK-BIDEB provides funding for short-term visits of foreign scientists with at least PhD degrees for seminars or trainings.

Another recent development in this area includes the establishment of the International Researchers Coordination Committee by the BTYK. The aim of the committee is to find solutions to the problems of international researchers in Turkey. Main issues of international researchers to be addressed by the committee are identified as follows:

- Lowering bureaucratic burden for obtaining and renewal of work permission for international researchers and their spouses;
- Solving problems regarding researchers' diploma equivalence and academic promotion;
- Improving education conditions of their children;
- Solving problems regarding social security and health insurance of international researchers to make sure that they can transfer their social security rights to Turkey without any problems, and that they can equally benefit from quality and safe health services accessible to the Turkish citizens.

The committee will consist of high-level officials from the Ministry of Foreign Affairs, MoF, MoNE, Ministry of Health, Ministry of Labour and Social Security, MoIT, YOK, TUBITAK and the Ministry of Internal Affairs. The committee will convene at least once a month for developing solutions to above issues and the working period of the committee will be extended by BTYK, if required.

Regarding the opening up of the national market for international researchers there are no specific targets or strategies in the national S&T strategy.

4.1.2 Policies enhancing the attractiveness of research careers in Europe

As highlighted in Section 3.3.2, public funding for human resource development has been increasing in line with the research strategy and there are scholarship programmes implemented by the MoNE, YOK and TUBITAK.

Tax incentives exist for R&D personnel working in TDZs, as noted in Section 3.3.2. Starting from 2008, the new R&D law provides tax benefits for researchers working outside TDZs in "R&D Centres" created by companies and approved by the government. In order to increase the demand for PhD graduates, TUBITAK's support

programme for industrial R&D provides for an additional 30% bonus support for the costs of R&D personnel with PhD degrees.

Other than increasing the budgets of the programmes mentioned above, no new specific actions and plans exist for 2009 on enhancing the attractiveness of research careers in Turkey.

On the other hand, there have been two funding mechanisms for graduate students for a long period of time, which include research assistantship in universities and scholarships from TUBITAK projects. Graduate students can be recruited as research assistants by universities, whose salaries are paid from the budgets of universities. Similarly, graduate students can be included in the research projects submitted to the ARDEB department of TUBITAK. As of October 2008, there were 3,544 scholarships provided by ARDEB through this mechanism.

As for the remuneration policies, salaries of academic staff at the public universities are not determined by universities and research institutes, while private universities are free in this respect.

Average total annual salary of researchers in Turkey in terms of Purchasing Power Standard (PPS) is €26,250. This is almost half the EU-25 average of €40,126. In 2007, women researchers constituted 30.7% of total researchers, while the EU27 average was 28% in the same year. According to the TURKSTAT, the share of women is 22% in the business sector, 23% in the government sector and 40% in the higher education sector. The difference in salaries between men and women researchers was calculated to be around 28% in favour of male researchers (European Commission, 2007).

There is no evidence about the uptake of the European Charter for Researchers in Turkey, which sets the general principles and requirements that enable the frame for successful research performance, knowledge dissemination and technological development, and to the career development of researchers.

Turkey is relatively well situated in Europe with respect to female employment in research area. National regulations and laws allow the restoration back to the same type of work after career breaks (i.e. maternal leave). Additionally, every university with over a certain number of employments should establish a day care in their premises, which also encourages females to work as researchers.

4.2 Governing research infrastructures

The main tool used for deciding on the research infrastructures to be supported are the Development Plans and the current national S&T strategy formulated at the end of national technology foresight exercise under the ‘Vision 2023 Project’. The DPT is responsible for the design and implementation of the Development Plans. In the preparation stage of the plans, ‘Specialised Committees’ on each sector, including science and technology, are formed by representatives from public organisations, private firms, private umbrella organisations and NGOs ensuring the participatory process at the highest level. The reports prepared by these committees are fed into the development plans and are used to identify priorities.

The Vision 2023 project is the first and only national technology foresight exercise of Turkey. The priority areas for R&D investment identified as a result of the exercise include Information Technologies, Biotechnology and Gene Technologies, Materials,

Nanotechnology, Design Technologies, Mechatronics, Production Methods and Machinery, Energy and Environmental Technologies.

In the implementation side, the infrastructure investment needs are usually identified by universities or the public research centres. For smaller investments, TUBITAK's project funding schemes are used. For bigger investments, applications are made directly to the DPT (also see Section 3.3.1).

Overall assessment shows that the infrastructure investments are various in nature. There is a need for strategy and coordination at national level. The BTYK decided in the current S&T strategy that new investments would be avoided as much as possible, and project applications, which target at better and effective use of available structures, would have the priority.

At the transnational level, Turkey is a member of the European Strategy Forum on Research Infrastructures (ESFRI), and actively participates in the thematic working groups and in the EU Roadmap Working Groups (in the fields of Biological and Medical Sciences, Physical Sciences and Engineering, Environmental Sciences, and Social Sciences and Humanities). As a part of the ESFRI related activities, the DPT is in the process of developing the Research Infrastructures Roadmap for Turkey. It is expected that the roadmap will be finalised by the end of 2009. In the roadmapping study, energy, biomedical, physics, engineering and social sciences are given priority. In addition, Turkey is a partner in the ESFRI projects such as the 'European Multidisciplinary Seafloor Observatory' and the 'Partnership for Advanced Computing in Europe', and is taking steps to participate in the 'Pan-European infrastructure for clinical trials and biotherapy'. Turkey does not commit funds for the implementation of the ESFRI Infrastructures.

Although the 'Implementation Plan for the International Science, Technology and Innovation Strategies (2008-2010)' does not address Turkey's participation in transnational infrastructures, there are actions being taken by various organisations for strengthening international collaborations. In 2007, ten Turkish research infrastructures opened up their infrastructures to foreign access through the European Portal on Research Infrastructures Database. These institutes include the following[15]:

- Trisonic Research Centre, Rotorcraft Design and Excellency Centre, Laboratory of Meteorological Instruments and Observation Methods, and Meteorological Observation Park of the Istanbul Technical University
- Central Research Institute for Crops
- Urban and Environmental Planning and Research Centre of the Istanbul Technical University
- Plant, Drug and Scientific Researches Centre of the Anadolu University
- Mineral and Coal Processing Unit of the Istanbul Technical University
- Electropol and Biosensor Research Laboratory of the Istanbul Technical University
- Mine Mechanisation and Technology Unit of the Istanbul Technical University
- Automotive Laboratory of the Istanbul Technical University
- Solar Energy Institute at the Ege University

[15] http://www.riportal.eu/public/index.cfm?fuseaction=ri.search

- Ottoman Bank Archives and Research Centre

The total cumulative investment for initial construction/setting up of the research institutes listed above is between €200-350m.

In addition to above developments, activities are being carried out by TUBITAK to establish collaborations with the International Centre for Genetic Engineering and Biotechnology, the European Space Agency (ESA), the British National Space Centre, the Netherlands Agency for Aerospace Programmes and the Russian Federal Space Agency. Among these institutions, collaborations with the ESA are attached higher priority. TUBITAK has recently completed the draft version of the roadmap and action plan for this purpose. The roadmap includes, inter alia, actions for creating dialogue groups and joint projects on space science, technology and earth observation, designing and implementing training programmes for Turkey, using the ESA facilities, and designing an international post-doctoral scholarship programme in the area.

4.3 Research organisations

As mentioned previously, universities are the biggest research performing sector in Turkey. There are 132 Turkish universities of which 38 are privately-owned. Universities employ around 80,000 academic staff and the total number of students is around 2 million. Every university has a budget of its own for the salaries and investments needed to fund their regular activities. Total budget of the universities for 2009 is around €4.9b which approximately corresponds to 3.4% of the total state budget. According to TURKSTAT, total R&D spending of the universities was around €1.6b in 2007 that is almost 45% of the total budget of universities in the same year. For research spending, academics need to prepare applications for their own projects to apply either to TUBITAK or DPT depending on the size of investment, as explained in previous sections. Universities also have to allocate a percentage of their revolving funds for R&D projects, which usually does not exceed 5% of their incomes from the revolving funds.

Almost every university aims to improve their quality in education and research in line with the Bologna Process. Governance reform activities in Turkey have mainly focused on developing the ‘Quality Management Standards for HEIs’ issued by the YOK. In 2005, a regulation concerning the ‘Quality Management and Evaluation Principles to be applied in Universities’ was published in the Official Gazette. According to the regulation, universities in Turkey have to establish a quality management system where an internal evaluation needs to be conducted every year and an external evaluation should be carried out every five years. Universities will have to develop their strategy plans according to the results of these evaluations. Public universities, in accordance with new public management law issued in 2003, have prepared the first strategic plans. In addition, the YOK has started working on the "National Qualification Framework" as part of the Bologna process.

There are more than 100 public research institutions in Turkey. Most of them are working in agriculture and forestry, and they are distributed all around the country. It is estimated that 11,798 researchers are employed by the public sector that constitute 10% of all researchers in Turkey (TURKSTAT, 2007)

The most active public research institutes are those established by TUBITAK (Marmara Research Centre, Defence Industries R&D Institute, National Electronics and Cryptology Research Institute, Space Technologies Research Institute, National

Metrology Institute, Basic Sciences Research Institute and Cukurova Advanced Agro-Technologies R&D Institute). The total number of TUBITAK personnel as of December 2008 was 3,402 (2,343 are permanent staff and the rest are hired on project-basis) of which 74% were researchers.

TUBITAK-MAM is the largest public research centre employing 1,002 researchers. There are six institutes in the centre, namely the Information Technologies Research Institute, Energy Systems & Environmental Research Institute, Materials Institute, Chemistry and Environment Institute, Food Science & Technology Research Institute, and Earth and Marine Sciences Research Institute.

The General Directorate for Agricultural Research (TAGEM), which is affiliated to the Ministry of Agriculture and Rural Affairs, is also one of the biggest public research organisations having seven central and nine regional research institutes and 34 thematic research institutes.

Another important public organisation associated with research is the TAEK. The research activities of the TAEK are carried out in Saraykoy Nuclear Research and Training Centre and Cekmece Nuclear Research Centre.

Public research institutes have their own budgets for carrying out their activities but when they need project funding the institutes need to apply to TUBITAK for each project separately. In general, both universities and research institutes have autonomy on research projects, however, the projects need to be approved by TUBITAK or DPT in order to receive required funding.

As for the private research organisations, due to tax incentives, there has been a trend towards moving R&D departments to technoparks (the TDZs) established close to the universities (also see Section 3.3.2 for information on technoparks). However, as noted in previous sections, the new R&D law, issued in 2008, allows companies with at least 50 FTE researchers to benefit from tax incentives without moving to a technopark after being evaluated by the Ministry of Industry and Trade.

Universities can send their researchers to work for other universities for short terms, according to Article 35 of the Higher Education Law (Law No. 2547). To benefit from this possibility, the Middle East Technical University (METU) started a national academic staff development programme in 2003 where they provide PhD programmes for research assistants of other universities in Turkey. As of May 2009, there are eight more universities implementing similar programmes with the inspiration from METU. The programmes are funded through the budgets of the universities. However, they need to submit proposals to the DPT for the PhD programmes that they plan to initiate. The DPT evaluates the proposals with regards to the strategic plans. Once the programmes are approved, universities receive their funding from the MoF every year according to the availability of funds in the state budget. For 2008-2009 period, the total budget allocated for this purpose by these nine universities is €12.8m.

4.4 Opening up national research programmes

Turkey participates actively in the European research framework programmes and schemes such as COST and EUREKA. The opening up of the national programmes to the international community is mainly limited with the obligations in these programmes. In fact, since Turkey is not an EU Member State, opening up national programmes has not been a policy consideration in the country. However, Turkey is represented by TUBITAK in the High Level Group on Joint Programming under the

Scientific and Technical Research Committee (CREST). The 'Implementation Plan for the International Science, Technology and Innovation Strategies (2008-2010)' does not address this issue either, while joint research projects are encouraged within the framework of bilateral S&T cooperation agreements with other countries.

As already explained in Section 4.1.1, collaborations with international researchers are encouraged by TUBITAK. The Turkish coordinator of research projects supported under the research programmes can request funding for hiring international experts, by filing another proposal under the International Researcher Programme. While submitting the project proposal, the coordinator needs to prove that relevant expertise does not exist in Turkey and the proposed international researcher has the necessary skills to complete the job. Also, the Turkish companies are allowed to purchase services from the international research community as long as the amount does not exceed a certain percentage of the total project budget (the percentage depends on whether the project is submitted by a big company or an SME, and whether the service provider is a university, a research centre or a private company).

The policy makers consider the Turkish involvement in the ERA-NET projects as an important opportunity for the integration of TARAL with the ERA. Turkey is involved in 19 ERA-NET projects. In the majority of these projects, Turkey is represented by TUBITAK. The Ministry of Agriculture and Rural Affairs participates in five projects in the field of food, agriculture, fishery and biotechnology, and the Ministry of Public Works and Settlement takes part in the project on the strategic networking of RDI programmes in construction and operation of buildings. In 2009, applications to nine new ERA-NET projects have been completed in the fields of nanotechnology, food, agriculture, fishery and biotechnology, research infrastructures, environment and health. The ERA-NET projects in which Turkey is involved include the following:

- Coordination of European research on emerging and major infectious diseases of livestock (EMIDA)
- Coordination of Agricultural Research in the Mediterranean Area (ARIMNet)
- Facing sustainability: new relationships between rural areas and agriculture in Europe (RURAGRI)
- Strategic networking of RDI programmes in construction and operation of buildings (ERACOBUILD)
- ERA-NET Materials (MATERA and MATERA+)
- The ERA-Net for research programmes on Nanomedicine (EuroNanoMed)
- The ERA-NET on wood material science and engineering (WoodWisdomNet 2)
- ICT-enabled Transformation of Manufacturing (Etranet)
- Coordination of European Research within ICT and Robotics in Agriculture and Related Environmental Issues (ICT-AGRI)
- Supporting urban sustainability research in Europe (Urban-net)
- Phytosanitary ERA-NET (EUPHRESCO)
- ERA-Net for research programs on rare diseases (E-RARE)
- Collective Research Networking (CORNET and CORNET II)
- Micro- and Nano- Technologies (MNT ERANET II)
- South East European Research Area for eInfrastructures (SEERA-EI)
- Transnational Foresight ERA-NET (FORSOCIETY)

- ICT enabled Transformation of Manufacturing (ETRANET)
- European Excellence in Food Safety Research Programming (SAFEFOODERA).

Turkey is also represented in the Innovative Medicines Initiative (IMI), Nanoelectronics Technologies 2020 (ENIAC) and Fuel Cells and Hydrogen (FCH) Joint Technology Initiatives of the EU through the Turkish universities and TUBITAK.

Turkey participates actively in the European research programmes such as the Research Framework Programmes (FP), the Competitiveness and Innovation Framework Programme (CIP), the European Cooperation in the field of Scientific and Technical Research (COST), EUREKA, European Science Foundation (ESF), European Heads of Research Councils (EUROHORCs) and European Molecular Biology Conference (EMBC); as well as regional organisations such as Black Sea Economic Cooperation (BSEC) and Economic Cooperation Organisation (ECO) and international organisations such as NATO, OECD, UNESCO and the International Council for Science (ICSU).

Turkey's contribution to FP7 has been €52m for 2007 and 2008. As of October 2008, there were 588 Turkish project partners in FP7 projects applications. 177 of these projects partners have been involved in selected projects.

Turkey participates in nine International Cooperation Networks (INCO-NET) established under FPs, which aim to increase research collaboration with different parts of the world.

In order to increase the success levels of the Turkish Research Community in FPs, an international non-profit association named the 'Turkish Research and Business Organisations-Public-Private Partnership' (TURBO) was established in 2004 by TUBITAK, KOSGEB, TOBB and the Confederation of Turkish Tradesmen and Craftsmen (TESK) in Brussels. TURBO aims at contributing Turkey to attain the success in the EU's RTD and private sector/enterprise-oriented programmes within the framework of the EU's Lisbon Strategy by providing information, communication, consultancy and training services, involving in target-oriented networks and carrying out lobbying activities.[16]

4.5 National ERA-related policies - a summary

Turkey is at the accession negotiation stage for EU membership and the process harmonisation with the EU *acquis* is still underway. However, the targets of the Turkish Research System are usually set in parallel with the ERA targets. Among the 35 topics to be discussed during the accession negotiations, the first screening topic that has been opened and the only one closed[17] has been the "Science and Research" chapter. The meetings were held in October and November 2005. According to the screening report, Turkey has reached a good level of alignment and capacity to implement the EU *acquis*. The main points for improvement have been identified as:

- ensuring and demonstrating scientific freedom regarding all relevant scientific institutions and the continuous as well as adequate availability of budgetary resources;

[16] www.turboppp.org
[17] As of May 2009.

- encouraging the participation of industry in research projects and creating the necessary conditions to stimulate investment in research by the private sector;
- undertaking actions to increase human resource capacities and to streamline research actions among universities;
- improving capacity building by participating in EU funded research programmes and ensuring full association in all Framework Programmes (including 7th Framework Programme/EURATOM).

The harmonisation process has positively affected Turkey's strategies in R&D and they are usually very much in line with the ERA targets.

Turkey participates actively in the European research programmesThe 'Turkish Research and Business Organisations-Public-Private Partnership' (TURBO) was established to raise the participation and the success of the Turkish Research Community in FPs, as already explained in Section 4.2.

With regards to the international mobility in general and the involvement in the EU programmes in particular, a major problem faced by the Turkish researchers is related to visa requirements for the EU counties. Both the high costs (varies between €100-250) and complex procedures involved create a disincentive for researchers.

Table 9: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	**Key characteristics of policies**
Labour market for researchers	• High on the policy agenda (however, no direct linkages are established with ERA as Turkey is not a member state)	• Increased amount of scholarships for foreign students • The new international researcher support scheme • Participation in the EU research mobility programmes, such as EURAXESS and Marie Curie grants.
Governance of research infrastructures	• Mainly focused on more effective use of the current infrastructure instead of establishing new ones • Active participation in the European Strategy Forum on Research Infrastructures (ESFRI) and actions being taken to prepare the national Research Infrastructures Roadmap • Ten research infrastructures opened up to foreign access through the European Portal on Research Infrastructures Database	• Increased budget for research
Autonomy of research institutions	• Higher interest from the Turkish universities but explicit policies are not yet in place • Public research institutions are not autonomous • The research institutions have the flexibility to determine the R&D topics to be undertaken while they need to apply to the funding agencies where their projects are evaluated according to the criteria designed by these agencies	• Considerable progress achieved in the implementation of the Bologna process

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Opening up of national research programmes	• Not mentioned in the policy documents or in the strategies developed so far • Active participation in the ERA-NET projects which are seen as a tool for the integration of TARAL with ERA.	• Inclusion of international researchers possible with affiliation to a Turkish research institute or company • Turkey gets involved in the common programmes on research in the ERA

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

Although the academic research policies and measures date back to early 1960s in Turkey, R&D policies and policy measures for the private sector were shaped in 1990s.

Political commitment to increase R&D investments has increased in this decade and ambitious targets were set to approach Barcelona target of the EU. Turkey aims to reach 2% GERD over GDP and 150,000 FTE R&D personnel by 2013. To reach these targets, government finance for R&D has increased since 2005 and new policy measures have been put in operation. The Turkish Research Area (TARAL) has been initiated to support and sustain these developments.

In line with the targets, stimulating greater R&D investment in R&D performing firms, increasing extramural R&D carried out in cooperation with the public sector and increasing R&D in the public sector have been the main focus of the policy mix in Turkey. The routes of stimulating firms that do not perform R&D yet and promoting the establishment of new indigenous R&D performing firms are addressed only by a few measures. There are no direct measures towards attracting R&D performing firms from abroad. However, the new R&D Law providing fiscal incentives for R&D activities of the private sector, indirectly aims to attract R&D centres of multinationals.

Reaching the S&T targets and absorbing increased public finance for R&D is a challenge for Turkey. Particularly, the contribution of business enterprises in the total GERD (just above 40%) is lower than that of the OECD average. In addition SMEs account for 99.9% of enterprises in Turkey, which, in general, have low capabilities and awareness for R&D. In addition, although majority of research is conducted by the universities, their results could not be fully exploited due to barriers mainly linked with the regulatory framework.

The R&D strategies and programmes focus on resource mobilisation and knowledge production while there is an obvious need for policies and measures for knowledge demand and knowledge circulation.

There is a need for enhancing policy mix by developing regional and sectoral approach in R&D support, as well as enhancing capabilities for R&D, which in turn will yield to higher R&D investments by the target groups. Development of a long-term policy-making practice, which is evidence based, will also contribute to the efforts for meeting national R&D investment goals. In that respect, it is important to adopt systematic monitoring and evaluation of the policies and programmes.

5.2 ERA-related policies

ERA plays a key role in the formulation of national targets and objectives. Participation in the EU framework programmes and the integration of the TARAL with the ERA is a priority for the government. To ensure access to the international knowledge, a programme was introduced by TUBITAK for the inclusion of international researchers in the research projects of national organisations. The number of scholarships has also increased for international students. In addition, the European programmes inspire some of the R&D support schemes designed in Turkey.

Turkey is determined to be involved in the community research and innovation programmes implemented at the European level and puts efforts to ensure higher level of participation in the programmes.

With respect to the national challenges for the national R&D-system in relation to ERA developments, the most important issue is the visa requirement, which is a barrier for movement and interaction of researchers throughout Europe. Visa processes are costly, time-consuming and very bureaucratic which is a disincentive for researchers' mobility. Since Turkey is not an EU Member State, opening national programmes in order to support the best research throughout Europe has not been a policy consideration in the country.

References

DPT (2006): Ninth Development Plan (2007-2013): http://www2.dpt.gov.tr/konj/DPT_Tanitim/pdf/Ninth_Development_Plan.pdf

European Commission (2007): Remuneration of researchers in the Public and Private Sectors http://ec.europa.eu/euraxess/pdf/final_report.pdf

European Commission (2008): European Innovation Scoreboard Comparative Analysis of Innovation Performance, PRO INNO Europe: http://www.proinno-europe.eu/EIS2008/website/docs/EIS_2008_Final_report.pdf

European Commission (2008): Turkey 2008 Progress Report: http://ec.europa.eu/enlargement/pdf/press_corner/key-documents/reports_nov_2008/turkey_progress_report_en.pdf

European Commission (2009): ERAWATCH Research Inventory for Turkey: http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&countryCode=TR&topicID=4

Elci, S. (2007): INNO-Policy TrendChart — Policy Trends and Appraisal Report, TURKEY, European Commission: http://www.proinno-europe.eu/extranet/upload/countryreports/Country_Report_Turkey_2007.pdf

Elci, S. (2008): INNO-Policy TrendChart — Policy Trends and Appraisal Report, TURKEY, European Commission: http://www.proinno-europe.eu/extranet/upload/countryreports/Country_Report_Turkey_2008.pdf

Audit Office of the President (2009): Report on the Assessment of Law on Technology Development Zones (Law No: 4691), Problems and Suggestions (in Turkish): http://cankaya.gov.tr/sayfa/cumhurbaskanligi/ddk/ddk26.pdf

TUBITAK (2008): Reports on BTYK Decisions between 2000 and 2008 (in Turkish): http://www.tubitak.gov.tr/home.do?all=t&ot=&rt=&sid=470

TURKSTAT (2007): Research and Development Statistics: http://www.turkstat.gov.tr/PreTablo.do?tb_id=8&ust_id=2

World Bank (2008): Turkey-National Innovation and Technology System: Recent Progress and Ongoing Challenges

List of Abbreviations

BERD	Business Enterprise Research and Development
BTYK	Supreme Council of Science and Technology
CIP	Community Innovation Programme
DPT	State Planning Organisation
EC	European Commission
EU	European Union
FDI	Foreign Direct Investment
FP	European Framework Programme for Research and Technology Development
FTE	Full Time Equivalent
GDP	Gross Domestic Product

GERD	Gross Domestic Expenditure on Research and Development
GOVERD	Government Expenditure on R&D
HEI	Higher Education Institution
HERD	Higher Education R&D expenditure
HES	Higher Education Sector
IPR	Intellectual Property Rights
KOSGEB	Small and Medium Industry Development Organisation
MoF	Ministry of Finance
MoIT	Ministry of Industry and Trade
MoNE	Ministry of National Education
OECD	Organisation for Economic Cooperation and Development
P-KKK	Money-Credit and Coordination Council
PPS	Purchasing Power Standard
PRO	Public Research Organisations
R&D	Research and Development
RDA	Regional Development Agency
S&E	Science & Engineering
S&T	Science and Technology
SCI	Science Citation Index
SME	Small and Medium Enterprises
STI	Science, Technology and Innovation
TARAL	Turkish Research Area
TPE	Turkish Patent Institute
TTGV	Technology Development Foundation of Turkey
TUBITAK	Scientific and Technological Research Council of Turkey
TURKSTAT	Turkish Statistical Institute
YOK	Higher Education Council
YPK	High Planning Council

RESEARCH SYSTEM ANALYSIS REPORT

Elements on Research System Analysis relevant for the policy Mix Reports 2009 for non EU Member States

Country: Turkey

TABLE OF CONTENTS

1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the renewed Lisbon Strategy and the European Research Area

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks. A particular consideration in the analysis is given to elements of Europeanisation in the governance of national research systems in the framework of the European Research Area, relaunched with the ERA Green Paper of the Commission in April 2007.

To ensure comparability across countries, a dual level analytical framework has been developed. On the *first level*, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

Table 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the *second* level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following two steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains four main subsections in correspondence with the four steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of the research system and governance and policy dynamics, opportunities and risks across all four domains in the light of the Lisbon Strategy's goals.

1.2 Overview of the structure of the national research system and its governance

The Turkish economy is among the world's 20 largest and 64% of its 73 million population is below 34 years old. The country has the largest labour force of the 27

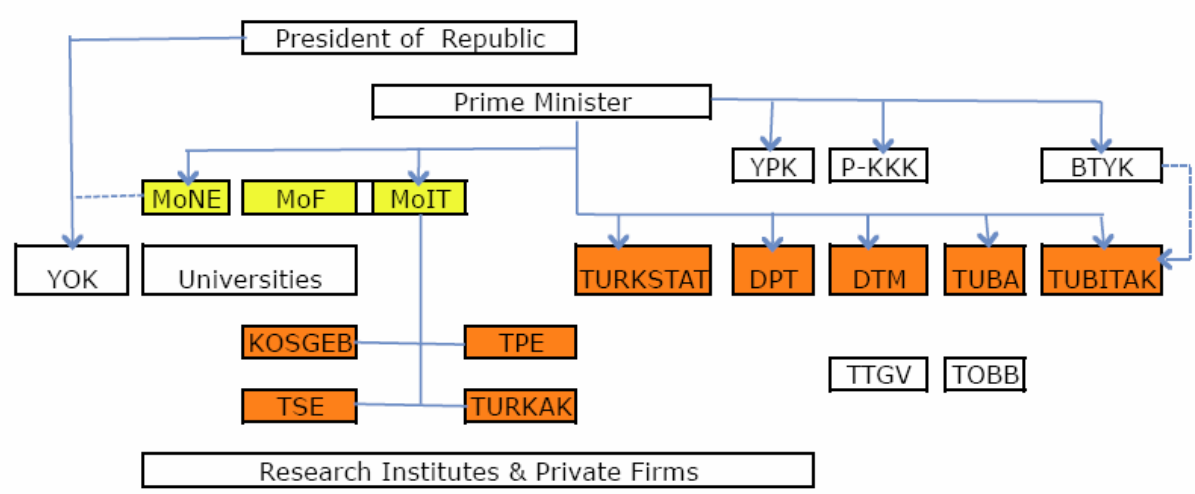
[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

European Countries with over 24.7 million people in 2007[2]. With an average GDP growth of 4.2 percent between 1988-2007, Turkey ranked the fifth in OECD economies. The estimated growth for 2008 is 3.4 percent.

According to R&D survey conducted by TURKSTAT, GERD in Turkey was €2.69b and the share of GERD in GDP was 0.71% in 2007. GERD per capita population was PPP$93.2. Total number of R&D personnel (full time equivalent) was 63,377 and that of per ten thousand labour force was 29.9. (TURKSTAT, 2007)

Turkey has a well-developed national research system that encompasses most of the actors and institutions that exist in EU countries. Established in 1983, the Supreme Council for Science and Technology (BTYK) is the highest level legally formalised body, which determines, directs and coordinates research and innovation policies. The Scientific and Technological Research Council of Turkey (TUBITAK), which was created in 1963, is affiliated to the Prime Ministry and acts as the secretariat of the BTYK. The BTYK is headed by the Prime Minister and composed of relevant Ministers, heads of public and private bodies, universities and non-governmental organisations.

Figure 1: Overview of the governance structure of the Turkish research system



Source: ERAWATCH Network (2008)

The State Planning Organisation (DPT) and the High Planning Council (YPK) are two other important actors in the design and implementation of research and innovation policies. The Money-Credit and Coordination Council (P-KKK), an operational arm of the DPT, is responsible for the determination of monetary policies for state support programmes and the allocation of funds for this purpose.

The Ministry of National Education (MoNE) and the Higher Education Council (YOK) design and implement education and training policies and integrate them with research and innovation policies. Ministry of Finance (MoF) contributes to the design and implementation of fiscal incentives for R&D. The Under-Secretariat of the Treasury (HM) and Under-Secretariat of Foreign Trade (DTM) are actively involved in the formulation of policies and in policy implementation as they mainly provide finance to research and innovation programmes. The Turkish Statistical Institute (TURKSTAT) is responsible for conducting R&D and innovation surveys. The Turkish

[2] Prime Ministry Investment Support and Promotion Agency (2008)

Academy of Sciences (TUBA) determines and recommends scientific priority areas and proposes legislation to the government on issues related to scientists and researchers. TUBA also designs and implements programmes to encourage scientific studies.

On the implementation side, TUBITAK itself is the main body managing research programmes. The Directorate-General of Industrial R&D of the Ministry of Industry and Trade (MoIT), the Technology and Innovation Support Programmes Directorate of TUBITAK (TUBITAK-TEYDEB), the Technology Development Foundation of Turkey (TTGV) and the Small and Medium Industry Development Organisation (KOSGEB) are the main agencies implementing industrial R&D support programmes. Both TUBITAK-TEYDEB and TTGV use government resources for stimulating R&D and innovation in private sector companies (TUBITAK-TEYDEB provides grants, whereas, TTGV provides soft loans). MoIT, at the same time, stimulates the creation of technoparks to encourage university-business collaboration.

KOSGEB, affiliated to MoIT, deals with the design and implementation of small and medium-sized enterprise (SME) policies, which also cover aspects of research and innovation. In addition, KOSGEB helps to create an environment for university–industry cooperation in its technology development centres. The Turkish Patent Institute (TPE) is an autonomous body affiliated to the MoIT which is responsible for carrying out the procedures related to industrial and intellectual property rights (IPR) and for informing and guiding researchers, industrialists and R&D institutes on IPR related issues. The Turkish Accreditation Agency (TURKAK) is also affiliated to the MoIT and deals with increasing the competitiveness of industry by accrediting organisations and laboratories, and ensuring they operate in accordance with national and international standards. Established as one of the institutes of TUBITAK with an autonomous structure, the National Metrology Institute (UME) carries out scientific metrology activities and provides measurement, training, consultancy, information dissemination and infrastructure services. For nuclear research activities, the Turkish Atomic Energy Institute (TAEK) is the main body both for strategy preparation and for carrying out research activities. The Turkish Standards Institution (TSE) prepares, inspects and publishes standards in Turkey. TSE also conducts R&D about metrology and calibration. The Unions of Chambers and Commodity Exchanges of Turkey (TOBB) is a semi-public body, which represents the private sector in research and innovation policy-making and implementation process.

The institutional role of the regions in research governance

There has not been any regional approach on research and innovation policy-making and implementation in Turkey. However, the government puts strong emphasis on regional development. As an important step in that respect, a law on the establishment of regional development agencies (RDA) was issued in February 2006. Two pilot RDAs, namely Cukurova and Izmir, are in operation and as of 2009, they have started providing funding at their regions at NUTS II level. The support programmes of the two pilot RDAs focus on increasing production and employment levels in their regions. On the other hand, both RDAs have included stimulation of R&D and innovation in their regional development strategies.

There are 26 NUTSII level regions in Turkey and the government is in the process of establishing RDAs in the remaining 24 regions. Eight more RDAs were established as of May 2009 in Istanbul, Konya, Samsun, Erzurum, Van, Gaziantep, Diyarbakir and Mardin, and the rest are planned to be created by December 2009.

Apart from this development, some regions take steps to design and implement regional innovation strategies mainly as a result of the EU Research Framework Programmes. Currently, these programmes are one of the main driving forces for the regions to implement regional innovation projects. There are two projects recently completed this way: 'Regional Innovation Strategies' project in Mersin (RIS-Mersin) and 'Supporting Potential and Existing Research Intensive SMEs' in Adana. While the former aims at designing the innovation strategy for Mersin region with the involvement of regional stakeholders, the latter deals with the question of the optimisation of the regional innovation system in Adana. Both Mersin and Adana are covered by one of the two pilot RDAs (Cukurova Development Agency). (Elci, 2008) In addition to these projects, a pilot RIS study has been completed in Izmir region under the Euromed Technology and Innovation Programme.

Main research performer groups

The main research performers in Turkey are the universities. They conduct a large portion of R&D (48.2% of GERD in 2007) and employ majority of the researchers (46.6% of full-time equivalent R&D personnel in 2007). The number of research publications, as the main output of the university research, has also been increasing depending on the increased research at the universities (from 15,403 in 2004 to 21,779 in 2007). According to TUBITAK, with 311 publications per million populations in 2007, Turkey ranked the 44th in the world. On the other hand, with an increase rate of 109% for the same indicator in the 2002-2009 period, Turkey ranks the sixth globally.

Traditionally, the older universities, which are located in Turkey's three major cities of Ankara, Istanbul and Izmir, and have better research infrastructure and human resources, are stronger in research. With respect to the number of research projects proposed by universities to TUBITAK and the amount of financial support provided by TUBITAK to these projects in 2008, the best performing five universities are Ege University, Ankara University, Istanbul Technical University, Hacettepe University and the Middle East Technical University. All of these universities are public universities.

In 2008, out of 4,400 project proposals submitted by universities to TUBITAK, 1015 were proposed by the best performing five universities. TUBITAK selected 930 projects (with a total budget of around €61m) out of 4,400 proposals. Nearly one-third of all projects supported both in terms of number and amount of funding are those proposed by these five universities.

Three out of five best performing universities in research projects (Hacettepe University, Ankara University and Ege University) are also among the top five universities in the number of publications in the Science Citation Index (SCI). The other two universities, which are also public universities, are Istanbul University and Gazi University. Among 17,786 publications in SCI by all Turkish universities in 2007, the number of publications produced by these universities was 4,756[3]. However, when the number of publications per researcher is taken into consideration, the best performing five universities are listed as TOBB University of Economics and Technology, Bozok University, Baskent University, Gebze Institute of Technology and Koc University. Three of these universities are private (TOBB University of

[3] http://www.yok.gov.tr/index.php?option=com_docman&task=doc_download&gid=193

Economics and Technology, Baskent University and Koc University) and the remaining two are public universities.

The Marmara Research Centre of TUBITAK (TUBITAK-MAM) is the biggest public research organisation which provides contractual research, testing, training, consultancy, analysis and certification services in its research centres, and creates an environment for the generation and growth of high-tech firms in its technopark. Other institutes of TUBITAK (Defence Industries R&D Institute, National Electronics and Cryptology Research Institute, Space Technologies Research Institute, National Metrology Institute, Basic Sciences Research Institute and Cukurova Advanced Agro-Technologies R&D Institute) are the most active organisations conducting research in their fields of specialisation.

With regard to private R&D performers in Turkey, there are six University–Industry Joint Research Centres (USAMs), established jointly by universities, TUBITAK and at least three companies or an umbrella organisation, with mixed funding. The USAMs' main activity is pre-competitive research although they can conduct contract research for a partner company. There are no private research centres carrying out contracted research, though some companies have established their R&D centres as separate entities in and out of the technoparks to benefit from the fiscal incentives provided by the Ministries of Industry and Trade, and Finance.

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges related to the provision of inputs for research activities are addressed by the national research system. Its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, with the Barcelona EU overall objective of an R&D investment of 3% of GDP and an appropriate public/private split as orientation, but also highlighting the need for a sufficient supply of qualified researchers.

Four different challenges in the domain of resource mobilisation for research which need to be addressed appropriately by the research system can be distinguished:

- Justifying resource provision for research activities;
- Securing long term investment in research;
- Dealing with uncertain returns and other barriers to private R&D investment; and
- Providing qualified human resources.

2.1 Analysis of system characteristics

2.1.1 Justifying resource provision for research activities

Research plays an important role in Turkey's general policy agenda. Since early 2000s, the government has intensified the actions to increase R&D expenditures and to develop a sound research base. These efforts has led to a remarkable increase in R&D expenditures, which rose 2.7-fold during 2002-2007 period, from €1.04b in 2002

to €2.69b in 2007. GERD as a percentage of R&D has increased from 0.53% in 2002 to 0.71% in 2007.

It should be noted, however, that stimulating R&D in the private and public sectors has always been an integral part of the five-year development plans. The 'Ninth Development Plan' (2007–2013) issued in the Official Gazette in July 2006 highlights the importance of R&D under the strategic objective of "increasing competitiveness" to contribute to the development of Turkey. The plan identifies five development axes for sustainable economic growth and social development:

- increasing competitiveness;
- increasing employment;
- strengthening human development and social solidarity;
- ensuring regional development;
- increasing the quality and effectiveness of public services.

The plan states that sectoral and thematic policies and priorities are considered under these axes and interrelated in a way that serves the same strategic objective.

In the plan, the category of R&D and innovation is seen as the main tool for achieving increased competitiveness.

2.1.2 Securing long term investment in research

In its sixth meeting on December 2000, the Supreme Council for Science and Technology (BTYK) took the decision that, new national S&T policies should be formulated, and priority areas should be set for the next two decades. The objective was to pave the way to create an innovative economy and society by 2023, which marks the 100th Anniversary of the foundation of the Turkish Republic. As a result, TUBITAK coordinated the project called "Vision 2023: Science and Technology Strategies" which involved a national technology foresight exercise. At the end of the project, TUBITAK, in collaboration with relevant public agencies, academia, private sector and the NGOs, designed the National Science and Technology Strategies. Through participatory workshops attended by relevant stakeholders, the vision and mission of the country's S&T strategy was developed. However, the policies have not been adopted as long-term strategies. Instead, in 2005, the BTYK approved the five-year implementation plan for the S&T strategies.

Before the issuance of the implementation plan in 2005, the mission and vision, the strategic goals, objectives, priorities and general mechanisms and funding policies of the strategy were approved by the BTYK in September 2004. The implementation plan aimed at translation of those strategic elements into actions, together with the responsible agencies and timelines. As an important element of the plan, BTYK defined the "Turkish Research Area" (TARAL) where the private and public sectors and non-governmental organisations strategically focus and collaborate on R&D. TUBITAK has been assigned as the organisation responsible for the effective functioning of TARAL. Integration of TARAL with the European Research Area (ERA) has also been one of the main tasks of TUBITAK.

The main R&D targets (to be reached by 2010) are identified as to increase the ratio of GERD/GDP to 2 percent (from 0.66 percent in 2002) (half of this amount being invested by the private sector), and to raise the number of full-time equivalent R&D personnel to 40,000 (from 23,995 in 2002). However, a new methodology for

calculating GDP was put into force in 2008, and as a result, GERD was recalculated as 0.60% for 2006 and 0.71% for 2007. The goal of 40,000 FTE researchers was reached mainly due to the revision of the FTE ratios by TURKSTAT. As a result, in 2008, the government set the new date for the achievement of the 2% target as 2013 The target for FTE R&D personnel to be reached by 2013 was determined as 150,000.

As a first step in the implementation of this strategy, an additional budget of approximately €206m was added to existing public funds for R&D in 2005. Similarly, the public funds for R&D was increased by another 20% in 2006 and reached €230m. Overall, the targets set out for 2013 are ambitious and in line with the Lisbon Strategy. The commitment of the government continues to allocate the necessary funding required for reaching the targets. However, it is expected that a longer-term perspective is adopted for the sustainability of the efforts and strategic orientation of R&D policies and practices.

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

Historically, higher education sector accounts for the majority of research in Turkey. Although there is a remarkable increase in the share of the business sector in R&D expenditure since the beginning of the 2000s, the share of gross domestic expenditure on R&D performed by business was 41.3% in 2007 as opposed to 69% OECD average.

As noted above the government aims to increase the share of business expenditure in R&D as part of the 2% target. According to Turkish Statistical Institute (TURKSTAT) the manufacturing sector stands out with nearly 68% of total BERD and service sector has a share of 30.7% in 2007.

The main policy measures used for increasing the percentage of BERD in GERD has been the support for R&D activities of the industry. Although the main characteristics of the measures have not changed since early 1990s, the amount of funding provided has increased to a large extent. On the other hand, a new measure was developed in 2008 to provide easier access of the SMEs to public funding, after the complaints about the complexity of current measures.

One of the barriers to business R&D investment was identified as low levels of IPR awareness. As a result, one aspect of the strategy mainly focused on developing policies and measures for increasing awareness towards IPR in Turkey. At the end of 2006 a new support programme was initiated in collaboration with the Turkish Patent Institute (TPE) and TUBITAK. According to this programme, Turkish citizens and companies established in Turkey under Turkish law where ownership by Turkish citizens exceeds 50% can apply for patent application support. In addition to this programme, TPE has been running a promotion campaign to emphasise the importance of IPR issues.

Another problem identified was the lack of private investment in R&D and for the creation of start-ups. Venture capital and business angel investments may facilitate access to finance for SMEs and start-ups not qualified for receiving bank loans. However, the venture capital industry is under-developed and business angel networks are almost non-existent. Although technology-based start-up companies are provided with supports mainly in incubators and technoparks, very little seed financing is available to stimulate the establishment of innovative start-ups and spin-

offs. In general, funding levels in government-supported programmes that aim to encourage new technology-based firms are insufficient, and the conditions for support discourage entrepreneurs. In 2008, a new measure to finance high-tech start-ups has been adopted under the R&D Law (the Law on Supporting Research and Development, No. 5746) issued by the government and implemented by the Ministries of Industry and Trade, and Finance.

2.1.4 Providing qualified human resources

Scarcity of human resources for R&D is another critical barrier for research in Turkey. There were 2.0 researchers per thousand of total employed in Turkey in 2006, which is lower than the EU-27 average of 5.8. One of the main reasons for this scarcity is a brain drain that claims a significant share of Turkish researchers who reside abroad upon completion of their PhDs.[4]

In 2007, the number of FTE R&D personnel was 63,000 and that of the FTE researchers was 50,000. Regarding the educational background, 26% of the FTE R&D personnel hold a PhD or a higher degree, 20% holds a masters degree, and 36% holds a bachelors degree. The rest has either a post-secondary non-tertiary or a lower degree. While the holders of a PhD or a higher degree constitute almost half of the FTE R&D personnel employed in the higher education, in the private enterprise sector, they make up for only 3% of the total R&D workforce.

Regarding the tertiary education, the number of all bachelors' degrees has grown approximately by 20% since 2001. The shares of science and engineering degrees as percentage of all bachelor's degrees were 8.1% and 9%, respectively, in 2006. Although the shares have remained the same, the number of graduates has continued to rise. The number of science and engineering graduates has increased since 2001 by 11% and 15%, and reached to 16,450 and 18,324 in 2006, respectively.

Public funding for human resource development has been increasing in line with the research strategy. YOK, MoNE and TUBITAK are the three major public institutions that provide scholarships. YOK has been providing teaching assistants with scholarships to encourage them to make graduate studies abroad. MoNE introduced a scholarship programme that targets to send 5,000 people abroad in 5 years for their graduate studies. TUBITAK has tripled the number of scholars since 2005. As of 2007, 6,800 scholarships were provided by TUBITAK.

There is an increased focus on science, technology and innovation in the new curricula designed and implemented by the MoNE since 2005, at the primary and secondary levels of education. Innovation has been integrated in the national education curricula as a topic under the course 'Technology and Design'.

TUBITAK and the MoNE organise various schemes to promote science and research in schools. Incentives and support have also been provided for university researchers by TUBITAK in the form of project support, scholarships and awards to increase the number of R&D personnel. In 2007, TUBITAK started a new support programme called the "Science and Society Support Programme" enabling teachers and academics to develop and implement projects to promote science in schools and universities.

[4] World Bank (2008) Turkey- National Innovation and Technology System: Recent Progress and Ongoing Challenges

Tax incentives exist for R&D personnel working in Technology Development Zones. Starting from 2008, the new R&D law provides tax benefits for R&D personnel working outside the technology development zones if the company for which the researcher works has been entitled as 'R&D Centre' by the government. In order to increase the demand for PhD graduates, TUBITAK's support programme for industrial R&D provides for an additional 30% bonus support for the costs of R&D personnel with PhD degrees.

2.2 Assessment of strengths and weaknesses

The mobilisation of higher resources for R&D is one of the strengths of the Turkish research system. As noted above, ambitious goals set for R&D investments are the main drivers for this development.

On the other hand, the decisions are mainly taken centrally, and the social partners, researchers, business and the general public's roles in the policy-making process remain limited. The lack of sectoral and regional dimensions of policy-making and implementation process has also been a weakness. Furthermore, the low levels of coordination and communication between the actors in the system may hinder effective coordination between domains of resource mobilisation, knowledge demand, knowledge production and knowledge circulation.

Main strengths	Main weaknesses
• Increasing emphasis and public resources for R&D with the 2% target • Government commitment for supporting R&D	• Low levels of BERD and demand levels from business enterprises • Centralised decision making process and lack of regional policies • Lack of sectoral policies and policy measures

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how research related knowledge demand contributes to the performance of the national research system. It is concerned with the mechanisms to determine the most appropriate use of and targets for resource inputs.

The setting and implementation of priorities can lead to co-ordination problems. Monitoring processes identifying the extent to which demand requirements are met are necessary but difficult to effectively implement due to the characteristics of knowledge outputs. Main challenges in this domain are therefore:

- Identifying the drivers of knowledge demand;
- Co-ordinating and channelling knowledge demands; and
- Monitoring demand fulfilment

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D targeted in IG7 of the Lisbon Strategy.

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

The demand for knowledge is mainly dependent on the structure of the industry. The Turkish industry consists of low- and low-to medium technology companies. Around 5.6 percent of Turkey's manufactured exports in 2005 were high-tech, which is among the lowest in the OECD where the average is 22 percent. Data on patents awarded by the European Patent Office (EPO) also suggest that Turkish firms may not be as inventive as their counterparts: In 2005 Turkey accounted for 1.9 patents per million of population, versus 4.2 in Poland, 4.3 in the Czech Republic and 18.9 in Hungary. Research carried out by the private sector represents around 40% of the total GERD in 2007. Despite a surge in the last two years, Turkey's enterprise sector (including both private and state-owned enterprises) is still a relatively small player in terms of performing R&D relative to OECD levels. Enterprises performed 37% of total R&D in Turkey in 2006 (compared to 27% in 2003), lower than the EU-27 and OECD averages of 62.5% and 68% respectively.[5]

The manufacturing sector accounted for nearly 68% of total BERD in 2007. The sub-sectors with the highest percentage of BERD in manufacturing sector are motor vehicles, trailers and semi-trailers, radio, television and communication equipment, machinery and equipment, and chemical, rubber, plastics and fuel products.

The universities are the highest performers of R&D in the country. HERD represents 48.2% of GERD in 2007, while GOVERD corresponds to 10.6% of GERD. Around 23% of university R&D and 4% of the total public research is funded by the private sector which is a sign of the low demand level from the private sector for knowledge created in the system. There is a consensus among the actors in the research system that the cooperation between the users and producers of knowledge should be improved.

3.1.2 Co-ordinating and channelling knowledge demands

The main tool used for co-ordinating and channelling knowledge demands is the Development Plans. The State Planning Organisation (DPT) is responsible for the design and implementation of the national development plans. The specialised committees on each sector, including science & technology, are formed by representatives from public institutions, private firms, private umbrella institutions, NGOs, to provide input to the plans.

The Vision 2023 project is the first and only national technology foresight exercise of Turkey. In its sixth meeting on December 2000, the BTYK took the decision that new national S&T policies should be formulated and priority areas should be set for the next two decades in order to create a prosperous society and economy based on innovation by 2023, the 100th Anniversary of the Turkish Republic. It was aimed to reach these objectives by ensuring the widest participation possible in the project with increased commitment around a shared vision. As a part of this initiative, a technology foresight study was carried out, together with three other sub-projects that aimed at collecting and evaluating data on the current science, technology and innovation capacity of the country. The sub-projects included the following:

[5] World Bank (2008) Turkey- National Innovation and Technology System: Recent Progress and Ongoing Challenges

- National Technology Competence Inventory Project
- Researcher Information System Project
- National Research Infrastructure Information System Project

The foresight panels, formed in 12 socio-economic areas, have started working in July 2002. After completion of the preliminary reports, the results were presented to related sectors for their opinions and recommendations. Delphi surveys, conducted to extend the content of the preliminary report and to call for opinions of the experts, were completed in July 2003. The conclusion reports were synthesised and eight strategic technological areas were determined by June 2004, and the "strategic technology roadmaps" have been elaborated after the formation of the working groups on socio-economic areas.

The strategy document, covering the science and technology policies for the next twenty years for Turkey, was prepared by using the synthesis report, Delphi findings and the outputs of the strategic technology working groups. The following priority areas were determined as a result of the outcomes of the Vision 2023 study:

- Information Technologies
- Biotechnology and Gene Technologies
- Materials
- Nanotechnology
- Design Technologies
- Mechatronics
- Production Methods and Machinery
- Energy and Environmental Technologies

Defence and space technologies were added to these priority areas by the BTYK in its meeting on 8 September 2004. The Vision 2023 was the first and only bottom-up effort for the determination of knowledge demand and a great amount of effort has been put into this process. However, the impact of the study has been limited. The support schemes in Turkey, so far, did not have a sectoral focus and no special measures, apart from those developed for defence and space, were designed for supporting above priority areas. Only some minor changes have been made to existing generic R&D support programmes.

On the other hand, measures promoting collaboration between the public and private sectors have been initiated. The new measures developed by TUBITAK in order to increase public–private collaboration include the 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms' (inspired by the EU technology platforms) and the 'Support Programme for Research Projects of Public Institutions' (KAMAG). Five pilot sectors (textiles, electric/electronics, metal, automotive and marine sciences) were chosen by TUBITAK to establishing technology platforms. TUBITAK then invited potentially interested individuals from industry, public sector and universities to participate and they have coordinated meetings. Once the temporary management boards have been selected, TUBITAK had left the coordination to these boards. Although project proposals are expected from each sector, the business side seems unwilling to participate in these platforms due to the limited concrete incentives.

The 'Industrial Thesis (San-Tez) Programme' of the MoIT initiated in late 2006 to stimulate co-operation between firms and universities by supporting masters and doctorate thesis written out by a number of graduate level students.

3.1.3 Monitoring demand fulfilment

The BTYK meets regularly every six months and TUBITAK prepares six monthly progress reports for these meetings as it acts as the secretariat of the BTYK. These reports usually provide data on the selected R&D indicators and the progress on the previous decisions of the BTYK.

The assessments of the national innovation system, key programmes and policies have been implemented since 2008 by the State Planning Organisation (DPT) and the World Bank as per the request of the government. It is expected that this assessment be finalised in 2009. In addition, OECD is carrying out the national innovation review with TUBITAK since 2008.

Other than above practices which do not address directly the need for monitoring demand, no systematic approaches are employed for this purpose.

3.2 Assessment of strengths and weaknesses

Main strengths	Main weaknesses
• Political commitment for investing in knowledge intensive sectors • Well established research system with an increasing financial resources	• No systematic monitoring of the demand fulfilment • The low to medium technology level of the business sector • Lack of sectoral/thematic focus in measures • Weak cooperation and communication between the actors of the research system

4 - Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role to create and develop excellent and useful scientific and technological knowledge. A response to knowledge demand has to balance two main generic challenges:

- On one hand, ensuring knowledge quality and excellence is the basis for scientific and technological advance. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities which often emerge at the frontiers of scientific disciplines. Quality assurance processes are here mainly the task of scientific actors due to the expertise required, but subject to corresponding institutional rigidities.
- On the other hand there is a high interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriate for economic knowledge producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to a corresponding exploitability challenge.

Both challenges are addressed in the research-related Integrated Guideline and in the ERA Green Paper.

4.1 Analysis of system characteristics

4.1.1 Improving quality and excellence of knowledge production

As noted before, universities perform a significant proportion of Turkey's R&D spending, and employ the majority of researchers. There are 132 universities in the country and the government is determined to increase the number of universities such that all the major cities in Turkey have at least one university established in its premises. Turkey ranks the 19th in the world in the total number of scientific publications. While, scientific publications per million populations are below the OECD average, the rate of increase between 2003-2006 is 48%, which is the highest among all OECD countries.

The other significant stakeholders for knowledge production in the Turkish research system include the public research institute and private research centres established in and out of technology parks. TUBITAK Marmara Research Centre (MAM) is the largest public contract research centre in the country. The technological fields covered by the centre include materials, chemistry and environment, ICT, genetic engineering and biotechnology, energy, food, earth and marine sciences. TÜBİTAK-MAM also runs a technopark and a technology free zone for high-tech enterprises.

TUBITAK has five more R&D institutes. These are Defence Industries R&D Institute, National Electronics & Cryptology Research Institute, Space Technologies Research Institute, National Metrology Institute, Basic Sciences Research Institute and Cukurova Advanced Agro-Technologies R&D Institute. TUBITAK also runs a National Observatory, the National Academic Network & Information Centre, the Turkish Industry Management Institute, the Ankara Test & Analysis Laboratory, and Bursa Test & Analysis Laboratory (for textile sector).

There are nearly 90 public research institutes, which mainly belong to various Ministries and are not actively collaborating with the business sector. The majority of these institutes work on traditional sector, such as agriculture and forestry.

There are also university-industry joint research centres established by regional universities, industrialists and TUBITAK (Ceramics Research Centre in Eskisehir Anadolu University, Textile Research Centre in Ege University, Biomedical Technologies Centre in Hacettepe University, Adana University-Industry Joint Research Centre in Cukurova University, Automotive Technologies R&D Centre in Istanbul Technical University and METU-OSTIM Advanced Manufacturing Systems and Technologies Centre in OSTIM Organized Industrial Zone).

As for the knowledge production by the business sector, with the help of the recently approved R&D Law, which provides generous fiscal incentives, large companies and multinationals located in Turkey have established their research centres. In addition, there are some large enterprises, which opened up branches or established new research-focused companies in technology parks. Many of the smaller firms have limited capacities regarding knowledge production, which mainly focuses on product development.

The Turkish innovation system includes nearly all the necessary actors required for quality and excellence in knowledge production. However, the linkages and coordination between the players are weak.

4.1.2 Improving exploitability of knowledge production

The performance of the Turkish research system regarding the exploitability of knowledge is relatively low. Universities and public research centres are mostly inward oriented and mechanisms for determining and responding to economic and societal needs are limited. There are both regulatory and cultural difficulties in the commercial exploitation of research results for the academics as well as for university-private sector collaboration. One of the output indicators for this area is the number of patent applications. Turkey is far behind the developed countries at both national and international patenting applications. Although patent applications to the European Patent Office (EPO) have increased from 5 at 1995 to 198 at 2005, Turkey ranks 20th among the OECD countries and has a share below 1% of total OECD applications.

Turkish Patent Institute (TPE) is the responsible agency for the granting and protection of intellectual property rights (IPR) and developing the related infrastructure for the robust working of IPR system in Turkey. While the IPR legislation in Turkey dates back to 1870s, TPE was established in 1994. Before the establishment of TPE, the MoIT was responsible for the IPR system.

The awareness on IPR has been fairly low among both the academics and the private sector firms. In the last 10 years, TPE has been implementing awareness raising activities on IPR issues. In the last few years, other actors of the Turkish research system, such as TUBITAK and KOSGEB, have also started to support TPE in these activities since patented applications is seen as a major tool for exploitability of knowledge produced. TUBITAK has developed a new measure for supporting the patent applications of Turkish citizens and companies both at the national and international levels.

Today, the increase in the number of patent applications shows that efforts put into awareness raising activities have started to pay off. The number of national patent applications has increased from a few hundreds to thousands in the last few years. National patent applications received by the TPE have been 1,090 and 1,285 in 2006 and 2007, respectively.

The development of mechanisms for bridging the gap between the research community and the business sector, and matching research activity to the country's economic specialisation have been high in the research policy agenda for the last few years. One of the tools developed by TUBITAK in order to increase public–private collaboration has been the 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms', introduced in January 2007, as explained in 2.1.2 above. The programme replaced the 'University-Industry Collaborations Centres Programme'. However, no new platforms with the inclusion of business sector could be successfully established as of December 2008.

In addition to this measure, in almost all the measures, the chances for support increase in the case of collaboration between university and industry.

4.2 Assessment of strengths and weaknesses

In addition to resource mobilisation, knowledge production has been an area of focus in the new S&T strategies and policy measures in Turkey. Further efforts are needed to encourage exploitation of research results. The main barrier in this respect has been related to the regulatory framework.

Main strengths	Main weaknesses
• Increased focus in S&T policies on the commercialisation of research results	• Disincentives in regulations governing university-business collaboration

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate flows and sharing of the knowledge produced. This is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who continue working in industry, and the comparatively low cost of the reproduction of knowledge once it is codified. However, there remain three challenges related to specific barriers to this circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors to overcome institutional barriers;
- Profiting from access to international knowledge by reducing barriers and increasing openness; and
- Enhancing absorptive capacity of knowledge users to mediate limited firm expertise and learning capabilities.

Effective knowledge sharing is one of the main axes of the ERA Green Paper and significant elements of IGL 7 relate to knowledge circulation. To be effectively addressed, these require a good knowledge of the system responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

Policy-makers and implementing agencies in Turkey have attached great importance to increasing the amount of public–private research collaboration. One of the measures aimed at stimulating such collaboration is the ‘Support Programme for Research Projects of Public Institutions’ implemented by TUBITAK. This programme was initiated as a result of the decision of the BTYK taken in March 2005 in order to support projects which aim to solve public institutions’ problems through R&D. Ministries and public bodies were asked to identify their needs and problems that could be responded to through R&D and to prepare research projects in line with them.

As a result of this development, three research intensive ministries (the Ministries of Agriculture and Rural Affairs, Health, Energy and Natural Resources) took steps to design comprehensive research programmes, namely the 'Public Agriculture Research Programme of Turkey', the 'Public Health Research Programme of Turkey' and the 'Public Research Programme for Energy and Natural Resources'. Other ministries and public bodies (such as the Ministry of Environment and Forestry, State Water Works, etc.) also developed research projects in cooperation with universities, research institutes and the private sector, and submitted them to TUBITAK. At the meeting of the BTYK on 7 March 2007, it was decided that an action plan and a research programme should be prepared on global warming and climate change by the Ministries of Environment and Forestry, Agriculture and Rural Affairs, Energy and Natural Resources. At the meeting of the BTYK held on 20 November 2007 it was stated that as a result of all these efforts 262 project applications had been received by TUBITAK with a total budget of approximately €380m and as of July 2007, 72 projects with a total budget of €100m had already been selected for support.

Another measure developed by TUBITAK to facilitate knowledge circulation is the 'Support Programme for the Initiative to Build Scientific and Technological Cooperation Networks and Platforms'.

The last tool for collaboration between university and industry is the 'Industrial Thesis Programme' where the MoIT support MS and PhD thesis studies that directly target solving the problems of enterprises. The measure was introduced in 2006.

5.1.2 Profiting from access to international knowledge

Turkey is attaching considerable importance to enhance international cooperation and to ensure practical outcomes from science, technology and innovation (STI) cooperation agreements.

In the 14th meeting of BTYK in 2006, it was decided to start a study to prepare the 'International Science, Technology and Innovation Strategy (2007-2010)' under the coordination of TUBITAK and with the participation of related institutions. Strategic framework and the vision of the International Science, Technology and Innovation Strategy have been decided as to become a competitive, respectful, reliable and active country in the international arena of STI.

This strategy points out four action lines in order to increase the capacity and capabilities in STI via international cooperation. These action lines are as follows:

- Increasing the effectiveness of international relations
- Developing international linkages for STI human resource development and mobility of researchers
- Enhancement of governance and coordination
- Informing and following-up.

Within the framework of several bilateral S&T cooperation agreements, joint research projects are funded and monitored, and financial support is provided for activities such as joint scientific meetings, exchange of scientists and scientific visits. TUBITAK also takes part in the intergovernmental meetings in the field of S&T and assists in preparation of the documents resulting from these meetings.

The Sixth Framework Programme (FP6) was the first framework programme of the EU in which Turkey participated as an associated state. Participation in the Fourth

and Fifth Framework Programmes was on a project basis and did not have a particularly remarkable impact. The impact of the FP6 had been threefold for Turkey. First, it led to increased awareness of research and innovation among all stakeholders. Second, it helped develop better coordination mechanisms with a strong public–private partnership for research. Third, it contributed to the development of proper legislation for research and researchers.

Turkey's performance in FP6 remained below the foreseen levels. The key issues listed by TUBITAK as the main problems encountered by Turkish researchers in FP6:

- Visa requirements from Turkish researchers;
- Excessive bureaucracy in project management;
- Lack of "National Detached Experts" and in-service trainees from Turkey;
- Low levels of participation by Turkish organisations in official and non-official networks;
- A considerable portion of the FP6 budget is allocated to large-scale projects and not enough Turkish organisations participate in these strategic projects;
- Due to the budgetary limitations in instruments such as STREPs and CRAFT, in which the participation levels of Turkish researchers were relatively high, even the projects passing the threshold could not be funded.

The statistics show that, during the period December 2002–April 2004 the success rate of projects with Turkish partners was 10.5%, whereas in the period May 2004–December 2006 the success rate increased to 18.7%. As a result of the increase in the success rate and the decision to integrate TARAL with ERA, Turkey decided to participate in FP7. In the 15th meeting of the BTYK in 2007, an action plan was proposed by TUBITAK in order to deal with the problems described above. In addition, the key reason for low performance on FP6 was identified as the low number of FTE R&D personnel in Turkey, when compared with the countries in the EU. In the long term, the target has been defined as increasing the number of FTE R&D personnel in Turkey, which is already a target of the Turkish Research Area (TARAL) as explained in above sections. In the short term, some of the actions to be taken are: running an awareness raising campaign about FP7, negotiating with the EU officials on the visa problem, and developing a new support scheme for increased participation of Turkish researchers in international organisations.

Brain drain is another important issue when considering international cooperation. Although there are significant number of Turkish scientists living abroad, who wants to work in their home country, the number of graduate students studying and willing to work abroad is increasing.

Regarding the destinations preferred for studying abroad, OECD countries comes first, with a share of approximately 90%. Among OECD countries, Germany and the USA appear to be the most popular destinations.

5.1.3 Absorptive capacity of knowledge users

Absorptive capacity of knowledge users is limited in Turkey. Although the awareness raising campaigns resulted in a greater interest towards government funds provided for R&D, only a small percentage of SMEs have the capability to develop project ideas, file successful project applications and implement projects successfully. The

problem is that companies, mainly SMEs, are not familiar with research activities and they are not willing to conduct back-office work required for receiving research grants. There are only a limited number of private consultancy companies and intermediary organisations, which can be of help to SMEs, if they are willing to pay the costs of such consultancy services.

In order to overcome this problem, TUBITAK initiated the 'SME Funding Programme' programme. The first two research projects of SMEs are supported through the programme with a limited budget and limited project duration. The project applications require less bureaucracy and evaluations are completed in a much shorter time frame. In addition, TUBITAK covers a limited amount of consultancy costs related to management of the project bureaucracy if the project is selected.

Another indicator for assessing the capacity of knowledge users is the human capital for R&D. The number of science and engineering graduates was 5.7 per 1,000 of population aged 20-29 in 2005, less than half the EU-27 average of 12.9 in the same year. Youth education attainment level defined as total percentage of the population aged 20 to 24 having completed at least upper secondary education was 44.7% in 2006 and is again much lower than the EU-27 average of 77.9%. Another aspect of human resources capital is lifelong learning and it is defined as percentage of adult population aged 25 to 64 participating in education and training. With 1.9% of participation in 2006 Turkey is much behind the EU-27 average of 9.7%.

The numbers regarding the education levels of the workforce are very low and Turkey ranks the least in almost all the indicators. However, investments into education have been increasing steadily in the last years and expenditure on educational institutions as a percentage of GDP has increased to 4.1% in 2004 from 2.4% in 1995. The increase in funding allows all other indicators regarding training and education to increase rapidly.

5.2 Assessment of strengths and weaknesses

Main strengths	Main weaknesses
• Young population • Very strong position in the international arena as a bridge between the continents and cultures	• Not enough number of intermediaries • Low education levels compared to EU and OECD • Mobility is low and visa requirements (and high costs and complex procedures involved) from EU counties make it harder

References

DPT (2006): Ninth Development Plan (2007-2013): http://www2.dpt.gov.tr/konj/DPT_Tanitim/pdf/Ninth_Development_Plan.pdf

European Commission (2007): Remuneration of researchers in the Public and Private Sectors http://ec.europa.eu/euraxess/pdf/final_report.pdf

European Commission (2008): European Innovation Scoreboard Comparative Analysis of Innovation Performance, PRO INNO Europe: http://www.proinno-europe.eu/EIS2008/website/docs/EIS_2008_Final_report.pdf

European Commission (2008): Turkey 2008 Progress Report: http://ec.europa.eu/enlargement/pdf/press_corner/key-documents/reports_nov_2008/turkey_progress_report_en.pdf

European Commission (2009): ERAWATCH Research Inventory for Turkey: http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&countryCode=TR&topicID=4

Elci, S. (2007): INNO-Policy TrendChart — Policy Trends and Appraisal Report, TURKEY, European Commission: http://www.proinno-europe.eu/extranet/upload/countryreports/Country_Report_Turkey_2007.pdf

Elci, S. (2008): INNO-Policy TrendChart — Policy Trends and Appraisal Report, TURKEY, European Commission: http://www.proinno-europe.eu/extranet/upload/countryreports/Country_Report_Turkey_2008.pdf

Audit Office of the President (2009): Report on the Assessment of Law on Technology Development Zones (Law No: 4691), Problems and Suggestions (in Turkish): http://cankaya.gov.tr/sayfa/cumhurbaskanligi/ddk/ddk26.pdf

TUBITAK (2008): Reports on BTYK Decisions between 2000 and 2008 (in Turkish): http://www.tubitak.gov.tr/home.do?all=t&ot=&rt=&sid=470

TURKSTAT (2007): Research and Development Statistics: http://www.turkstat.gov.tr/PreTablo.do?tb_id=8&ust_id=2

World Bank (2008): Turkey-National Innovation and Technology System: Recent Progress and Ongoing Challenges

List of Abbreviations

BERD	Business Enterprise Research and Development
BTYK	Supreme Council of Science and Technology
CIP	Community Innovation Programme
DPT	State Planning Organisation
EC	European Commission
EU	European Union
FDI	Foreign Direct Investment
FP	European Framework Programme for Research and Technology Development
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GOVERD	Government Expenditure on R&D
HEI	Higher Education Institution
HERD	Higher Education R&D expenditure
HES	Higher Education Sector
IPR	Intellectual Property Rights
KOSGEB	Small and Medium Industry Development Organisation
MoF	Ministry of Finance
MoIT	Ministry of Industry and Trade
MoNE	Ministry of National Education
OECD	Organisation for Economic Cooperation and Development
P-KKK	Money-Credit and Coordination Council
PPS	Purchasing Power Standard
PRO	Public Research Organisations
R&D	Research and Development
RDA	Regional Development Agency
S&E	Science & Engineering
S&T	Science and Technology
SCI	Science Citation Index
SME	Small and Medium Enterprises
STI	Science, Technology and Innovation
TARAL	Turkish Research Area
TPE	Turkish Patent Institute
TTGV	Technology Development Foundation of Turkey
TUBITAK	Scientific and Technological Research Council of Turkey
TURKSTAT	Turkish Statistical Institute
YOK	Higher Education Council
YPK	High Planning Council

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Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Turkey.

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