

The Potential Advantages and Synergies of an EU-Turkey Cooperation in Science, Technology and Innovation

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The Turkish economy has shown remarkable economic performance over the last decade. Currently, it is the 18th largest economy in the world. To increase its competitiveness and avoid the ‘middle-income trap’, Turkey set research and development as a priority area for the next decade, with the ambitious goal of reaching 3% of GERD/GDP by 2023. Despite several controversies about the EU accession process in general, the EU is still the best partner for Turkey to reach these goals. Turkey is an active member of the European research area. It is an associated member of the RDI Framework Programmes since 2002, it participated in and coordinated various scientific projects, policy-coordination actions, mobility programmes and won grants for excellent researchers. In the Turkish national STI strategy the three vertical and six horizontal axes consist of various scientific areas like ICT, Energy, Defence, Water, Food, which have been also set as priority areas in the European H2020 programme. We would like to focus in our article on possible synergies between priority areas, as well as on the role of SMEs in the innovation chain, which are enjoying a special attention in both Horizon 2020 and in Turkish national science, economic and innovation policy.

Keywords: Turkey, European Union, Horizon 2020, STI policy

JEL: F42, H52, I23, O14, O32

1. Introduction

The study focuses on the possibility and potential of cooperation in science, technology and innovation (STI) between the European Union and Turkey. One of the main problems the emerging Turkish economy has to face in the coming decade is to reach the status of a high-income

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economy. To reach this goal it would be of utmost important to increase the country's STI potential. We are going to give an overview on the current Turkish STI system, on the future visions, and on the results in an international comparison. While Turkey is still well behind the EU average in these areas, it has huge potential and ambitious plans to close the gap. Since the EU is still the best partner for this purpose, we examine the broader terms of EU-Turkey relations to see the framework of cooperation between the EU and Turkey. Finally, we try to outline the areas of cooperation between the EU and Turkey in STI to detect possible advantages and synergies.

2. Innovation and Economic Development

The significance of innovation in economic growth has been introduced by Schumpeter (1950), who characterized innovation as the process of "Creative Destruction", as "industrial mutation," which "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one." (Schumpeter, 1950, p.83). Narula (2003) uses innovation also in a more general sense: innovation is anything novel, it is the change in knowledge, ability and techniques required to produce goods and services of higher and better quality. He closely connects innovation to science and technology, which on the one hand represent the cumulative stock of innovations but on the other hand are advanced through innovation. He defines technology as the application of scientific knowledge for practical aims while science provides us with more generic knowledge, which may or not may generate products and services. The importance of science policy issues in being acknowledged to have strategic importance for national competitiveness and economic security has already been mentioned by Partha and David (1994).

In academic literature, the concept of a national innovation system emerged in the 1980s (Freeman, 1987; Lundvall, 1992; Nelson, 1993; Patel and Pavitt, 1994). It rests on the premise that understanding the linkages among the actors involved in innovation – private enterprises, universities and public research institutes – is the key to improve technology performance. Innovation and technical progress are the results of a complex set of relationships among actors producing, distributing and applying various kinds of knowledge. The most overarching definition comes from Metcalfe (1995), who describes the

national innovation system as a “set of distinct institutions which jointly and individually contributes to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies.”

The importance of collaboration is also the key message of Renda (2015). In her article she draws the conclusion that investing in research and development (R&D) is not going to be a sufficient strategy unless large and small companies are able to develop effective symbiotic relationships, they are supported by the university system, by public or private funding sources, they are demanded by a sufficiently large market, and facilitated by an innovation-oriented government.

Carayannis and Korres (2013) emphasise that technological change not only determines growth but also affects international competition and modernization within an economy. According to their concept development is understood as the process of economic transformation brought about by innovation. Innovation as well as science and technology have been recognized as a major source of competitiveness for nations and regions alike. The key determinant of their efficacy is the quality and quantity of entrepreneurship-enabled innovation that supports the link between university basic and applied research and the market, via technology transfer and commercialization mechanisms including government-university-industry partnerships and risk capital investments. In their book they conclude that a long-term strategy with the aim of developing regional knowledge economies must combine local bottom-up approaches with global or European top-down ones.

Europe maintains ambitions for building its future growth and prosperity on innovation. But Europe’s performance on innovation, especially on business innovation lags behind its main competitors. This can be mainly attributed to the lack of young innovative companies especially in innovation-based growth sectors. According to Veugelers and Cincera (2015) this could be counterbalanced by a European-wide general innovation policy aimed at improving the environment for innovation. To tackle specific barriers, external financing should be guaranteed for

highly innovative projects through public funding and by leveraging private risk funding.

Some authors find that European Framework Programmes are the adequate solutions for the previously mentioned deficiencies of Europe. They were able to provide stability and growth, both in terms of funding as well as in terms of a political message that placed a high priority on science and technology (Frietsch et al, 2015; Zarbá et al, 2014). Kalisz and Aluchna (2012) even declare that the three pillars of Horizon 2020 – excellent science, industrial leadership and societal challenges – appear much more in line with the needs of potential innovators and entrepreneurs than past Framework Programmes. As a result governments and science policy need to address large-scale societal challenges that market forces are unlikely to tackle by themselves and they have to create a fertile environment for entrepreneurship by tailoring regulation to the needs of innovation. And the involvement of an newly emerging and dynamic economy may be a benefit for the EU to reach these goals.

3. Turkey, an Emerging Economy of Europe

The performance of the Turkish economy over the past decade has been rather impressive, judged both by its own historical standards and by the performance of the region as a whole. (Öniş *et al.*, 2013, p.1415)

As a consequence of the 2001 economic crisis, deep and comprehensive reforms started. The implementation of the reforms was supported by the extended stand-by facility of the International Monetary Fund, but similar, if not even more important factors behind the success were the increasing European political support after 2002, and the forming of a new government by the reform-oriented, moderate Islamic AK party. The results of crisis management were convincing. The average economic growth remained over 6% from 2002 to 2007, and was able to return to this level after 2009 again. The chronically high inflation rate, a major sign of economic imbalances for decades, was reduced to one-digit levels. The stable macroeconomic environment and the prospects of closer integration to the EU encouraged foreign investments, the level of FDI grew from yearly \$1-2 billion to \$10-20 billion, flowing mostly into export-oriented manufacturing (Taymaz *et al.*, 2009). The competitiveness of exports was improved by the depreciation of the

currency in the first years. Exports became more diversified, not only in their product structure, but concerning target-countries as well. After the growing importance of European exports in the period 2002 to 2007, the post-crisis period lead to an increasing share of neighbouring regions (Middle East, CIS countries, Balkans), not only in trade, but in investment relations as well.

Turkey has started to shift from an economy largely based on agriculture and on an abundant low-skilled labour force used mainly in textile sector towards an industrial economy. Turkey is today a major European automotive producer, a world leader in shipbuilding, and a significant manufacturer of electronics and home appliances e.g. TV, white goods (OECD, 2012).

In electronics especially the home appliance sector developed dynamically, where domestic producers (Vestel, Beko) are prominent representatives of the exports. Turkish products are not the top quality brands, rather low and medium price products, but there is a demand for these products both on the domestic markets, and in neighbouring regions (e.g. in the Balkans).

In vehicle production, several multinationals (Ford, Renault, Fiat, Hyundai, Toyota, Honda, Opel, Mercedes, MAN) brought part of their production capacity to Turkey, largely due to the customs union agreement with the EU allowing a free export of products to the European Single Market. In bus production, domestic brands (Otokar, BMC, Temsa) are dominating.

Despite its rapid growth after the crisis in 2001, the Turkish economy falls short of expectations with respect to global competitiveness (Turkish Industrial Strategy Document, 2010, p.12). Particularly with the integration of China and India into the global economy, it no longer seems to be possible for Turkey to be able to rely upon cheap labour to get ahead in the competitiveness. Increasing Turkish competitiveness requires the creation of an efficiently functioning market mechanism, an attractive investment environment and institutionalization. Companies have to be able to sustain themselves through a highly skilled workforce (ibid.).

In the post-war era, many countries have managed to fairly rapidly reach middle-income status, but few have gone on to become high-income economies. Rather, after an initial period of rapid ascent, many countries have experienced a sharp slowdown in growth and productivity, falling into what has been called a “middle-income trap.”³

Turkey is well aware of this. As the Turkish Finance minister, Mehmet Simsek points on it in his article in the Wall Street Journal (Simsek, 2014), despite the progress, Turkey still faces great challenges in its effort to escape the middle-income trap. Success will require sound macroeconomic policies and additional structural reforms, and a supportive global economic environment is necessary, too. Turkey’s top reform priorities are, however, to enhance the quality of the country’s workforce by improving the quality of education, to make progress in labour-market flexibility and to boost productivity through technological advancement (ibid.).

4. Turkey’s Scientific Landscape and Future Plans

In 2014, with a total GDP of 799,5 billion USD, Turkish economy ranked 18th in the list of world economies⁴. Vision 2023, initiated in 2004 for the 100th Anniversary of the Turkish Republic in 2023 would like to see Turkey as one of the 10 largest economies in the world, and to reach this goal it formulates recommendations and ambitious targets on the fields of economy, health, energy and tourism. To increase the technological and innovative capacity of the country, the Vision sets the targets to raise GERD (gross domestic expenditure on R&D)/GDP to 3%, and BERD (Business enterprise expenditure on R&D)/GDP to 2%. The number of FTE researchers should be 300 000, 180 000 of these should work in the private sector.

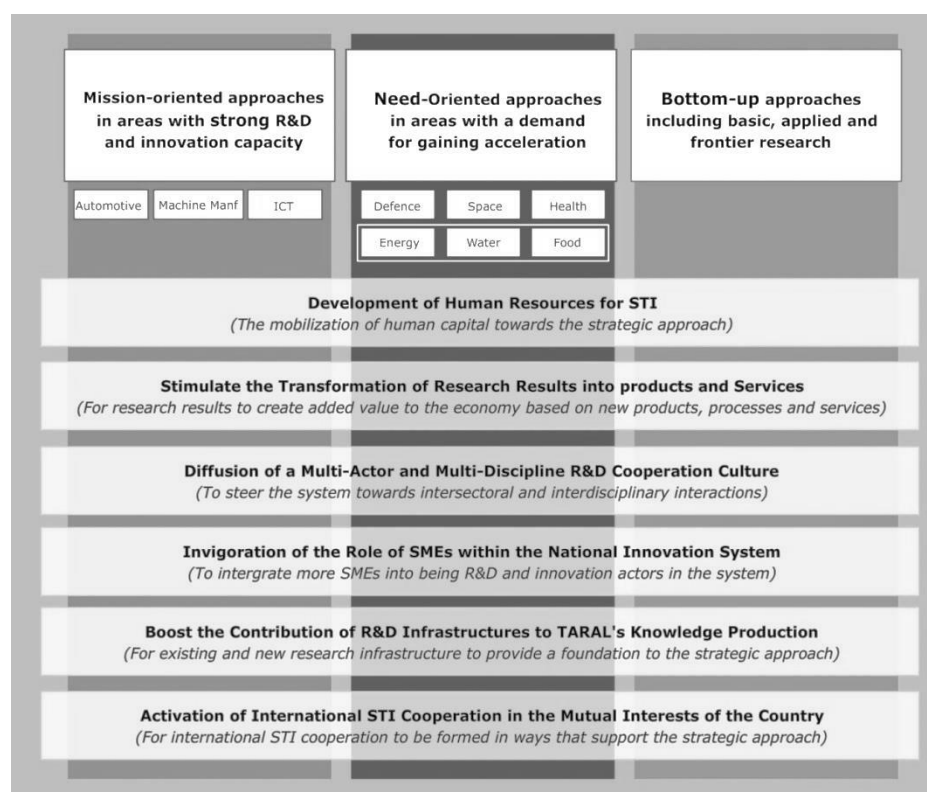
This general vision on STI should be implemented by more concrete plans, like the National Science and Technology Policies Implementation Plan for 2005-2010 (BTP-UP) and the National Science,

³ World Bank estimates that of 101 middle-income economies in 1960, only 13 became high income by 2008 (Agénor et al, 2012) Actually, the growth patterns of the remaining countries do not conform to one clear pattern that can be easily characterized as a “trap.” Still, the “MIC Trap” concept is useful for guiding policy discussions. (Im – Rosenblatt, 2013)

⁴ Worldbank statistics

Technology and Innovation Strategy 2011-2016 (UBTYS). UBTYS is a fundamental strategy document comprising of Turkey's STI vision, priorities, and main objectives for a six year period. It was mainly focusing on disseminating culture of multilateral and multidisciplinary RDI cooperation, stimulating sectoral and regional RDI dynamics, encouraging SMEs to become stronger actors within the national innovation system, and enhancing the contribution of research infrastructures to the knowledge creation capacity of TARAL⁵. UBTYS consisted of three vertical and six horizontal axes, which all serve the vertical ones.

Figure 1: Strategic Framework of the National STI Strategy, 2011-2016



Source: TÜBİTAK Turkish scientific programmes and strategies

⁵ The “Turkish Research Area” (TARAL) initiative was launched in 2004 with inspiration from the ERA. TARAL, a platform for public, private and NGO stakeholders to coordinate future R&D priorities and collaboration, is aimed to be integrated with the ERA.

As it can be seen from Figure 1, the three vertical axes are devoted to three different approaches: Mission-oriented approaches, with strong R&D and innovation capacity cover the automotive industry, machine manufacturing and ICT. Need-oriented approaches in areas with a demand for gaining acceleration, mainly coming from the society are Energy, Water, Food, Health, Defence and Space. On the three areas Energy, Water and Food three working groups have been established to prepare national RDI strategies on these fields. The third approach is targeted at bottom-up initiatives including basic, applied and frontier research.

Devoted to the first horizontal pillar of UBTYS, the S&T Human Resources Strategy was accepted in 2010. The strategy tries to increase the quantity and quality of human resources for Science and Technology by providing better research environment and by improving researchers' skills and experiences partly via mobility schemes.

Although one of the main STI targets of BTP-UP – to reach 150 000 FTE R&D personnel by 2013 – has not been reached, new, even more ambitious targets of Vision 2023 are on the horizon: the number of FTE researchers should be 300 000 and 60% of them should work for the industry. As a result, the strategy does not only have the aim to increase the number of researchers but it has to improve the sectoral and occupational distribution, too.

Turkey's 2023 target is to reach 500 billion dollars of export volume and to be a country manufacturing and exporting national automobile, aircraft, ship and satellites. The Turkish Industrial Strategy Documents⁶ were prepared with the long-term vision of becoming the production base of Eurasia in medium and high-tech products (Turkish Industrial Strategy Document, 2010). In addition to this long-term vision, the overall objective of the industrial strategy is to increasing the competitiveness and efficiency of Turkish industry by transforming the industry towards a structure where mainly high-tech products with high added value are produced, which has qualified labour and which at the same time, is sensitive to the environment and the society (idib., p.49). The main means to reach these objectives are to increase the weight of

⁶ Turkish Industrial Strategy Document (2011-2014) and Turkish Industrial Strategy (2015-2018).

mid- and high-tech companies and sectors, and to introduce high added-value products in low-tech sectors.

Eight horizontal industrial policy areas have been identified: Investment and business environment, International Trade and Investment, Skills and Human Resources, SME's Access to Finance, Technological Development of Companies, Infrastructure Sectors like telecommunication, energy or transport, Environment and Regional Development. The main sectoral areas were the automotive, the machinery, the white goods, the electronics, the textiles and clothing, the food and finally the iron and steel sector.

The Tenth Development Plan (2014-2018) of Turkey also sets the framework for Science, Technology and Innovation for the coming years. The Plan formulates concrete developments and targets. On the basis of the plan the primary aim of R&D and innovation policy is „contributing to increase of technology and innovation activities with a private sector focus and get benefits from these activities, to commercialization of results of R&D activities via constituting an innovation based ecosystem, and to achievement of high global competitive power with branded technology products.” (The Tenth Development Plan, 2014, p.86)

Table 1: Developments and Targets in R&D and Innovation

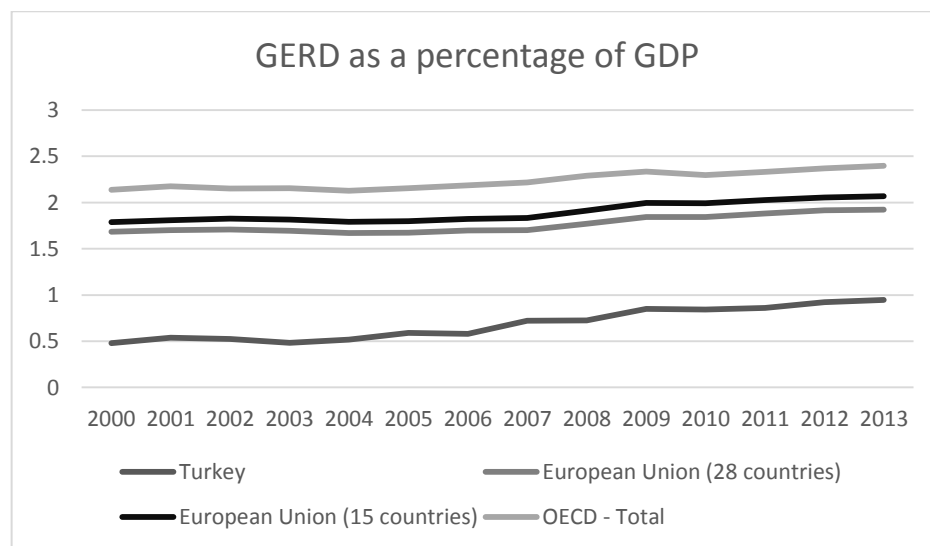
	2006	2011	2013	2018
Share of R&D Expenditures in GDP (%)	0,6	0,86	0,92	1,8
Share of Private Sector in R&D Expenditures (%)	37	43,2	46	60
Number of FTE R&D Personnel	54 444	92 801	100 000	220 000
Number of FTE Researchers	42 663	72 109	80 000	176 000
Share of Private Sector in R&D Personnel (%)	33,1	48,9	52	60

Source: 2006 and 2011 data are from TURKSTAT. 2013 and 2018 data are estimates of the Tenth Development Plan.

As seen in the table above the original plans for 2013 set in the National Science and Technology Policies Implementation Plan for 2005-2010 (BTP-UP), the share of R&D Expenditures in GDP (2%) and the number of FTE R&D personnel (150 000) – had to be modified. The new estimations made by the Tenth Development Plan have been over fulfilled though: GERD/GDP in 2013 was 0,95%, the number of FTE R&D Personnel was about 113 000.

OECD Science and Technology Indicators show that Turkey still lags behind the EU or the OECD average, nevertheless almost all the indicators show a stable and significant growth since 2000.

Figure 2: GERD as a Percentage of GDP in Turkey, in EU15 and EU 28 and in the OECD

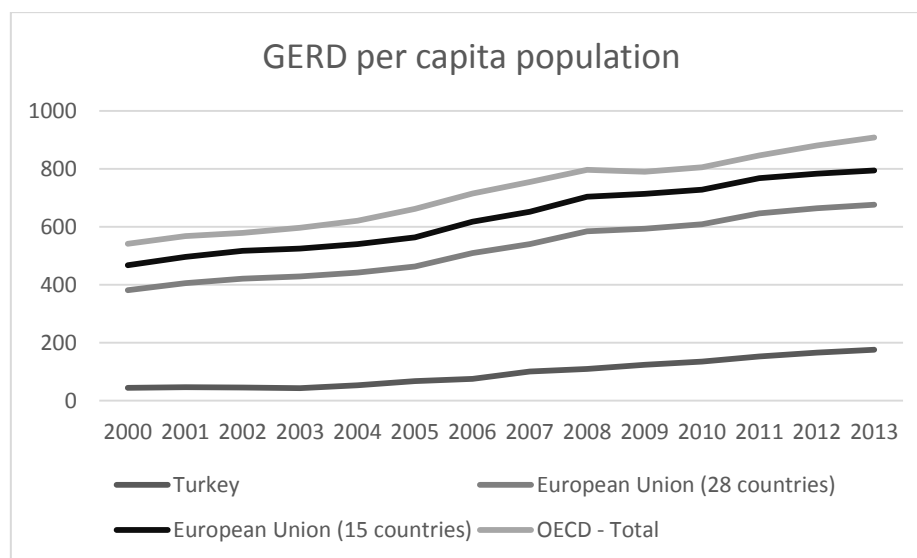


Source: OECD, Science and Technology Indicators

As mentioned above, Turkey – similarly to the Europe 2020 target - has the ambitious goal to reach 3% GERD/ GDP in the next decade. Currently this indicator of Turkey stands at 0,95%⁷, but with an impressive average yearly growth of 17% between 2003 and 2013.

⁷ According to the latest data (2013) the EU 15 is slightly above 2% (2,06%), with the new member states deteriorating the EU28 aggregated data to 1,92%. Both the EU and

Figure 3: GERD per Capita Population in Turkey, in EU15 and EU 28 and in the OECD



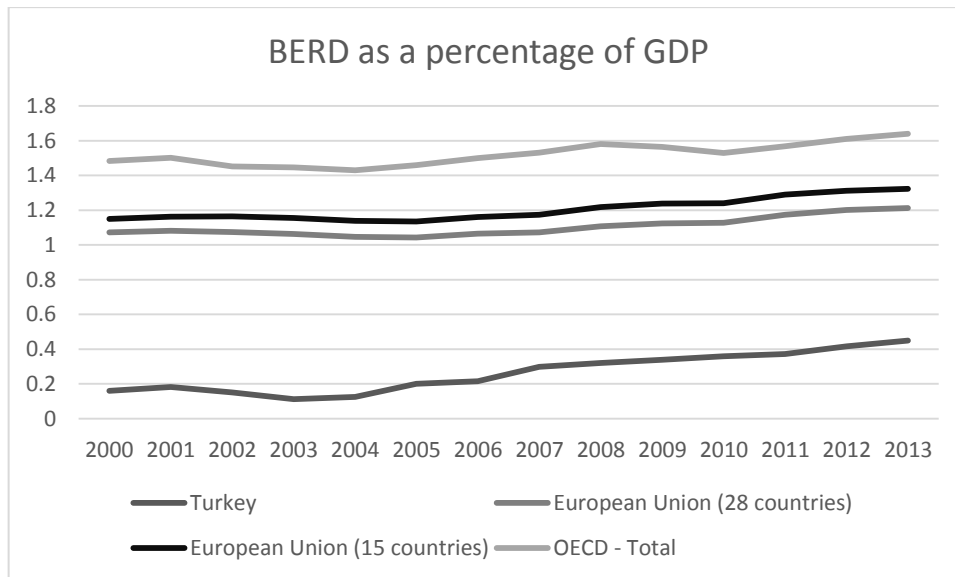
Source: OECD, Science and Technology Indicators

Turkey has a large⁸ and growing population, which makes the difference in terms of GERD per capita even more significant. Nevertheless a stable growing tendency is also to be observed in these statistics.

Turkey have already failed to fulfil the objective of reaching the 3% GERD/GDP set by the Lisbon Strategy for 2010, and Turkey is also far from the wishful 2% of the Ninth Development Plan for 2013.

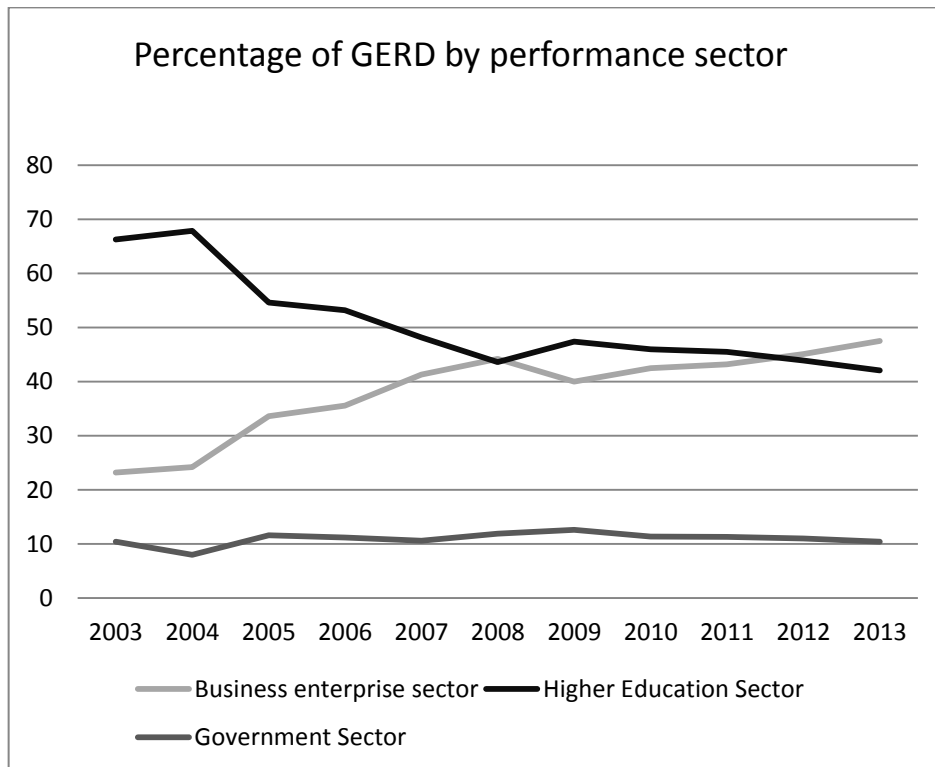
⁸ Based on the national census in 2014 it is about 77 695 904 persons

Figure 4: BERD as a Percentage of GDP in Turkey, in EU15 and EU 28 and in the OECD



Source: OECD, Science and Technology Indicators

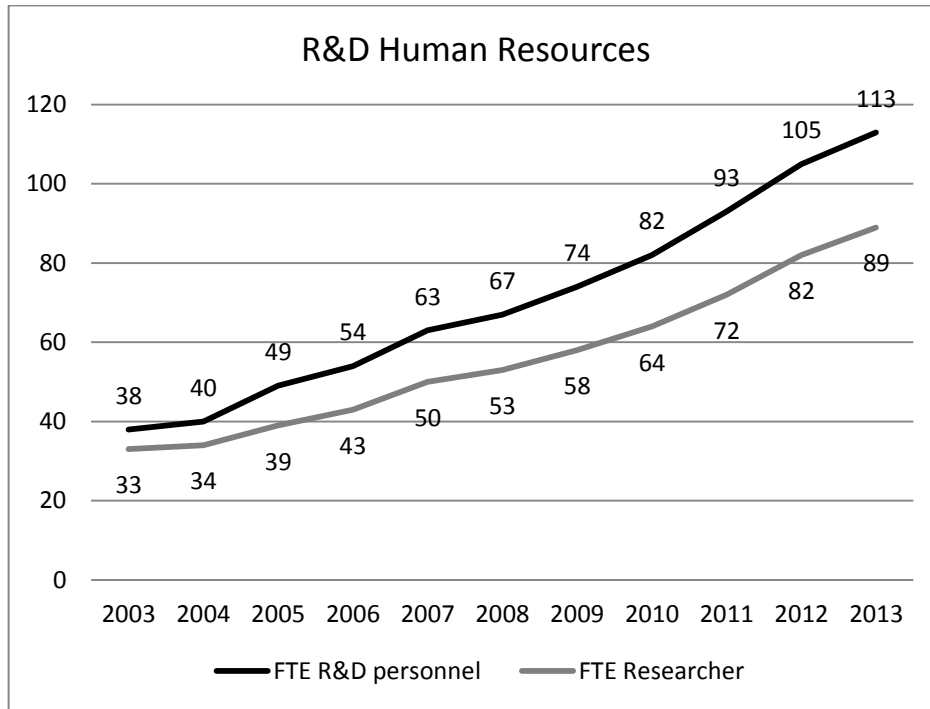
The active involvement of the business sector both in carrying out and in funding Research and Development is also a target shared by the EU and Turkey. The so called Business enterprise expenditure on R&D (BERD) should amount to 60% of the total GERD and should reach 2%, if we take into consideration the 3% GERD targets. Turkey, with its current level of 0,45% is relatively close to the 60% proportion but very far from the 2% general BERD goal. Even if we take into consideration its current pace of growth, reaching this target does not seem to be realistic. Nevertheless the changing tendency between the business sector and the higher education sector is a remarkable phenomenon (Figure 5), which can be the result of increased support for the business sector.

Figure 5: Percentage of GERD by Performance Sectors in Turkey

Source: TÜBİTAK Scientific, Technological and Innovation Statistics

Statistics on human resources is another hot-topic in the future plans for Turkey. As it can be seen on the below figure, the original goals of the BTP-UP – 180 000 FTE researchers for 2013 – could not be reached but the estimations of the 10th Development Plan's – 80 000 FTE researchers – could be easily fulfilled.

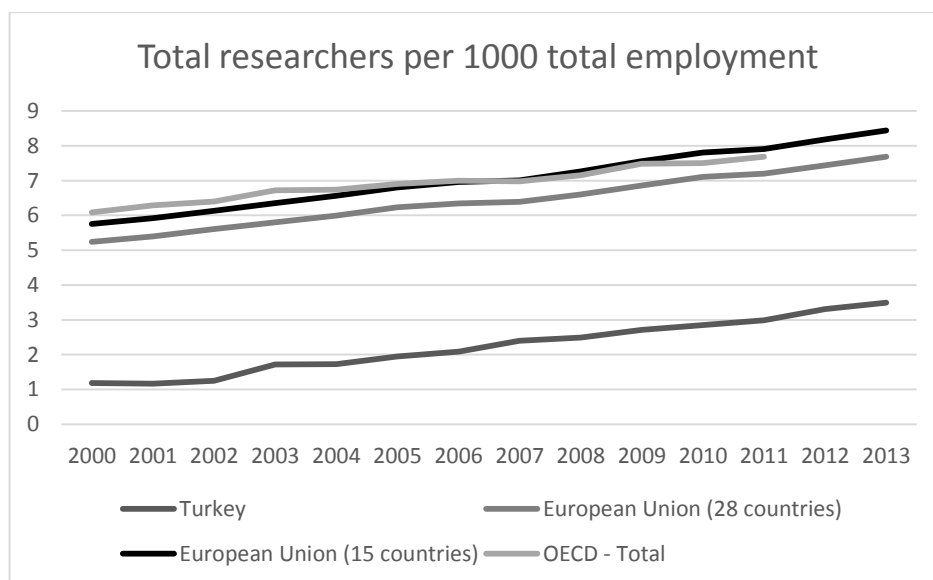
Figure 6: R&D Human Resources in FTE in Turkey (Number x 1000)



Source: TÜBİTAK Scientific, Technological and Innovation Statistics

If we want to compare the human resources development in Turkey with data in the EU and the OECD countries, we can see a similar trend to the ones in GERD and BERD: lower initial levels and rapid growth is characteristic for Turkey. The Full Time Equivalent (FTE) number of researchers increased from 38 000 to 113 000 between 2003 and 2013.

Figure 7: Total Researchers per 1000 Total Employment in Turkey, EU15/28 and OECD



Source: OECD, Science and Technology Indicators

Due to the large population and the low employment rate⁹ of Turkey simple comparison of the above data – total researchers per 1000 total employment – might be misleading though. Such interpretations, which only emphasise the quick growth compared to the previous year or period, do not mention the originally low standards. The pace of growth in European and OECD countries might seem slower but there is hardly any difference in real growth between these country groupings and Turkey, so the original differences hardly diminish. Nevertheless quick and balanced growth is a positive phenomenon, which can ensure the stable development of the Turkish innovation-based economy.

And the best partner to reach these goals is obviously the European Union. The framework used by the European Union in preparing

⁹ According to the latest OECD data from 2015 employment is slightly above 50% in Turkey, compared to the EU 65,3 % and the OECD 66,1% average data. (<http://stats.oecd.org/viewhtml.aspx?datasetcode=STLABOUR&lang=en>) This is mainly due to the low employment of women – only 30% of women are employed in Turkey, which is about half of the EU average (60%). Almost the same percentage of men are employed in Turkey and in the EU (69% vs. 70%).

industrial policies makes important contributions to the strategy determination process of Turkey, both in terms of content and methodology. With the Lisbon Strategy and H2020, the Union intends to make Europe attractive for investment and employment, and to set targets focusing on knowledge and innovation for growth. The question is, how much Turkey and the EU are able (and ready) to cooperate.

5. Turkey-EU relations¹⁰

The relations between the European Union are full of ambiguities. Since its creation in 1923, Turkey showed an eager wish to belong to the European nations. Turks adopted deep reforms in its constitutional, political and economic structure to be able to start accession negotiations with the EU in 2005. The negotiations started a decade ago already, still, while Croatia was able to finish the process and join the EU in this time period, in case of Turkey the process is still open. The idea of enlargement is not popular in Europe, especially not if it is concerning Turkey. Nowadays, the EU plays for time in enlargement, while Turkey becomes more and more frustrated.

Being not clearly a European country, Turkey's inclusion to the integration process in the 1960s came rather from political motives, influenced also by the U.S. strategic interests under Cold War circumstances. The reluctance of Europe was visible in the 1990s, when Turkey was not accepted as a candidate, but also recently, since the beginning of accession negotiations. For a long time, the main arguments against Turkish accession were summarized with the words 'too big, too poor and too Muslim'.

The accession negotiation process with Turkey started in 2005, and came to a near stalemate situation by 2010. Until now, negotiations had been opened in fourteen chapters, but only one¹¹ was provisionally

¹⁰ Partly based on Szigetvári, 2014

¹¹ The *acquis* in Chapter 25 – Science and Research – as laid down in Title XVIII of the Treaty requires the Member States to ensure the necessary implementing capacities to pursue the Community objectives and activities in the field of research and technological development, including adequate staffing. The Member States also need to adhere to and to implement specific Science and Research objectives and activities as developed by the open method of coordination. The *acquis* in this Chapter does not require transposition of EU rules into the national legal order. (Screening Report Turkey, 2006)

closed, while most of the others are blocked: eight by the EU Council in 2006, for Turkey's rejection to open its ports and airports to traffic from Cyprus, five by France in 2007, while Cyprus froze six further chapters in 2009.

There are many reasons, however, why the EU should be interested in cooperating with Turkey. Besides regional political issues and Turkey's increasing role as an energy hub, the changing global environment, its role in the current migration flows and Turkey's economic potentials are also among them. Of course the Turkish economy is still very much depending on the European engine, but with its more diversified export structure (both concerning goods and partners) and its increasing domestic demand, the dependency from Europe is decreasing, which gives Turkey a greater manoeuvring room vis-a-vis Europe. The participation of Turkey on the G-20 meetings means that the country's regional and global profile has grown since it first evinced a desire to join the EU, which gives Turkey a further impetus to negotiate more on equal terms with the EU.

In 2012, the European Commission has launched a so called 'positive agenda' towards Turkey. In its framework "working groups" were created to accelerate the process of alignment of Turkey with EU policies and standards. As Enlargement Commissioner Stefan Füle said: „its aim is to keep the accession process alive and put it properly back on track after a period of stagnation, which has been a source of frustration on both sides.” (European Commission, 2012) According to official explanation, this initiative is not replacing the existing process but provides a new momentum to Turkey's accession process (ibid.).

In 2013, the approach initiated by the positive agenda has turned out to be the most promising tool which ends up in positive results, strengthening both sides readiness for further cooperation. In case of the accession process, the two sides deal fundamentally on an unequal base. The candidate country has to adopt the European „acquis”, and can negotiate only on temporary derogations. Maybe the most important difference by the positive agenda is that there are equal partners negotiating on issues of mutual interest.

EU-Turkey relations have a deep complexity, but both sides are well aware of the necessity of cooperation. And the area of science, research

and innovation is one of the fields where cooperation may be mutually advantageous. As Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science said on 4th of June 2014, when Turkey signed the Association Agreement to Horizon 2020: “Turkey is a much valued partner. Its dynamic business environment is a perfect test bed for the development of innovative products and services – making cooperation a win-win for researchers and enterprises on both sides.”¹²

6. Possibilities for Cooperation: Advantages and Synergies in EU and Turkish Priorities

We have already reflected on parallel issues between the STI targets of the EU and Turkey. If we look at the R&D-innovation objectives of Europe 2020 – inherited from the Lisbon Strategy – we can see similarities with Vision 2023 goals like the target of reaching 3% of GERD/GDP to be invested in R&D and innovation. Compared to the employment target of 75% of the 20-64 year-olds in Europe, Turkey is less ambitious, they want to achieve 55% employment, but on the other hand a very ambitious 5% unemployment rate. As for the climate change and energy priority, while Europe aims at 20% of energy from renewables, Turkey intends to reach the 30% level; both Turkey and Europe want to increase their energy efficiency by 20%. Not mentioned in Vision 2023 but it is an interesting comparison that current drop-out rate in Europe is 12,8%, Europe2020 target is 10% while this number in Turkey is almost 40%. There is also a huge difference in the enrolment to tertiary education: EU is characterized by a current level of 35,8% and with a target of 40% for 2020. Turkey has a current level of 18%. Sustainable growth in the number of research personnel does not seem to be realistic without a proper educational system. The fifth target of Europe2020 about fighting poverty and social exclusion can not be compared with the economic targets of Vision 2023, which focuses rather on economic growth and on the very ambitious goal of becoming one of the 10 largest economies of the world.

¹² http://europa.eu/rapid/press-release_IP-14-631_en.htm

Table 2: Europe2020 Objectives for Growth, Jobs and Societal Challenges

	2006	2007	2008	2009	2010	2011	2012	EU average
	Turkey							
Employment rate of the population aged 20-64	48,2	48,2	48,4	47,8	50	52,2	52,8	68,4
GERD/GDP	0,58	0,72	0,73	0,85	0,84	0,86	0,92	2,07
Greenhouse emission, 1990=100	187	203	196	198				83
Share of population, finished tertiary education	11,9	12,3	13	14,7	15,5	16,3	18	35,7
Share of population (18-24) with maximum lower secondary education	48,8	46,9	45,5	44,3	43,1	41,9	39,6	12,7
Share of population at risk of poverty or exclusion	72,4							24,8

Source: European Commission (2014d)

As far as the activity of Turkey in the EU's R&D programs is concerned, Turkey has been an associated member in EU Framework Programmes for Research and Development since 2002; it also signed the Association Agreement to Horizon 2020 on 4th of June 2014. In his presentation about Turkey's participation in Framework Programme 7 Robert-Jan Smits, Director General of DG Research and Innovation on behalf of EU highlighted the strong participation of Turkish scientists in Marie Skłodowska Curie Actions, in the Research for the benefit of SMEs instrument as well as in the thematic fields ICT and Environment (Smits, 2014). As it can be seen in Table 3, on the basis of the seventh FP7 Monitoring Report the number of successful applicants in Turkey was 1122 with a funding of 165 million Euro.¹³ The success rate of Turkish researchers was around 16,1%, which is below the EU average (21,6%). It is remarkable that the success rate of Candidate and Associated countries was even higher than the one of the EU28 countries (21,9%). The difference is even more conspicuous if we have a look at the success rates in retained EU contribution: compared to the 19,2% EU average Turkey had a success rate of 7,2%. Candidate and Associated countries are close to the EU average again with a success rate of 18,7%.

Table 3: Number of Applicants in Retained Proposals and Corresponding Success Rate for the 7-year Period

	2007	2008	2009	2010	2011	2012	2013	Total	Rate
Turkey	141	119	183	206	200	182	91	1122	16,1%
EU	1924 2	1241 2	1759 2	1517 4	1749 3	1903 1	1145 4	11239 8	21,6%
Candidate & Associated	1583	1221	1730	1455	1543	1699	1072	10303	21,9%

Source: European Commission (2015) Seventh FP7 Monitoring Report

¹³ Due to a number of still running projects, this amount might further increase.

Table 4: Number of Requested EU Financial Contribution in Retained Proposals (in € million) and Corresponding Success Rates

	2007	2008	2009	2010	2011	2012	2013	Total	Rate
Turkey	25,15	16,32	24,04	21,33	30,04	37,09	11,39	165,4	7,2%
EU	5881	4340	5306	4999	5705	6794	4261	37289	19,2%
Candidate& Associated	482	442	599	484	513	722	417	3658	18,7%

Source: European Commission (2015) Seventh FP7 Monitoring Report

Research Organisations were the most active applicants (25,41%) closely followed by Public Bodies – mainly TÜBİTAK¹⁴ (22,22%). The Higher Education sector (16,02%) and Private business – SMEs – were responsible for another third of the applications. The top 5 participants were TÜBİTAK, the Middle East Technical University, Koç University, Bilkent University and Sabanci University (Smits, 2014).

7. Synergies and Possibilities in H2020

Horizon 2020 is the new Framework Programme for Research and Development of the European Union for the period 2014-2020. For this seven-year period H2020 has a budget of around 80 billion Euro.

Turkey has published a Position Paper on Horizon 2020 in June 2012. Generally speaking they welcomed the new programme and highlighted the similarities with their National Science, Technology and Innovation Strategy (2011-2016). Nevertheless they emphasised the importance of SMEs in the economies of both the EU and Turkey and mentioned the relative importance of capacity building compared to scientific

¹⁴ TÜBİTAK is one of the leading institutions in the STI policy system in Turkey since 1963. It is an autonomous institution that is governed by the Science Board. TÜBİTAK contributes to the advancement of S&T and innovation in Turkey via its research, development and innovation (RDI) funding and performing functions.

excellence for Candidate Countries, which can not benefit from the Structural Funds. This comment has not been finally taken into consideration by the EU but the new IPA II (Instrument for Pre-accession Assistance) can be also used for scientific capacity building purposes.

TÜBİTAK's EU Framework Programmes National Coordination Office (NCO) is taking actions in order to enable Turkey to benefit from Horizon 2020 to the highest extent. In this context, researchers will be supported for their travels, organization of events, writing projects, and pre-evaluations of the proposals. Besides, successful Turkish researchers in Horizon 2020 Programme will also be financially awarded by TÜBİTAK. The next table summarises the similarities, synergies and adaptation techniques of Turkey with the three main pillars of Horizon 2020.

Table 5: Synergies between Horizon 2020 and Turkish STI Policy Programmes/Strategies

Horizon 2020	Turkey
Pillar I.: Excellent Science: reinforce and extend the excellence in RDI (25,3 B €)	New policy tool to improve the quality and impact of scientific publications – articles in high impact factor journals are rewarded
I.1: European Research Council (ERC) - ERC starting grants - ERC consolidator grants - ERC advanced grants	ERC Principal Investigator Support Programme for - project writing - pre-evaluation - interview trainings Above Threshold Awards (Reserve list 12000€ etc.) ERC Success Award - 25000 € + budget x 9% - 30000 € + budget x 9% - 35000 € + budget x 9%
I.2: Future and Emerging Technologies (FET) - FET Open (mainly on ICT) - FET Proactive - FET Flagships (Human Brain, Graphene)	ICT is one of the Mission-oriented areas of UBTYS
I.3: Marie Skłodowska-Curie actions (MC) Individual Fellowships (IF) European Fellowships (EF) Global Fellowships (GF) Research and Innovation Staff Exchange (RISE)	MSCA Pre-Evaluation Support programme Above Threshold Awards (above 80 scores) TÜBİTAK Science Fellowship Grant Programmes (BİDEB) - Fellowship for Visiting Scientists and Scientists on Sabbatical Leave (2221) - Reintegration Research Fellowship Programme (2232) - Co-Funded Brain Circulation Scheme (2236) - Graduate Scholarship Programme for International Students (2215) - Research Fellowship Programme for Foreign Citizens (2216)
I.4: European Research Infrastructures, including e-Infrastructures	E-Government and e-Infrastructures – SCST – 2013 Turkey is member of ESFRI (European Strategy Forum on Research Infrastructures), Ministry of Development is working on a roadmap 108 research infrastructures activated, 65 being developed + 97 advanced research centres
Pillar II: Industrial Leadership: focus on innovation and the private sector	Turkish Industrial Strategy Document: „to make Turkey the production base of medium and high technology products in Eurasia.”

Horizon 2020	Turkey
<p>II.1: Leadership in Enabling and Industrial Technologies</p> <p>ICT Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, and Biotechnology Space</p>	<p>Automotive industry, machine manufacturing and ICT are the three mission-oriented research areas in UBTYS</p> <p>Space is one of the Need-oriented areas in the second pillar of UBTYS</p>
II.2: Access to risk finance	Industry Oriented Support Programme of TÜBİTAK on Venture Capital (1514)
II.3: Innovation in SMEs – SME Instrument (from idea to market)	Individual Entrepreneurship Support Programme (1512) with a very similar structure to the SME instrument: idea – prototype – commercialization
<p>Pillar III: Societal Challenges</p> <p>Health, Demographic Change and Wellbeing Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy Secure, Clean and Efficient Energy Smart, Green and Integrated Transport Climate Action, Environment, Resource Efficiency and Raw Materials Europe in a changing world - Inclusive, innovative and reflective societies Secure societies – Protecting freedom and security of Europe and its citizens</p>	<p>Health, Food, Water, Energy and Security (Defence) are five areas of the second pillar of UBTYS</p> <p>The National Food, Water and Energy R&D and Innovation Strategies 2011-2016 have been accepted by SCST and are coordinated by TÜBİTAK</p> <p>The Turkish Energy Efficiency Strategy (2012-2023) has been adopted</p>

Source: European Commission Horizon2020 Programme official website <http://ec.europa.eu/programmes/horizon2020/>, TÜBİTAK Turkish scientific programmes and strategies <http://www.tubitak.gov.tr/en>, Gölükcü, 2015, Karatas, 2015

EU member states and Associated Countries of the Framework Programmes foster the successful participation of their scientific community in Horizon 2020 by providing various support mechanisms. There are three major types of support structures: countries might apply EU priorities and funding schemes in their own national support system. The second mechanism is built on giving professional advice and support during the application procedure. The third option is that the national government provides funds to motivate researchers for the application. The Turkish government applies a mixture of these three mechanisms. National Contact Points under TÜBİTAK are mainly responsible for giving information and advice during the proposal preparation. The other two forms are used in various ways connected to the main pillars of Horizon 2020.

As Excellence remained an important pillar of Horizon 2020, and both OECD and the Innovation Union have criticized Turkey because of its low performance on innovation and excellent research, some new policy tools have been developed to achieve better results. Two important programmes of the Excellent Science pillar are the Grants of the European Research Council (ERC) and the mobility programmes of the Marie Skłodowska-Curie Actions. On the one hand TÜBİTAK facilitates applicants in both schemes by providing project-writing, pre-evaluation and interview support and training possibilities, which makes the project-preparation phase more successful. Another tool is the Above Threshold Award, which provides financial support for highly evaluated but in the final round not selected proposals. Such a scheme reduces the risk of application and increases the possibilities to receive financing. Most excellent researchers are the target group for the so called ERC Success Awards, which tops up ERC grants with an additional national budget, giving even more scientific freedom and possibilities for the best scientists. There are Turkish mobility schemes, which are developed in line with MSC Actions. They mainly facilitate the reintegration of Turkish scientists or offer a possibility to international visiting scientists to carry out research in Turkey.

Future and Emerging Technologies, Enabling and Industrial Technologies as well as the thematic fields of the Societal Challenges are reflected in the national priorities of the Turkish science policy, more concretely in the vertical pillars of the National Science, Technology and Innovation Strategy. European targets and priority areas

have been taken into account while the National Food, Water and Energy R&D and Innovation Strategies have been developed for 2011-2016.

Turkey is not only a member country of ESFRI, the European Strategy Forum on Research Infrastructures, but national decisions about new infrastructures are also made in accordance with the guidelines of the Forum.

The SME instrument is a new tool in the second pillar of Horizon 2020. It gives support to small and medium-sized enterprises to develop and commercialise their innovative ideas in three phases. TÜBITAK 1512, a support programme for individual entrepreneurs is a very similar initiative in four stages. In the first stage a feasibility study has to be developed and submitted in both programmes. In the second phase – in the second and third stage in the Turkish system – the real work is carried out by the realisation of the innovative project idea. At the end of this stage the prototype has to be ready for commercialisation, which is facilitated in the last stage. This is a progressive funding scheme, where you can only apply for the next phase if you have accomplished the previous one with success. Using the Turkish model can be a very good test bed for local SME-s to cope with higher competition on the EU level.

Table 6: TÜBITAK 1512 - Support Programme for Individual Entrepreneurs

	Applicant	Duration	Type of support	Budget (€)	Output
Stage 1: from idea to project	entrepreneur	-	entrepreneurship training, coaching	-	Project proposal
Stage 2: start-up, technology	entrepreneur	12 months	100% grants and coaching	max. 47000	Prototype, demo etc.
Stage 3: Advanced R&D project support	corporation	18 months	75% grants	max. 238000	Commercial prototype
Stage 4: Commercialisation	corporation	12 months	Brokerage event, access to venture capital	-	Marketed product

Source: ERAWATCH Turkey-Specific Information

8. Conclusions

Turkey has the ambitious goal to become one of the 10 largest economies in the world. In order to realise this ambition, further investment in RDI is necessary. The STI target of 3% GERD/GDP seems to be a precondition for the economic targets of Vision 2023. And in spite of its impressive growth, the current levels of GERD and BERD are still far away from Vision 2023 goals. Becoming one of the largest economies of the world means also internationalisation, openness and networking with the rest of the world. In addition to Turkey's strong relations to the USA and to the MENA region, Europe is the main partner not only in economic but also in scientific terms.

Taking into account previous tendencies and current efforts Turkey has good chances to increase its participation in Horizon 2020 compared to previous Framework Programmes. It already has a lot of experience and a strong NCP support on the field of Marie Skłodowska Curie actions, so an active participation is very likely on this field. Due to massive support for excellence, an increased number of applications and winning proposals for ERC grants are to be expected.

The Individual Entrepreneurship Support Programme can be a good test bed for Turkish SME-s to apply successfully in the SME instrument. New strategies on Food, Water and Energy help to build up local excellence and facilitate the participation in international consortia on these three Societal Challenges.

Nevertheless there are still some challenges for Turkey to cope with:

- I. Developing and implementing a Smart Specialisation Strategy could support more focussed programme building and funding, which would enhance economic growth and international cooperation on these selected areas.
- II. Strengthening capacity building on a national level with the use of IPA II funds by investing in universities, national research centres and infrastructures.
- III. Further encouraging knowledge transfer from academia to industry.

- IV. Supporting scientific excellence by encouraging patent applications and international scientific co-publications in high impact factor journals.
- V. Constant monitoring and impact assessment of current programmes by developing indicators and monitoring systems.

Existing programmes, strategies and funding schemes already cover all these challenging areas and Vision 2023 targets might give another impetus to further growth in RDI investments on the side of the government. Nevertheless it is of crucial importance that these investments should not only be reflected in improving statistics but also in real structural changes. Scientific excellence can not be achieved by solely facilitating the number of patent applications and the publication in high impact-factor journals. Excellence is much more a bottom-up, organic process, which is built upon a well-developed education system, on stable government policy and a transparent and effective support system.

Turkey is a large emerging market economy with steadily growing performance indicators. Nevertheless the coming years will show if Turkey is able to become from an agriculture and labour-intensive industry-based economy, built on cheap low-skilled labour force to a highly competitive, innovation and technology-based economy. Focused, efficient and properly monitored investment in STI and international cooperation are the only ways to achieve the ambitious goals of Vision 2023.

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