THE STEM NEED IN TURKEY FOR 2023

Executive Summary
June 2017

The report prepared by PwC in cooperation with TÜSİAD (The Turkish Industry and Business Association), entitled "The STEM Need in Turkey for 2023", highlights the critical role of STEM fields and underlines the significance of STEM skills, which are the foundation for the innovation needed for financial growth.

The report includes information about Turkey's ranking in relation to emerging and developed countries in terms of the number of STEM graduates, and changes in this ranking over the years.

In addition, PwC has analysed and forecast the employment need in STEM fields and the number of potential employees expected to graduate from STEM-related departments and join the workforce, outlining STEM employment needs by industry.

Significance of STEM fields

To keep up with and sustain digital transformation, Turkey needs a sufficient number of qualified workers. The business world needs a workforce with STEM skills—skills related to science, technology, engineering and mathematics—in order to stay in the race in the global economy, which is led by technology, innovation and digitalisation.

An international, generally-accepted STEM education and work classification has not been done, yet there is consensus among experts that some fields require STEM knowledge. Science fields include space sciences, earth sciences, life sciences (ecology, genetics, pathology, nutrition, etc.), physics and chemistry; technology fields include computer sciences and informatics (cryptology, programming, artificial intelligence, etc.); engineering fields include mechanical, industrial, electrical, materials and construction engineering; mathematics fields include algebra, geometry, statistics and game theory.

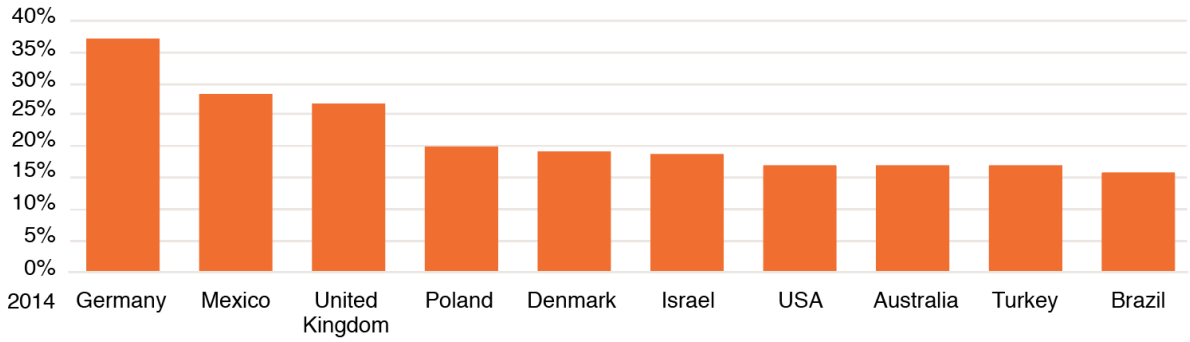
In today's world, where technological transformation plays a critical role, productive, entrepreneurial and discovery-based education is fundamental. STEM education not only improves education quality, but it also responds to the needs of the business world as it develops an interdisciplinary approach, teaches how to use theoretical information in practice, encourages critical thinking and instils problem solving skills.

STEM graduation rates

The percentage of STEM graduates in selected countries, taken from the graduate data by field published by the OECD in 2014, is presented in Graph 1. In Turkey, 17% percent of graduates are

STEM graduates, which is more than in Brazil (16%) and equal to the USA (17%) and Australia (17%). Turkey falls behind the other OECD countries included in the graph.

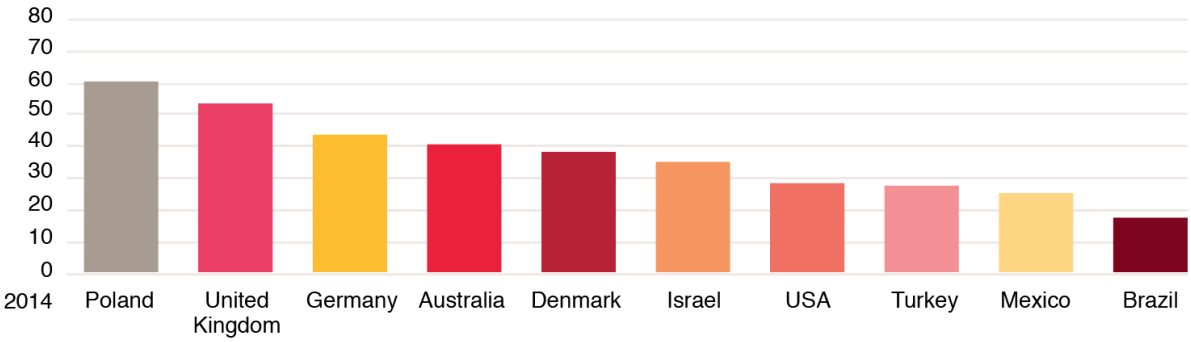
Graph 1: Ratio of STEM graduates and post-graduates to total graduates by country



Source: USA, Germany, Australia, United Kingdom, Brazil, Denmark, Israel, Mexico and Poland's graduate data by OECD fields, national statics for Turkey and PwC STEM matching analyses

In terms of percentage of STEM graduates in the total workforce, Turkey is ahead of other emerging countries like Brazil (17%) and Mexico (26%), with 27% of its 2014 graduates falling into this category, as presented in Graph 2.

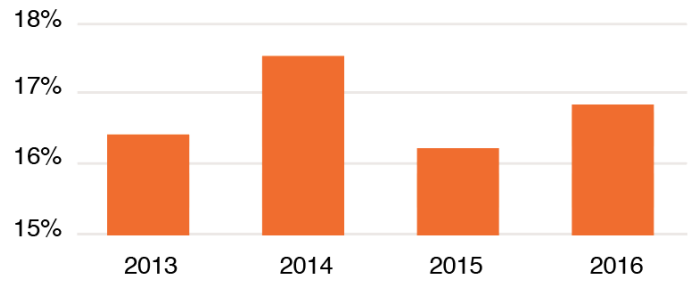
Graph 2: Rates of STEM graduates and post-graduates in the total workforce by country



*PwC STEM Matching
** 2014 rates were calculated usign base scores and stated in tens of thousands
Source: USA, Germany, Australia, United Kingdom, Brazil, Denmark, Israel, Mexico and Poland's graduate data by OECD fields, national statistics for Turkey and the word bank's workforce data

As demonstrated in Graph 3, the percentage of STEM graduates in Turkey between 2013 and 2016 was around 17%.

Graph 3: Percentage of STEM graduates and post-graduates in the total graduates in Turkey



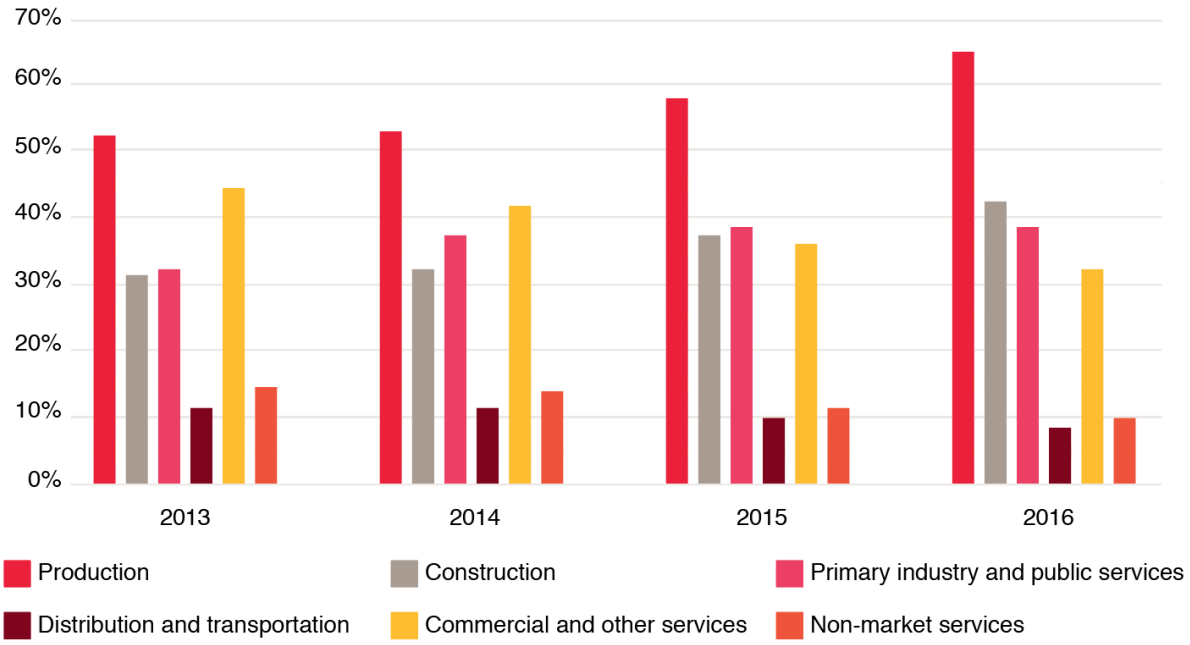
Source: YÖK (the Council of Higher Education) number of graduates by departments and *PwC STEM matching analyses

STEM employment needs analyses

Industries in Turkey are classified into six main categories: production, construction, distribution and transportation, primary industry and public services, commercial and other services, and non-market services. STEM employment needs for 2023 were determined by industry to create forecasts.

As presented in Graph 4, the base percentages of STEM graduates by industry in the period between 2013 and 2016 were 57% in the production industry, 36% in the construction industry, 37% in the primary industry and public services, 10% in the distribution and transportation industry, 39% in commercial and other services, and 13% in non-market services. STEM graduates also contribute extensively to the economy in lines of business outside these industries. The reasons for this are lack of awareness about STEM fields in Turkey and the fact that STEM students do not have enough information about the fields in which they can use their competencies. Other factors include selecting different career paths and having different career expectations, as well as the fact that the equivalents of STEM fields in the job market do not meet the demands of individuals.

Graph 4: The distribution of STEM graduates by industry in Turkey and percentage of STEM graduates in the total workforce



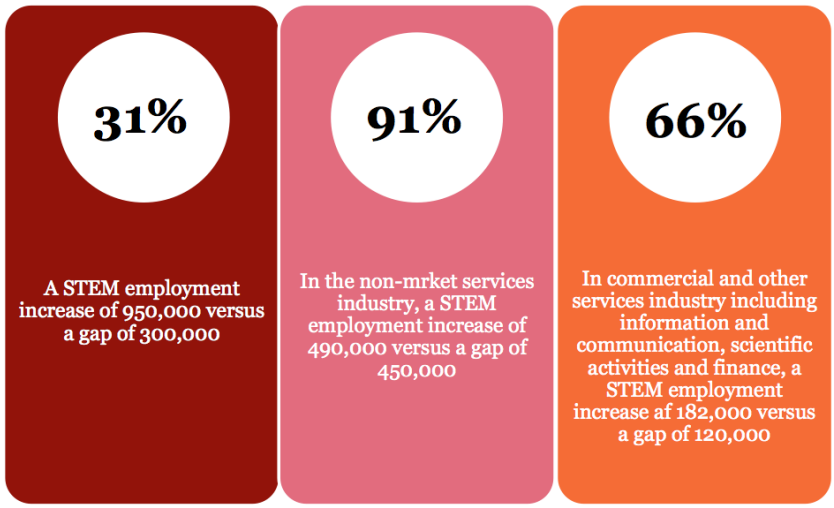
Source: YÖK (the Council of Higher Education) data, TUİK (the Turkish Statistical Institute) data, PwC STEM matching analyses

PwC's analysis shows that in 2023 total employment in all industries will be around 34 million, 3.5 million of which will be STEM graduates. In the period between 2016 and 2023, the STEM employment requirement is forecast to reach 1 million, 300,000 of which (around 31%) will not be met. The industries that will have the largest gaps are non-market services[1] (91% gap) and commercial and other services[2] (66% gap). In the period between 2016 and 2023, STEM employment in non-market services will increase by approximately 490,000 and the gap will remain at 450,000, while STEM employment in the commercial and other services industry will increase by 182,000 and the gap will remain at 120,000.

[1] *Human health and social services, administration and support services, public administration and defence.*

[2] *Other service activities, information and communication, professional, scientific and technical activities, real estate activities, finance and insurance activities*

Graph 5 : Major findings of the estimates for the 2016-2023 period



What should we do?

- In a period when digital transformation and the industrial 4.0 (r)evolution are becoming more and more widespread, prioritising STEM is highly critical.
- In order to provide the required STEM workforce in Turkey; government, education community and business community should act together on forming policies, programs and actions.
- It is essential that STEM education is implemented at all educational levels from pre-school to university, and that the quality of education is improved. To raise creative, innovative, analytical individuals with critical thinking and problem solving skills, the curriculum, educational methods and teacher training should be improved.
- The higher education curriculum should be enriched to meet the needs and expectations of the business world, and the cooperation between universities and industries should be enhanced to ensure education complies with the needs of business life.
- Guiding STEM graduates towards STEM fields as much as possible is important for providing the qualified workforce required in technology and innovation fields.
- Companies should sustain their significant role in creating an innovative environment by carrying out R&D activities and providing risk capital, and they should play a more active role in investing in STEM education and supporting STEM skills, thereby taking the necessary steps to compete globally. It is critical that efforts to expand the business fields related to STEM (i.e. R&D development, expand R&D to all levels) should accelerate.
- By creating the required STEM profiles in business, providing more information about the workforce required and providing work and internship opportunities, companies can create opportunities for students to better prepare for work life.

- Analyses should be conducted to reveal the number of STEM graduates in Turkey's workforce and the distribution of these employees by industry. The necessary capacity building plan to increase the number of STEM graduates in Turkey should be implemented. TÜİK (the Turkish Statistical Institute), İŞKUR (the Turkish Employment Agency), YÖK (the Council of Higher Education), the Ministry of Education and universities should form joint study groups, together ensuring that data quality is improved and details include STEM data. In addition, companies should provide data and share their estimates with public institutions, so public policies can be created based on evidence and practice-based data.
- Investment in STEM fields has gained importance throughout the world recently, with significant efforts stretching over a long period of time and new efforts continuously being initiated. Steps to improve STEM education and the workforce should be handled at an international political level and supported by the public. Action plans should be implemented with the cooperation of the public, education sphere and business sphere, and progress should be closely followed.