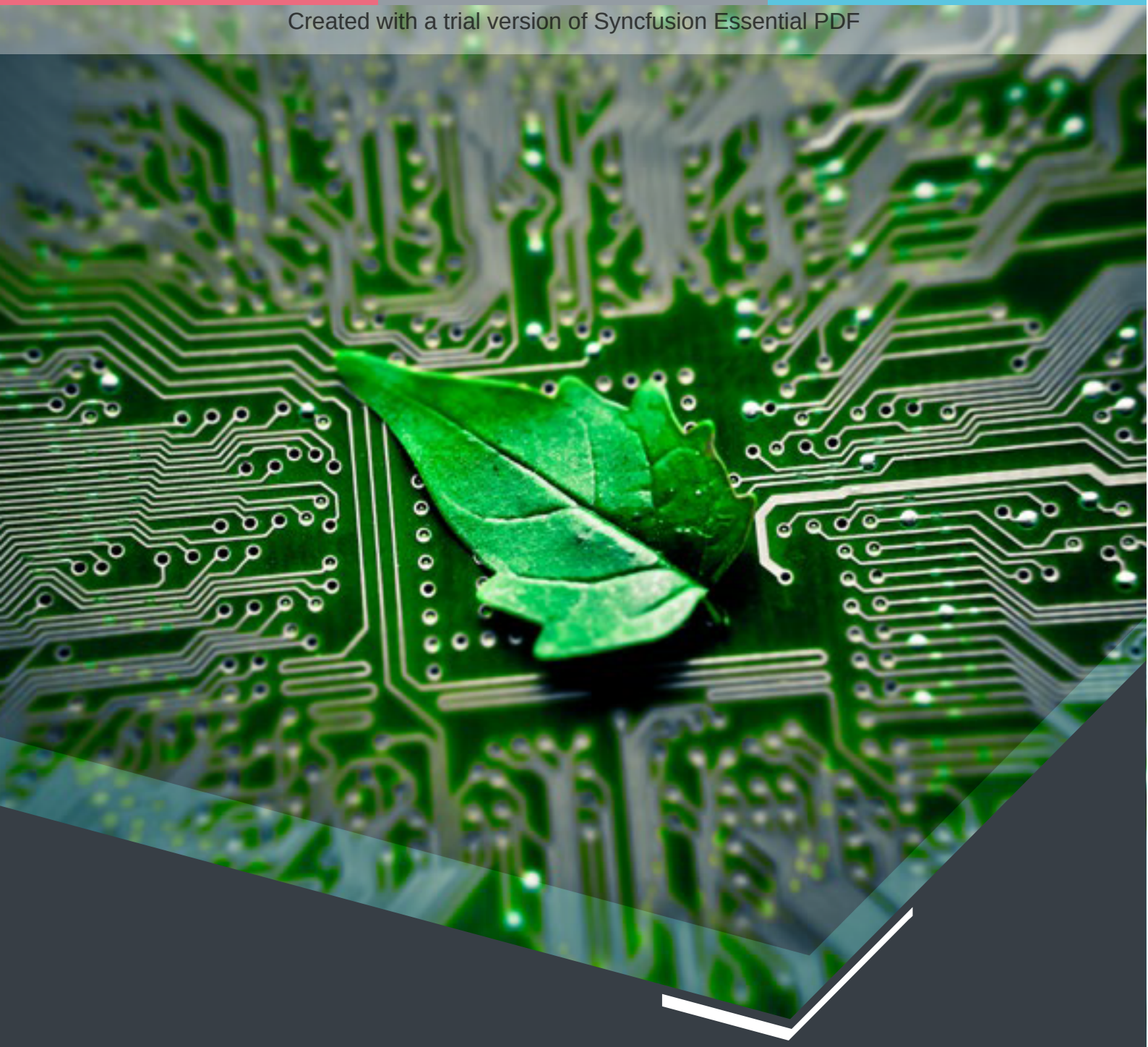

DEVELOPMENT INSIGHTS

Unlocking The Transformation: Digitalization & Green Tech

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TSKB

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Unlocking The Transformation: Digitalization & Green Tech

Digitalization and its effects, which can be defined as digital technologies and data which alter existing economic activities and bring about new economic activities, have become one of the most important issues of economic life in recent years. Despite the added value which digitalization offers in all economic activities, discussion continues surrounding the harmonization problems it will create in the labour markets and the inequalities in access to digitalization, observed among and within countries. The international literature, which started to focus on the spread of the Internet in the second half of the 1990s, is expanding today with the increasing number of studies and publications on the subject carried out by different institutions and organizations such as the World Bank, the OECD, the United Nations and the World Economic Forum.

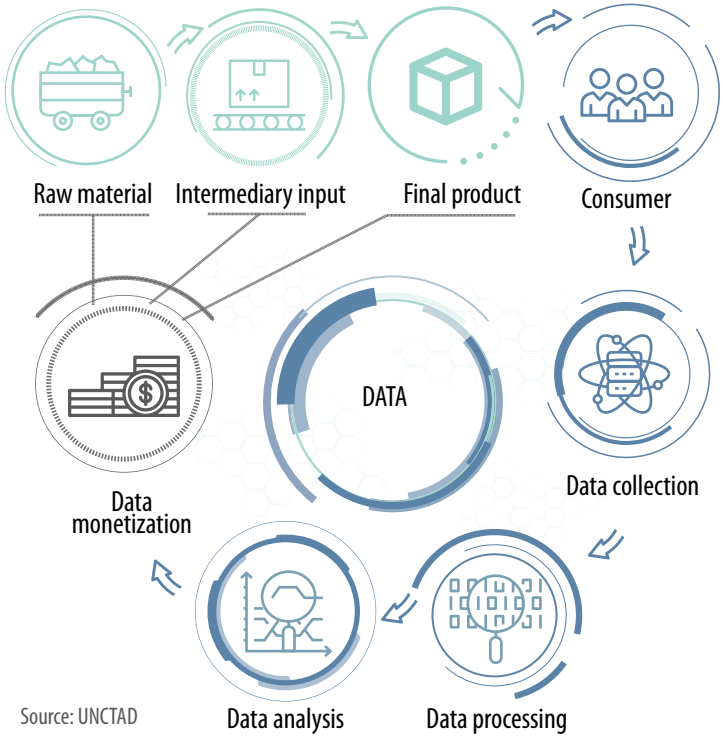
The importance of digitalization has recently become apparent with the COVID-19 pandemic. While the pandemic has put great pressure on the national health systems and led to production halts in manufacturing industry, the reflections of social restrictions on the services sector has left the world economy fragile. At this point, digitalization has significantly reduced the total cost of the pandemic by allowing services to be accessible remotely, despite the various qualitative losses it has imposed in social, economic and educational activities. In this period, online retail has replaced traditional retail more rapidly, while the use of big data has facilitated rapid and accurate decision-making in managing the pandemic. This period, which has been marked by a rapid expansion in the influence of digitalization, has one distinctive characteristic; during the pandemic, rather than being focused on cost optimization and efficiency gains as in previous periods, digital solutions played a role in the birth of new businesses.[1]

Another factor placing digitalization in the spotlight is that it is one of the important accelerators of climate action steps with the advantages of digital technologies in the use of energy and resources. While climate change has become one of the main topics of discussion when it comes to development all over the world, we find it meaningful to discuss the possible effects of digital technologies on growth and employment markets specifically to Turkey, as well as the role they can play in the transition to a green, circular economy.

The Age of Digital Platforms

One of the most prominent features of recent years is the dramatic increase in the volume of digital data on the internet. This increase has been accompanied by big data analysis, artificial intelligence and cloud computing solutions. The ongoing increase in the number of people and devices able to access the internet indicates that the role of digital data and technologies will continue to grow in the coming period as the digital economy continues its evolution with the collection, analysis and use of digital data accumulated in almost all areas of life. The digital footprints created by personal, social and commercial activities on digital platforms has enabled the continued growth of the digital data pool.[2]

Figure 1: Value From Digital Data



Source: UNCTAD

[1] UNIDO. (2020). COVID-19 Implications & Responses: Digital Transformation & Industrial Recovery.
[2] UNCTAD. (2019). Digital Economy Report 2019.

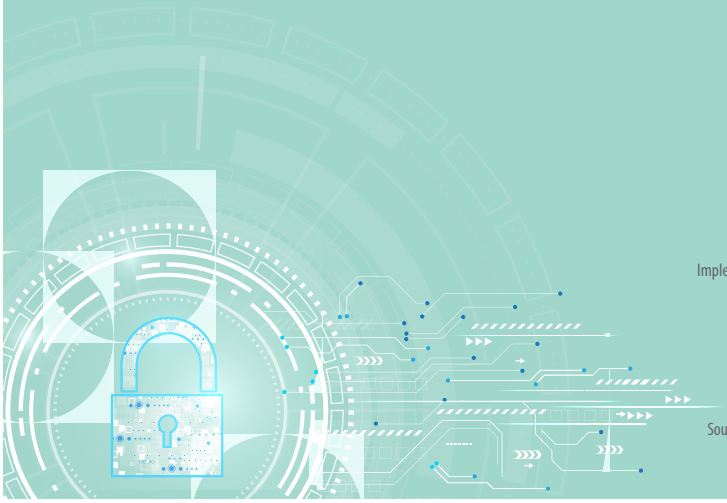
Focus 1:

Mounting Cybersecurity Concerns

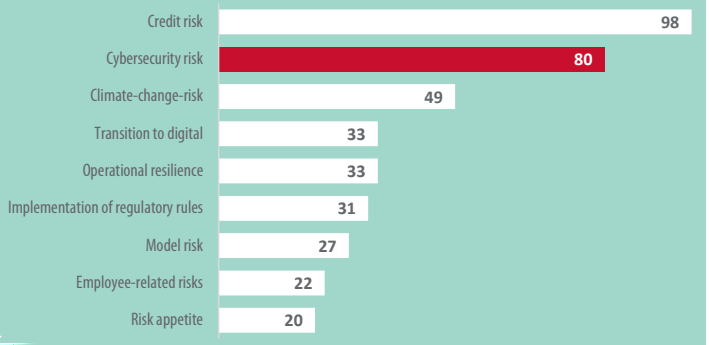
Cyber-attacks are becoming increasingly common and sophisticated in the face of the increasing interest in digital products and services and the active role of technologies such as the internet of things (IoT) in both consumer products and the industry. These attacks, which threaten the integrity and confidentiality of data, hamper the adaptation and operations of individuals, businesses and governments to the digital age.

A survey published by Ernst & Young (EY) and the Institute of International Finance (IIF) in June 2021 found that the banking sector, which is tightly supervized and regulated all over the world, views cybersecurity as one of the most serious risk factors in the near term.[3] According to a study conducted with the risk managers of 88 financial institutions from 33 countries, cybersecurity risk is considered as a key priority for the coming year by 80% of respondents, ranking second in the survey after credit risk.

OECD data indicates that individuals are also vulnerable to cyber-attacks. Accordingly, 29.9% of individuals using the internet in the EU countries in 2019 stated that they had encountered phishing attacks, where users are directed to fake sites in order to obtain their password or credit card information. This rate remains relatively low in Turkey, at 13.8%.



Graph 1: Risk Issues in Banking
(%, survey participants)



Source: EY, IIF, TSKB Economic Research

Today, digital platforms such as Facebook, Amazon and Alibaba, which are among the largest companies in the world, not only bring together different sides of commercial life, but also collect and analyse the data on the actions and transactions of the parties. The collection and storage of data, and the generation of insights and models from them form the "data value chain", which feeds all business processes. In these circumstances, the ability to access data and transform data into information is vital for the competitiveness of companies and economies.

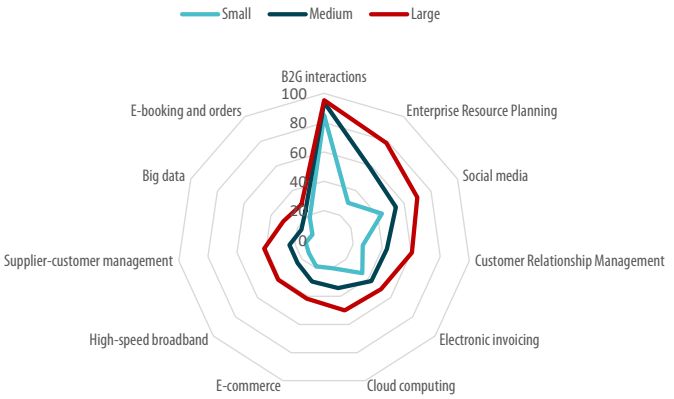
Although global digital platforms offer opportunities for the companies in developing countries, the power inequality between individual companies and platforms stands out as an element that should not be ignored. Today, the USA accounts for 73% of the world's 70 largest digital platforms by market value, with China comprising an 18% share.[4] Naturally, it can be said that the control of data is largely in the hands of a small number of actors in these countries. In this equation, although local digital platforms have the chance to generate solutions for local users by using regional market information, they are fighting an uphill struggle against large global corporations, which is difficult to sustain. The acquisitions carried out by tech giants all over the world also confirms this trend. Despite the great divergence between countries, the work carried out in developing countries in the field of digital platforms is valuable in creating job opportunities, which require relatively developed technical and analytical skills. On the other hand, developing countries which provide positive conditions in legislation and infrastructure are potentially attractive for digital companies seeking to enter new markets and learn local ways of doing business. Foreign direct investments in the digital field paves the way for new technology and know-how to enter different geographical regions while ramping up the industry's job creating potential.

[3] EY. (2021). Resilient Banking: Capturing Opportunities and Managing Risks over the Long Term
[4] https://www.economist.com/business/2020/02/20/the-eu-wants-to-set-the-rules-for-the-world-of-technology

A New Era for SMEs

Companies operating in developing countries stand to benefit from global digital platforms if they possess the necessary digital preparation. In particular, SMEs may access domestic and international markets which they previously would have been unable to reach, while they can also lower their transaction costs. Digital platforms promise economies of scale and productivity gains for the SMEs, which accounted for 72.4% of total employment, 44.1% of production by value and 36.6% of Turkey's exports in 2019.[5] On the other hand, studies into SMEs find that companies in this group continue to lag behind in the spread of digital technologies around the world. (Graphic 2).

Graph 2: Digital Diffusion in OECD Countries by Firm Size (%, 2015-2018)

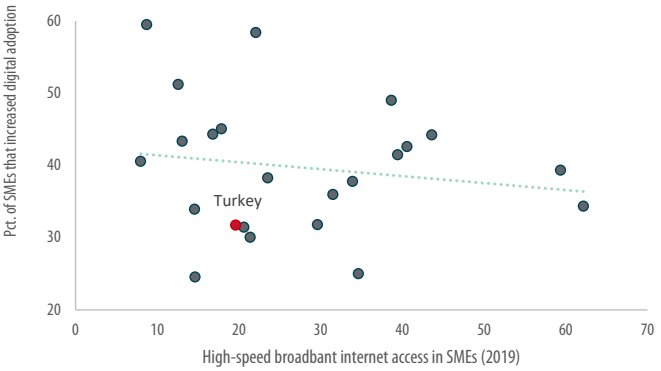


Source: OECD, TSKB Economic Research

While SMEs demonstrate a performance similar to large corporations in communication with the public (B2G- Business to Government) with approximately 90% adaptation, they lag behind in other areas. One of the main reasons behind the negative divergence seen among SMEs is connectivity; connectivity is what allows companies to adapt their business models to the digital environment and to continue their operations in situations which require social distancing, such as the COVID-19 pandemic. According to 2019 figures, while 22% of SMEs enjoy high-speed broadband access in the OECD on average, this rate is slightly lower in Turkey at 19.6%. [6]

With the myriad of difficulties which it has brought about, the COVID-19 pandemic has served as a catalyst requiring companies to rapidly progress through stages which would be planned over a much longer time span under normal conditions. The pandemic has triggered a rise in the use of digital technologies in SMEs across a wide range of industries in OECD countries. According to the OECD figures for July 2021, an average of 39.7% of the SMEs in these countries started to benefit more from digital technologies after the COVID-19 pandemic began. In Turkey, this rate stood at 31.2% (Graph 3). As

Graph 3: Internet Access and Digital Adaptation of SMEs



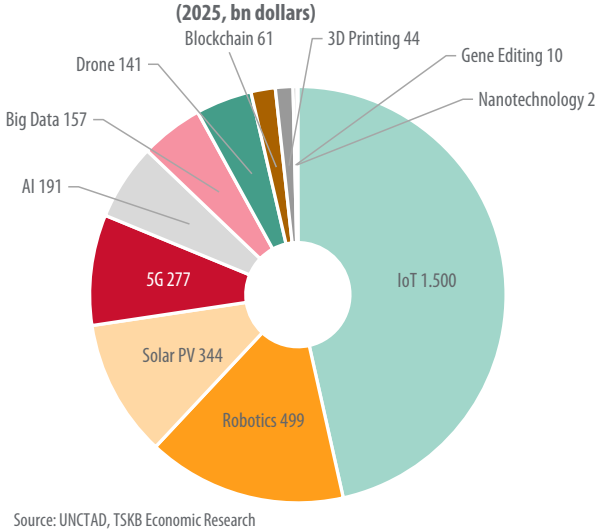
Source: OECD, TSKB Economic Research

the trend line in the graph indicates, SMEs felt the need to take more steps in the name of adaptation in the pandemic environment in countries with limited access to high-speed internet and consequently, lower levels of digitalization. Nevertheless, this relationship is far from complete considering the significant discrepancies between countries, and the countries behind in terms of access should accelerate their adaptation.

Emerging Digital Technologies

The progress achieved in collecting, processing and transferring data has paved the way for the birth of a number of new digital technologies referred to as "frontier technologies". These technologies, which have stepped up their presence in various industries, started to accelerate the transformation in the manufacturing, service and energy production industries. Eleven frontier technologies, which are estimated to have had market size of USD 350 billion in 2018, are expected to create a total market of USD 3.2 trillion in 2025.[7] The IoT and robotics, which are among the technologies in Graph 4, are expected to command a share of more than 60% in the total in 2025 with estimated market sizes of USD 1.5 and 0.5 trillion, respectively.

Graph 4: Estimated Market Size of Frontier Technologies (2025, bn dollars)



Source: UNCTAD, TSKB Economic Research

[5] TurkStat Small and Medium Enterprise Statistics 2020
[6] OECD. (2021). SME and Entrepreneurship Outlook 2021
[7] UNCTAD. (2021). Technology and Innovation Report 2021

For the developing countries, which have prepared themselves for certain strategic frontier technologies in terms of workforce skill level, infrastructure and finance, the exponential growth in these areas offers a window of opportunity. The application of these technologies to existing lines of business stands to offer a competitive advantage in favour of developing countries in the near future through the discovery of new products and services.

A study prepared by the United Nations Conference on Trade and Development (UNCTAD) aims to measure the capacity of countries to use, absorb and adapt border technologies. The Readiness for Frontier Technologies Index is calculated on five key elements: i) diffusion of information and communication technologies (ICT), ii) skills, iii) R&D activities, iv) industrial activity and v) access to financing. In the study, which examined 158 countries, Turkey ranked 55th, slightly behind similar selected countries (Table 1).

Viewing the data from Turkey's perspective, "R&D activities" emerges as an area with a strong performance compared to similar countries. Although the share of R&D expenditures in GDP is lower than the average for developed countries, at 1.09% in Turkey as of 2020, the high share of the ICT (Information and Communications Technologies) industry in the private sector R&D expenditures stands a positive indicator of Turkey's position in digitalization. ICT accounts for approximately 44% of private sector R&D expenditures in Turkey, compared to 36% in OECD countries.[8]

However, Turkey's ranking in "diffusion of ICT" and "industrial activity", which is based on exports of high-tech manufacturing industry and exports of digital services are significantly lower than its overall ranking. On the other hand, the workforce skill level also emerges as another development area. The requirements brought about by the new age in terms of skills will be discussed in detail in the following sections of the report.

Table 1: Rankings of Selected Countries in Frontier Technologies Readiness Index*

Country	Total Ranking	ICT Ranking	Skills	R&D Ranking	Industry Activity	Finance Ranking
US	1	14	17	2	20	2
China	25	99	96	1	7	6
Czechia	26	30	23	32	18	72
Russia	27	39	28	11	66	45
Poland	28	32	30	30	32	70
Hungary	37	27	43	48	16	99
Brazil	41	73	53	17	42	60
India	43	93	108	4	28	76
Romania	45	44	70	34	38	115
South Africa	54	69	84	39	71	13
Turkey	55	75	63	27	78	49
Mexico	57	68	83	29	33	96

Source: UNCTAD Technology & Innovation Report 2021, TSKB Economic Research
*Sorted high to low

[8] The OECD R&D statistics 2017

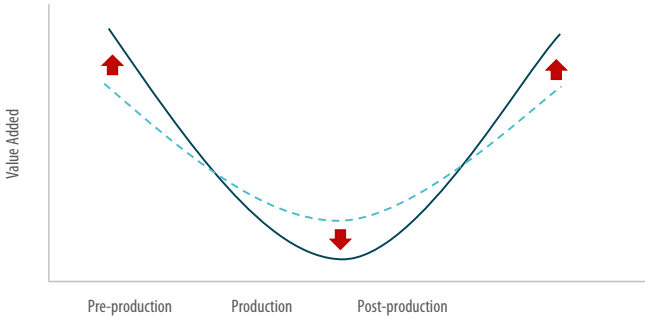
The New Era Requires a Different Development Path

The rise of digitalization in existing production links is also transforming the value creation process. With the spread of digital technologies, manufacturing and service processes have become intertwined. Robotics and process automation speeds up production process in manufacturing and reduces the added value of this phase.[9] On the other hand, data-based services are increasingly feeding the pre-production processes, while software supports and after-sales services are feeding the post-production processes. This situation can be illustrated by the "smiling curve" in Graph 5.

With the collection, storage and analysis of data, digitalization offers new potential for added value. The use of meaningful data with integrity has a positive impact on all processes not only in manufacturing industry, but also in the agricultural and services industries. In other words, digitalization allows industries to undergo structural transformation within themselves.

Automation, which is one of the elements of digitalization, is ushering in a whole new playing field for developing countries which are threatened by the middle-income trap. The increasing use of advanced machinery necessitates a new interpretation of the story of structural transformation, which involves the withdrawal of the workforce from agriculture and services to the manufacturing industry, bringing greater productivity gains. The use of industrial robots remains limited to a small number of industries such as automotive and electronics. In most industries, such as textiles and clothing, human labour remains technically and economically ahead of automation. In the next decade, however, advanced robots are expected to become cheaper, while their capabilities and efficiency are expected to increase significantly.[10]

Graph 5: Digitallzaiton Effect and 'Smiling Curve'



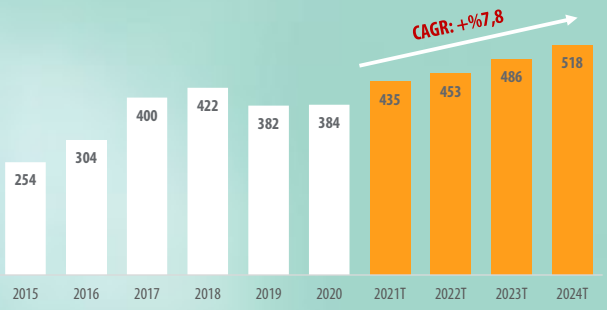
Source: UNCTAD

Focus 2

2021 Could Be a Record Year for Robots

According to data compiled by the International Federation of Robotics (IFR), the number of industrial robots in factories worldwide increased by 10% in 2020 compared to the previous year, exceeding 3 million. Having decreased in 2019 due to the effects of the trade war between China and the USA, there was an upturn in new installations again despite the uncertainties created by the pandemic (Graph 6). In the industrial robot market, of which the Asian continent accounts for 71% in 2020, China and Japan share the top two places with 168,000 units with 39,000 units respectively, followed by the USA with 31,000 units. The market is expected to achieve a compound average growth rate of close to 8% in the 2021-2024 period. The installations of 435,000, which are expected at the end of 2021, represent a new peak level for the industry.

Graph 6: Global Industrial Robot Installations (yearly, thousand)



Source: IFR, TSKB Economic Research

[9] Hallward-Driemeier ve Nayyar. (2018). Trouble in the Making? The Future of Manifacturing-Led Development.
[10] UNCTAD. (2020). World Investment Report 2020

In the last 30 years, multinational companies have moved various parts of their production processes to developing countries. The relatively low labour costs in these geographical areas have been a contributing factor in this trend. However, the future development and spread of automation may lead to a decrease in the share of labour costs in total costs, thus bringing production back to developed economies. If these conditions occur, developing countries may have to compete with developed economies in labour intensive industries.[11] The pace of reshoring will depend on the development of robot technology and what policies are adopted in the countries with existing production bases, and it will differ between industries. Some of the multinational companies may also choose to continue benefiting from their talent pool in their existing facilities.

The transformation scenarios, which can be seen in global value chains for the coming years, are not limited to reshoring. Technology, local policies and sustainability trends can enable different production models to be experienced in different industries and geographical areas.[12] For example, 3D printing and additive manufacturing technologies can enable international companies to carry out their production in micro factories in different regions in the industries, where production processes are relatively simple. While digital technologies allow centralized control of the production network in this scenario, where value chains are shortened and centralized, they can create cost advantages by ensuring that production is close to the market.

Of course, not all possible scenarios are disruptive to global value chains. In particular, in industries where robot technology is not economically or technically viable, there is the possibility of further fragmentation of the supply chain in order to gain resistance against the risk of geographical concentration in production. In this scenario with limited exploitation of economies of scale, digital technologies will play a role in the coordination and control of production spread over a wider geographical area.

In the upcoming period, the use technology will be one of the main variables for the scenarios mentioned above. Therefore, developing countries have to utilize growth strategies that prioritize human capital in order to hedge against potential damage to employment markets and maintain their competitive advantage in the exported product bundle. While digital technologies such as artificial intelligence and automation will replace physical work, they will also lead to the emergence of new employment areas, where humans have a comparative advantage.[13] Building of an education system, which takes into account the new production conditions and that increases the skills especially in the field of information and communication technologies, will play a vital role in the struggle of developing countries against the middle-income trap.

Focus 3
Fintek as an Instrument of Inclusiveness

Digitalization has the potential to deepen existing inequalities, yet it can also serve sustainable development in various aspects. Fintek, which can be defined as the integration of digital technologies into products by financial service providers in order to improve usage and access by customers, is one of them.

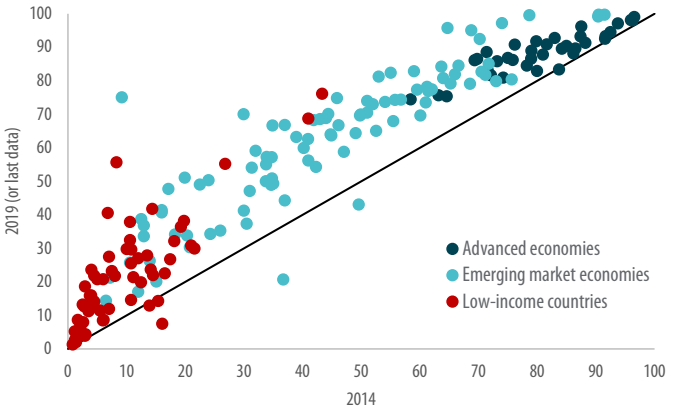
Today, the poorest segments of societies are faced with having to choose the most unpredictable or risky methods in order to conserve their resources, borrow money or transfer resources. A significant portion of human population cannot currently access financial services due to physical transportation difficulties, high costs or cultural preferences. The data reveals that 1.7 billion adults worldwide do not have a bank account.[14] Fintek, on the other hand, offers a cheaper and easier way to deliver financial services to customers. Fintek offers significant advantages over traditional banking, which depends on the expansion of its branch network and therefore has to bear the additional costs of serving a small number of customers in rural areas. Considering that an estimated 1.1 billion of the 1.7 billion individuals without a bank account have mobile phones, the mobile banking services and payment systems provided by Fintek may bring significant gains with respect to financial inclusion in the coming period. We will see that blockchain technology, which has application areas such as money transfer, foreign trade and financing, and the use of loans will maintain its place on the agenda. While work on a joint digital currency continues in Europe, the decision to issue blockchain-based digital central bank money in Turkey's 11th Development Plan demonstrates that this element of Fintek has also found a domestic response.

[11] Glawe ve Wagner. (2018). The Middle Income Trap 2.0: The Increasing Role of Human Capital in the Age of Automation and Implications for Developing Asia.
[12] UNCTAD. (2020). World Investment Report 2020.
[13] Acemoglu and Restrepo. (2016). The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment.
[14] https://www.itu.int/en/mediacentre/backgrounders/Pages/digital-financial-inclusion.aspx

Digital Gap and Skill Mismatch Will Be Main Challenges

The "digital gap", which expresses the inequality between those who can benefit from the advantages brought about by the digital age and those who lack access to these advantages is one of the main agenda items of digitalization. Today, there are significant differences between individuals, businesses and geographical regions at different socio-cultural levels in terms of using information technologies and accessing the internet. Although infrastructure investments, which have spread around the world in recent years, have gone some way towards closing this gap, it could be claimed there is still some way to go, given that basic services are increasingly shifting to an online environment. According to World Bank data, in the last five years before the COVID-19 pandemic, the rate of individuals accessing the internet increased in all but 4 of 186 countries, with significant discrepancies between country groups remaining (Graph 7). In this period, internet access increased by 7.7 percentage points on average in developed economies, by 18.1 percentage points in developing countries and by 12.0 percentage points in low-income countries.

Graph 7: Global Internet Access
(perc. of adults having access to internet)

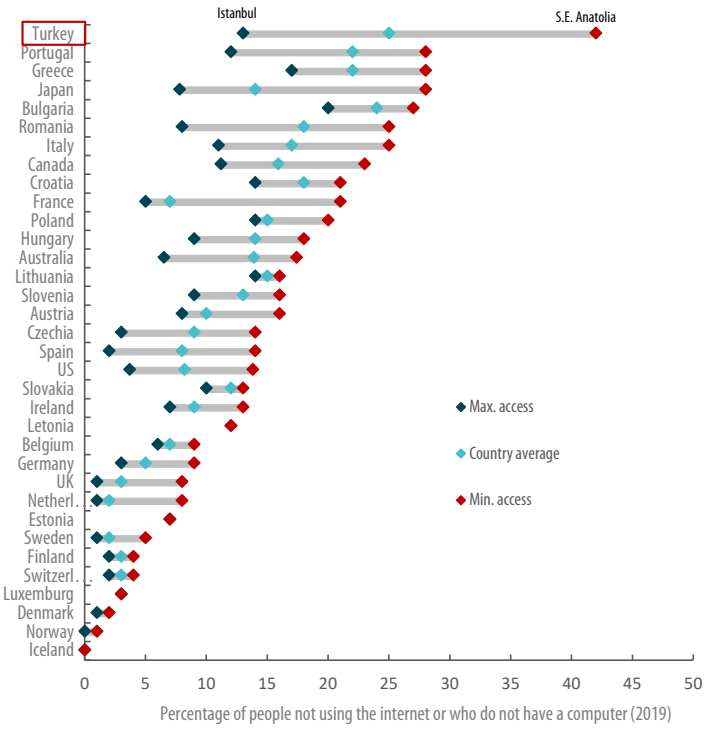


Source: World Bank, TSKB Economic Research

The digital disparity, which manifests itself between industrialized countries and countries that lag behind in this field, emerges within the countries as a disparity between urban and rural regions. When people who do not have access to a smartphone, computer or the internet are unable to access digital information which will improve their current living conditions, they become even more disadvantaged with the digital transition of basic services and business models. This was especially evident during the COVID-19 pandemic, where the continuity of both conventional education and the courses that provide technical skills was only possible with remote access. During this time, the availability of high-speed internet, which is required by digital products such as virtual classrooms and video conferencing, within countries has gained importance.

According to OECD data, Turkey suffers from the widest regional digital disparity among the 34 countries included in the calculation (Graph 8). Considering the calculations based on the TR2 regions, the ratio of the population who do not use the internet or do not own a computer is 13% in Istanbul, but as high as 42% in South-eastern Anatolia. This 29 percentage-point difference is 9 percentage points higher than the country with the next widest disparity (Japan). Considering the role which digitalization will play in development in the coming years, it is clear that there is an area of development in this area in Turkey, where there are already inter-regional inequalities. South-eastern Anatolia, the region which lags behind when it comes to accessing digital tools, was the 4th poorest region among 26 regions in terms of per capita GDP in 2019, being 49% below the national average and 69% below Istanbul's per capita GDP. [15]

Graph 8: Regional Digital Gap Among OECD Countries

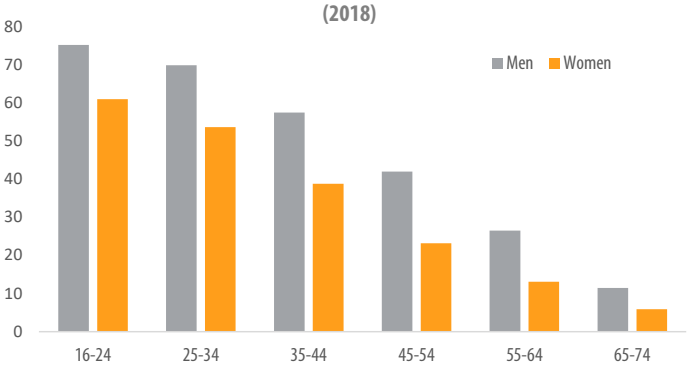


Source: OECD, TSKB Economic Research

The statistics on computer usage in Turkey demonstrate that the computer usage rate increased by 20 percentage points in the last decade and reached 59.6% as of

2018. However, when the data is analyzed by gender breakdown, another dimension of the digital disparity becomes apparent (Graph 9). There is an average 16 percentage-point difference between men and women in working age groups in terms of computer use, an important indicator of digital skills. In addition, the rate of penetration, which is significantly lower than the national average among individuals over the age of 35, indicates that businesses will need basic IT training to increase their use of digital technology.

Graph 9: Gender and Age Differences in Computer Use in Turkey (2018)



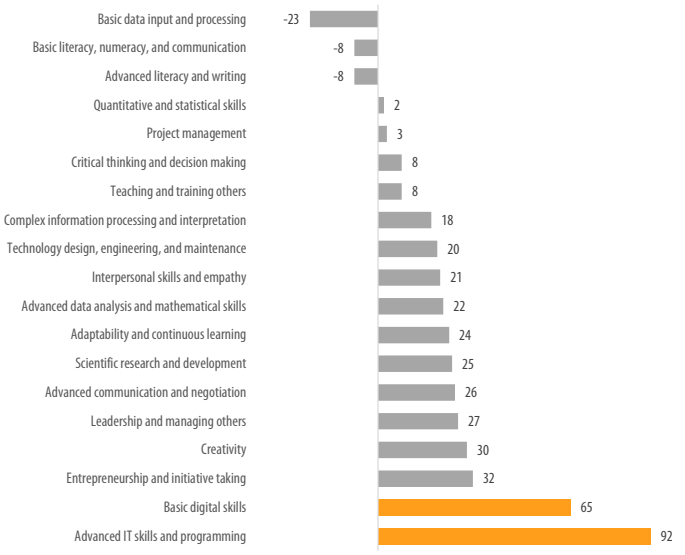
Source: TurkStat, TSKB Economic Research

The rapid penetration of digital technologies such as automation and artificial intelligence in all areas of working life distinguishes Industry 4.0 from previous industrial revolutions. In this period, it is seen that the speed of development and implementation of technologies is progressing ahead of both policy making and social cohesion. Increasing number of international studies also emphasizes that in the near future, economies have to take measures for upskilling in order to prevent inequalities between different work force groups and to achieve long-term competitiveness and sustainable development.

A study published by McKinsey in 2018 discusses the changes that the new era will bring in workforce skills. In the report, which states that employees will increasingly use online applications and technological tools, and accordingly the time spent in jobs requiring physical skills will decrease by 16% and the time spent in basic cognitive tasks will decrease by 17% in Western European countries between 2016 and 2030.[16]

It is reported that the duration of use of social and emotional skills and technological skills will increase by 22% and 52%, respectively. Another study mentioned in the same report focuses on the use of sub-skills in these countries (Graph 9). This study estimates that the use of basic digital skills will increase by 65% and the use of advanced technology skills will increase by 92% by 2030.

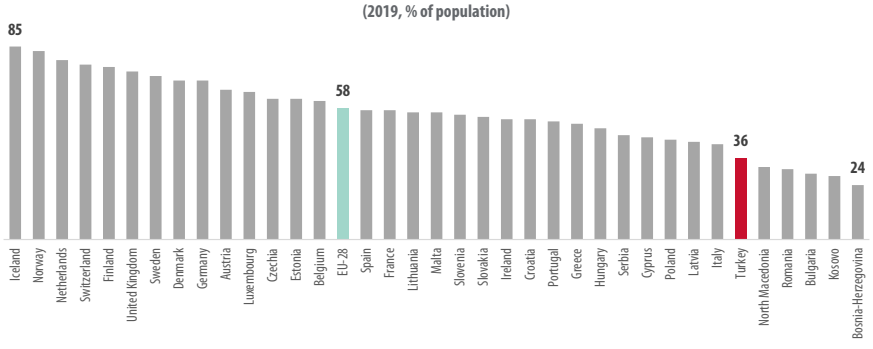
Graph 10: Estimated Change in the Use of Skill Groups (%, 2018-2030)



Source: McKinsey, TSKB Economic Research

The strong position that the information technologies skill set will achieve in working life in the near term will require the establishment of education policies which take this situation into account. According to Eurostat 2019 data, the proportion of individuals aged 16-74 who possess basic or superior digital skills is 36%. This ratio places Turkey in 31st place among the 36 countries included in the study, some 22 percentage points below the EU average (Graph 10).

Graph 11: Digital Skills of Adults
(2019, % of population)



Source: Eurostat, TSKB Economic Research

[15] The TURKSTAT Provincial Gross Domestic Product Statistics 2019
[16] McKinsey. (2018). The Rise of the Digital Challengers – How digitization can become the next growth engine for Central Europe and Eastern Europe.

Digital Technologies Offer Green Opportunities

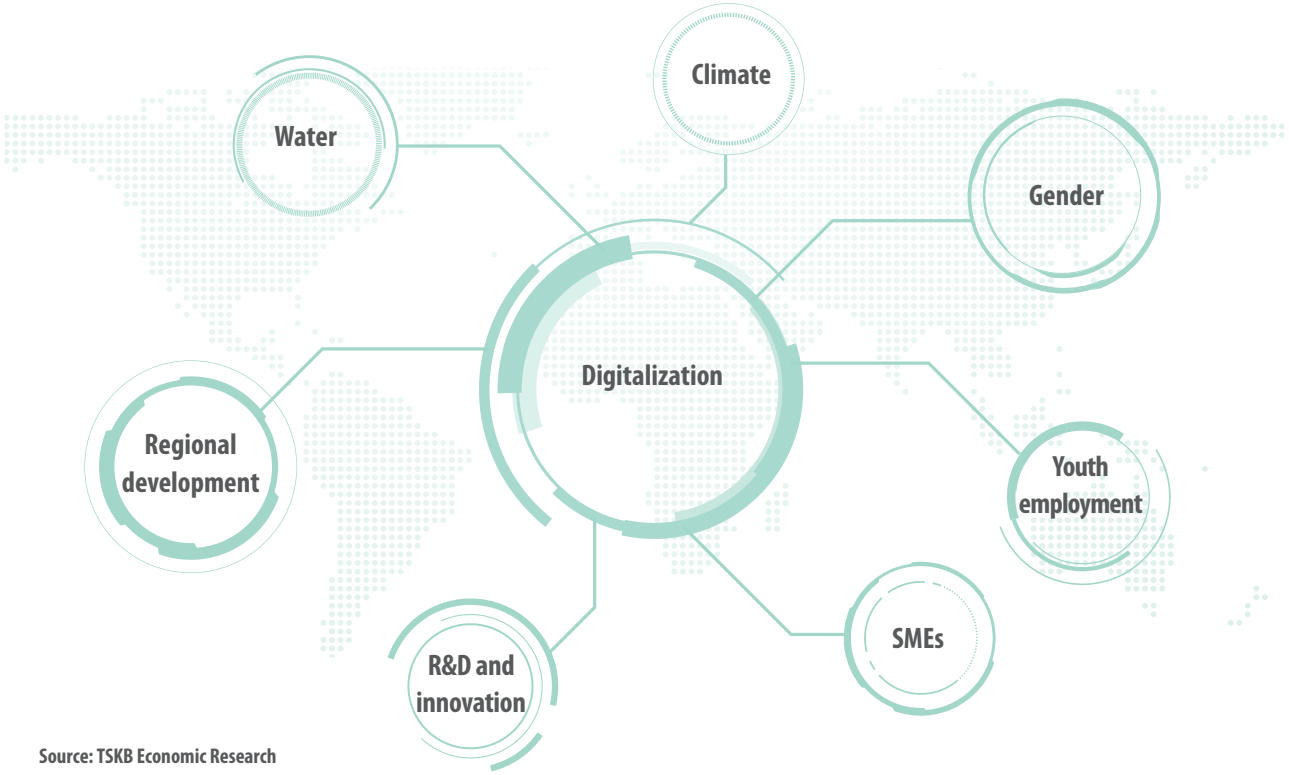
Until recently, environmental policies had been considered separately from economic and social development policies. Today, however, extreme climate events have become increasingly apparent and have had a negative impact on economic life, which has changed this situation. The last few years have placed a fair and green transformation at the heart of development debates. At this point, the natural synergy between the digital economy and green technologies, which can be expressed as technologies that reduce or reverse the negative environmental effects of human activity, highlights the tremendous potential of digitalization when it comes to climate action.

Digital technologies such as the IoT, big data and artificial intelligence with the dense data network they provide increase the availability of information about all stages of pre-production, production and post-production. Thus, they contribute to the sustainable decision-making process for both product and service providers and consumers. Advances in data collection and transmission provide insight into the final status of parts and products, and enable the goods whose economic life has expired to join the value creation cycle through reuse, remanufacturing or recycling, thus improving material efficiency and decreasing the volume of industrial waste.[17] Digitalization also manifests itself in precision farming technologies. Sensor-assisted systems increase environmental sustainability by supporting decision making mechanisms on issues such as irrigation and fertilization.

The other contributions provided by digital technologies with regard to climate include the convenience of monitoring environmental impacts. Advanced sensor and satellite imaging techniques allow monitoring of critical or fragile ecosystems. Similar techniques can also be used to measure anthropogenic (i.e. originating in human activity) greenhouse gas emissions.

Although digital technologies have the potential to support circular systems and a sustainable economy, they require various measures to increase global production and consumption. First of all, the digital industry is an energy-intensive area and has a significant environmental footprint. The information and communication industry accounted for more than 5% of electricity demand in 2018, causing significant greenhouse gas emissions globally, and this proportion is likely to rise to 20% by 2030.[18] Considering that demand for data centres, digital services and cloud computing services will grow in the near future, it is clear that the digital transformation must be accompanied by a transformation in energy.

Figure 2: Digitalization and Related TSKB Economic Research Publication Topics



Source: TSKB Economic Research

[17] UNIDO. (2019). Bracing for the New Industrial Revolution: Elements of a Strategic Response
[18] ECERA. (2018). Digital Circular Economy: A Cornerstone of a Sustainable European Industry Transformation

Digitalization also serves climate action with the change it creates in consumer preferences and life practices. Increasing access to the digital world and, in parallel, enabling easier access to information has, combined with increasing environmental awareness, paved the way for consumers to evaluate their preferred products and services from a sustainability perspective. At the same time, many activities which had taken place face-to-face before have been found to be possible via remote access – a point especially demonstrated during the COVID-19 pandemic. Despite the loss of various qualifications, work, education and cultural life have been transferred to the digital environment. At this point, it was observed that emissions arising from transportation decreased significantly.

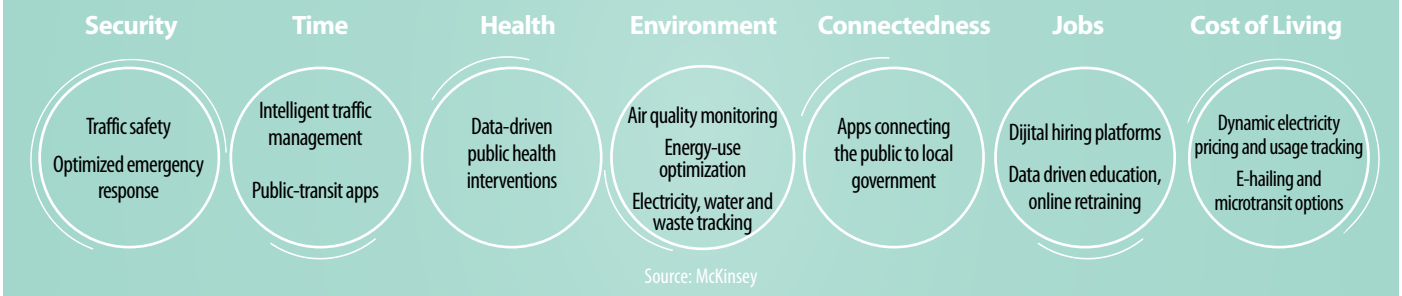
As mentioned in various parts of the report, digitalization touches many other areas of development as well as climate, as depicted in Figure 3. The TSKB Economic Research publications related to these issues can be accessed from the link.

Focus 4
Smart Cities Can Play a Role in Combating Climate Change

Today, 55% of the world's population resides in cities, a proportion projected to reach 68% by 2050.[19] Cities account for an important share of energy consumption and greenhouse gas emissions as well as economic activity. Smart cities, which remain a work in progress, are expected to come to the forefront in the near future within the framework of tackling climate change. "Smart cities", which is defined by the European Commission as making traditional networks and services more efficient for inhabitants and businesses with digital solutions, offer solutions in areas such as transport, water supply, waste and heating.

Smart city solutions, which are generally based on 5G and IoT technologies and summarized in Figure 3, primarily require a strong telecommunication infrastructure. Beyond that, the development of user-friendly mobile applications to turn raw data into insight and action and the adoption of these applications by users will determine the success of smart cities.

Figure 3: Digital Smart City Solutions



Source: McKinsey

[19] UN World Urbanization Prospects 2018

Policy Steps are Accelerating

In the new competitive conditions created by Industry 4.0, the importance of digitalization is highlighted in both academia and policy documents. While the steps in the US, which is home to big technology companies called BigTech, focus more on the "digital State" field, the European Union (EU), Turkey's largest commercial partner, sets out a more comprehensive example. With the announcement published in March 2021, the European Commission described the 2021-2030 period as the "digital decade of the EU" and announced the strategic goals it has set in the field of digitalization.[20] The EU goals stand on four pillars. The prominent goals are listed below:

1) To ensure that citizens and professionals have a high level of digital skills
   - *Basic digital skills among 80% of the adult population*
   - *20 million ICT professionals across the Union*
   - *Increasing female participation in related professions*
2) Reliable and sustainable digital infrastructure
   - *5G coverage in all populated areas*
   - *A 20% share in global production of sustainable semiconductors*
3) Digital transformation of work
   - *Use cloud computing, big data and Artificial Intelligence technologies in 75% of computers*
   - *A basic level of digital intensity in at least 90% of SMEs*
   - *A doubling in the number of unicorn ventures*
4) Digitalization in public services
   - *All essential public services to be online*

In 2021, we also saw that 28 member states and 26 companies in the EU signed the "Declaration on a Green and Digital Transformation" and established the European Green Digital Coalition. With this declaration, members commit to invest more in green digital technologies, thereby supporting the EU's goal of making Europe the world's first carbon-neutral continent by 2050. Members are expected to take action at the national level in the following areas:

- Contributing to the creation of the world's digital twin so climate change can be monitored
- The use of technology for decarbonisation in energy networks
- Precision farming
- Development of cost-effective cloud and blockchain infrastructure
- Supporting smart and sustainable transport systems
- Digitalization of public services
- Development of energy efficient hardware technologies
- Funding of green start-ups and the SMEs

The process of digitalization in the EU is cited in policy documents and charts out a possible development path for other countries. A similar trend is also prevailing in Turkey. The National Artificial Intelligence Strategy, published in 2021, addresses the measures and governance mechanism that will put artificial intelligence studies, which will be carried out in the country in the next 5 years, on a common footing. The 2022-2024 Medium-Term Program, announced in September, briefly touches on the subject under the heading of "policies and measures". The program emphasizes that pioneering research in frontier technologies such as quantum, artificial intelligence, biotechnology, genetics, and next-generation nuclear energy will receive support. These developments highlight the public support for the importance given to the issue.

[20] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_983

Conclusion

While innovation cycles are getting shorter, digitalization processes, which are the most important aspects of innovation today, are becoming complex and unpredictable. This rapid transformation brings adaptation problems and related negative socio-political developments along, even in developed countries, where digital skills and infrastructure are more supportive.

In the field of digitalization, knowledge generation and the acquisition of skills at a company level are vital when it comes to increasing innovation capacity. Training activities to be carried out in the public and private sectors, consultancy services and internship opportunities to be provided to the young population may be the factors which will accelerate the necessary workforce transition. However, the full realization of the economic, social and environmental benefits of digitalization depends on the dissemination of skills throughout society. International examples reveal that the older age groups lack access to digital services. Along with this group, the pace of digital transformation should also be monitored in other relatively fragile segments of society, such as among women and young people. In countries such as Turkey characterized by wide regional economic disparities and where the infrastructure required for digitalization is patchy, these efforts will also take on a geographical dimension.

Technologies requiring vast amounts of data such as the IoT and cloud computing add efficiency to all layers of the value chain, but these technologies have very high energy needs. This means that the establishment of these technologies must be accompanied by renewable energy generation and energy efficiency efforts. Considering the information and communication industry's need for scarce underground resources, especially certain metals, it is imperative that the industry's own use of resources becomes as efficient as possible to have a meaningful contribution to global efforts on sustainability.[21]

Progress in digital technologies will directly serve some of the sustainable development goals (the SDGs) included in the United Nations' 2030 agenda. These are i) End Poverty, ii) Decent Work and Economic Growth, and iii) Industry, Innovation and Infrastructure.[22] In addition, opportunities such as remote access, tracking, imaging and big data analysis offered by digital technologies have the potential to contribute significantly to the green transformation as well as basic services such as education and health. In this respect, digitalization has an indirect link with many other SDGs.

[21] ECERA. (2018). Digital Circular Economy: A Cornerstone of a Sustainable European Industry Transformation
[22] UNIDO. (2019). Bracing for the New Industrial Revolution: Elements of a Strategic Response

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