

A Study on the Need for Research and Eco-innovation in Digital Technology

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ABSTRACT

Our country is experiencing a very important transition period for the future. Future success is largely due to the correct determination of the science and technology line and its application with a strategic planning approach. Environmental impacts of technological activities include environmental problems that arise as a result of any process. The steadily declining current energy sources direct attention to the development of technologies for the use of alternative energy sources. 2016 has brought many challenges for the global and Turkish economy. With the global stagnation in its seventh year, Turkish economy has seen a recession in the third quarter of 2016 after 27 consecutive quarters of growth. Nevertheless, the fiscal discipline in place since 2002 and stable implementation of macroeconomic policies are among the key elements which increase the resistance of Turkish economy against external shocks. Turkey's impressive economic performance over the past 14 years has encouraged experts and international institutions to make confident projections about Turkey's economic future. In Today's world where the natural resources are rapidly consumed, regional and global environmental problems get to a point that threatens the future of humanity, cultural values melt in the globalization pot, sustainable strategies need to be considered in a holistic approach. The beginning of the 21. century has been a turning point in technology and industrial developments reaching the peak access to resources, whereas the degradation of ecological balance and the destruction of natural resources has been a severe result.

Keywords: Sustainability, Sustainable Development, Industry, Technology, Research And Development

I. INTRODUCTION

Sustainable development is defined as “development that meets today's needs without sacrificing the ability to meet the needs of future generations”. Within this definition, sustainable development should be addressed in three dimensions: economic, social and environmental. The sustainable development approach requires that all economic and social policies of an individual country are integrated with environmental policies and strategies.

However, while Turkey is taking its place in the economic and social growth competition, it has not

sufficiently taken into account the environmental dimension within the framework of the concept of sustainable development. Recognizing the fact that in our country the concept of sustainable development is based on neighborhoods, national strategies, objectives and practices should be shaped with this action.

The “Digital Transformation in Industry Working Group” formed for this purpose works to offer a more active support to reaching the shared objectives including attracting new investments with high added value, positioning the country as an important regional investment and research and development

centre and ensuring a highly-qualified work force [1, 2].

Despite the local and international challenges of 2016, the government's determination to continue with the structural reforms aimed at increasing the competitive edge of Turkish economy in encouraging in terms of assuring the investors in the term to come [3]. Despite the limiting effects of geopolitical developments, Turkey's relations with the countries in the region are in a trend of normalization and the diversification of export markets and the increase in demand in the European Union (EU) are estimated to positively affect the current account balance in 2017.

Turkey is a dynamic and growing G20 economy that links east and west in a unique way. In addition to being one of the world's fastest growing economies. Turkey also supports international investors' growth via a business friendly agenda and through access to a large domestic market and neighboring international markets. International companies directly investing in Turkey provide a strategic contribution to the sustainable development and the global competitiveness of our country [3]. International direct investments have critical importance on research and development concentration, export, increase in employment in Turkey and on development of small and medium-sized enterprises (SMEs) and creation of an eco-system in competitive standards in global markets [4].

In that period where major changes and new trends in global and regional economic policies are emerged, it is important to observe and closely follow the dynamics. For this reason, quickly continuing the bilateral commercial and investment agreements increasingly developing around the world and having economic, legal and structural reforms, especially being in the progress for our country during the modernization process of customs union and in this respect growing of Turkish economy in consistent and

more competitive platform for a medium term program and being in a quick and determined progress in order to increase the public welfare are critical.

It is known that the environment, which is accepted as public goods, is important in terms of sustainable development. Every plan must be considered in order to achieve a balance between man and nature, the conscious consumption of existing resources, and the continuity of continuing the needs of present and future generations. Protecting the natural environment will bring not only eco-system development but also economic and social development [5].

The concept of sustainability is now being addressed by many disciplines in different fields. Sustainability is a key concept for high efficiency that envisages that the functions of any social, economic or ecological continuity system will go on without disrupting and without consuming the resources [6].

The concept of sustainable development has been discussed on a global scale in this process and become the sole priority of social and economic development. In order to adapt sustainable development to urban life, it requires to establish a link between environmental protection, economic efficiency and social progress. In sustainable urban development, the main goal is to raise the quality of life and meet the targeted socio-economic conditions by creating environmental policies in doing so. It should not have an impact on the prosperity of future generations when a sustainable society benefits from the environment and the economy [7-9].

II. FOURTH INDUSTRIAL REVOLUTION

The commission continues its activities and works with the world bank to introduce the current status of SMEs for the purposes of value chain, potential improvement areas and possible contributions by

international companies to SMEs. Within the frame of these efforts, actions regarding the improvement of management capabilities and efficiency of SMEs will be indicated and solutions for avoiding middle income trap will be developed [10]. Organizational performance measuring variables to be considered for SMEs performance will be in subjective measures.

The industrial sector and industrialization play an important role in the economic growth and development process. Nevertheless, it is possible that rapid industrialization may have some adverse environmental effects. The most important of these adverse effects is the rapid consumption of exhaustible resources and environmental pollution. From this point of view, it is very important to minimize the environmental damages of industrialization, to manage waste, to prevent air-water-soil pollution for sustainable development.

Eco-industrial zones (or eco-industrial parks) can be defined as industrial parks which is aimed sustainable development through cooperation between businesses and local community to reduce waste and pollution, share resources (information, materials, water, energy, infrastructure and natural resources). The first example of eco-industrial park can be seen in Denmark, and have recently become increasingly widespread in other countries, especially in China. In this through the study, it will be possible to put forward the importance of ecological industrial parks in terms of environmental sustainability and at the same time to make suggestions and policy implications for Turkey through the findings from other countries' experiences [9, 11].

The concept of globalization emerged in technologically developed countries as a result of important political, social and technological developments. The concept of sustainable development is important for developing countries in the world. The economic growth efforts resulting

from increase in the world population have resulted in environmental problems and created in balances between the economy and environment. Environmental pollution forced Western countries to protect world environment since the 1980s. Increasing interest in environmental issues produced efforts for finding solutions for in balances between economic growth and environment. The 1987 Report of the World Commission on Environmental and Development made sustainable development an important issue diverting some attention from economic growth. Additional efforts to increase investment towards the protection of environment can only bring sustainable development [6].

A. Why Turkey?

Turkey is perfect investment destination with its strategic location and its motivated and qualified workforce. Global investors are invited to be a part of Turkey's economic and social growth.

A dynamic population combined with a highly skilled labour force, geographical location, international partnerships, and modern infrastructure make Turkey an attractive partner of choice. Today, with 8 facilities in five cities, and over 2.000 employees across the country, Turkey is headquarters for power services, healthcare eastern growth markets, and transportation. Supporting emerging markets is crucial to global growth, and localization efforts by means of building infrastructure, supporting and investing in innovation, and leveraging our strength in the digital transformation of Turkey and its key industries [3, 12, 13].

Turkey will be a future star with its young and dynamic population and strategic location. Our investments are a guarantee of our confidence in Turkey. With our successful Turkish team, we are a real part of Turkish fashion and are helping to sustain it. Turkey is a growing energy market and a candidate to be become one of the most important players in

energy in its region by functioning as an energy hub for the EU countries. Booming economy reaching \$857 billion in 2016, up from \$314 billion in 2003. Turkey is expected to be one of the fastest growing economies of the OECD members during 2014-2025, with an annual average growth rate of 4.9%. Turkey attracted \$180 billion of foreign direct investment during the past 13 years, whereas it attracted \$15 billion in the preceding eight decades.

Republic of Turkey Prime Ministry-Investment support and promotion agency of Turkey (ISPAT);
Who we are: ISPAT is the official organization that promotes the investment environment of Turkey and provides assistance to investors, reports directly to the Prime Ministry.

What we do: To present investment opportunities to the investors and provide assistance during all the stages of their investments, to serve as the reference point for international investors and the point of contact for all institutions engaged in promoting and attracting investments at national-regional and local levels, to offer free of charge services including market information and analyses-site selection-coordination with relevant governmental institutions and facilitate legal procedures and applications such as establishing business operations-incentive applications-obtaining licenses and work permits.

How we work: Multilingual (Turkish, English, German, French, Italian, Arabic, Spanish, Chinese, Japanese and Korean) and dedicated professionals who ensure guidance for successful investment in Turkey, one-stop shop approach, result-oriented, our network of country advisors covers the countries indicated (Spain, France, UK, USA, Canada, Germany, China, South Korea, Japan, India, Singapore, Saudi Arabia and Dubai) [13].

B. Industrial Digital Transformation

Turkey in a transition to medium-high technology:
Turkey's eco-system in production and services;

Established in order to contribute to the transition process to medium-high technology from the perspective by focusing on "technology and innovation", continues its activities within the frame of establishment of a convenient investment platform in accordance with international norms and a competitive market mechanism. Contemporary global economy is going through a revolutionary change called "industry 4.0" marked by a global "industrial digital transformation". Turkey is a part of this process and makes the necessary changes to ensure that its economy is in line with this global transformation [3, 9]. Today we witness the changes in manufacturing methods of all sector from health, finance and energy to food, automotive and construction and the changes in the methods of doing business.

At the crossroads of Europe and Asia, Turkey's geography has much to offer to investors. Turkey is an essential transport corridor, offering excellent access to global trade routes by air, land and sea. Bordered by the Marmara, Black, Aegean and Mediterranean seas, in addition to various land borders [9]. Turkey offers convenient access to Europe, Asia and North Africa. All global companies and brands would like to be in Turkish market and grow here. Turkey is a market with a high pace of improvement for global brands and allows penetration to the regional markets. Today the growth potential is not at the developed markets like USA, EU, Canada, Australia, Japan, but it at the developing markets like South America, Asia Pacific, Middle East and North Africa. Turkey's impressive economic performance over the past 14 years has encouraged experts and international institutions to make confident projections about Turkey's economic future. Low inflation and stable conjuncture of the developed economies cause companies to focus on costs, not investments. However, in developing markets like Turkey, there is a potential growth rate up to 4.9% and the need for new investments [2, 13].

Sustainable development is a development approach that aims to meet the needs of today's generation without jeopardizing the ability of future generations to meet their own needs. Sustainability is a holistic approach with economic, environmental and social dimensions that requires planning and programming to establish a balance between needs of human life and the availability of natural resources that is compatible with. The application of a sustainable development model to economic growth and development may be effective if regional resources and elements support it [13, 14].

With this paradigm shift, the understanding of regional development, which is increasing in importance in the world, could become functional in Turkey only from the second half of the year 2000 and since 2006, regional development agencies have been established as new actors in public financial management. Development agencies, in addition to their economic and social functions, play a specific role in sustainable development and support the process through various means [3].

C. Economic Dimension of Digital Technology

Digital technology is crucial in many parts of our daily life today. Nowadays, no business department could function properly without digital technology, no bank, hospital or factory could operate effectively and no telephone would be operational any more. Digital technology will evolve in the basic infrastructure for all vital social, business and economic processes. Every commercial and public service will be provided through this e-infrastructure [2, 15]. Therefore, information and communication technology (ICT) will continue to play a defining role by providing the critical infrastructure for the global economy. A selection of statements:

- ICTs will grow out to be the basic and critical infrastructure for all vital social and economic processes

- ICTs will be indispensable to address the key challenges that society is facing in, for instance, urban planning, transport and logistics, in crime prevention and risk management, in health care and in coping with scarce resources. And, last but not least, ICTs will continue to play a defining role in our economy by providing the critical infrastructure for the global economy
- From a societal perspective, guarantees for universal access to robust, trustworthy and secure infrastructure services, and standards and open interfaces will become crucially important
- ICT is not only a solution to existing problems, but also a disruptive force in itself, having a pervasive and transformative impact on society.

Today, the dominant view of digital technology is as an enabler technology that is used exclusively as an instrument to reach certain targets. However, recent history shows many examples in which digital technology has proven to be a disruptive force in itself: services like social media, Google maps and Skype, combined with innovative platforms such as smart phones and tablets capable of executing apps have opened completely new roads to information access, information sharing, individual communication and business opportunities, also SMEs. The importance of the underlying communication infrastructure implies a clear need for continued research and development of the technology enables behind it (Figure 1).

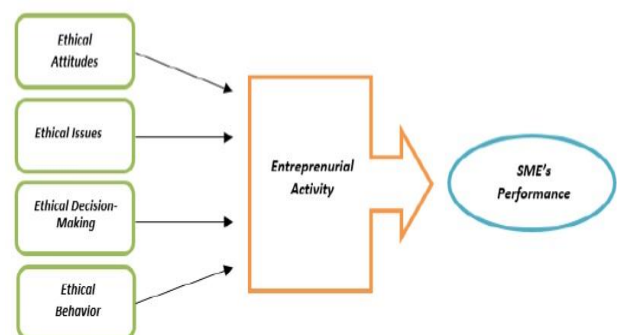


Figure 1. SMEs performance chart [16]

Many examples support the observation that digital technology has grown into a disruptive force in itself. The smart phone with all its apps makes its way not only into the consumer domain, but also more and more as mobile access to information and services in the business domain [2]. Also access to many services is increasingly shifting to the internet, as for example banking, buying and goods by consumers and government services.

The sustainable development approach, which encompasses three key elements-economic, social and environmental-requires the integration of all economic and social policies of an individual country with environmental policies-strategies, and the establishment of national strategies and objectives (Figure 2) [13, 17].

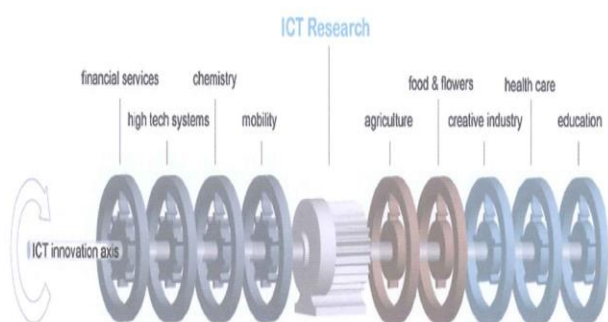


Figure 2. ICT innovation axis driving and application areas

For business, cloud computing is at present creating radically new possibilities to roll-out global services at very low capital costs. New suppliers of cloud based services have entered the digital technology field and rapidly established themselves as dominant competitors in different industry segments where they change the rules of the game. This impact of digital technology on daily life has most impact on the behaviour of younger generations that grow up with these developments. Also the report observes that digital technology has in many ways been a driver of social and economic change and will remain such a transformative force in the coming decades.

Opportunities will emerge in an unpredictable way, as in the past, which requires the continuous evaluation of emerging innovation opportunities generated by new digital technology [18].

Experts believe that intelligent embedded systems will drive new applications that also affect sectors like manufacturing and energy. The results will be systems, technical processes and workflows that are continuously optimised from both an ecological and economic perspective. Developments in digital technology will continue to increase their influence on the manufacturing, energy and medical technology sectors. The continued maturing and rapid growth in the use of digital technology through to 2030 implies that it will become the key infrastructure for the future European knowledge society. The future knowledge society will be a society in which massive amounts of information and data are processed and given meaning. The generation of information and data by sensors, machines and information enhanced products requires progress in the basic technology needed to realise the computing power that has to process all the data into useful information. Multicore processing technologies are essential components in accelerating the day-to-day processing power needs according to the state of the art technology of high performance computing. There is a wide consensus that the time from now to 2030 will be one of permanent change and disruption. In 2030 the world population will reach the magic number of 8 billion people, only 23% of whom will live in Europe and the Americas. The way of living and doing business will be fundamentally different from what is today.

ICT describes how the axis of innovation is driven by ICT research. ICT creates new markets for established operators and opens up existing markets to new players. So ICT can be visualised as an axis of innovation running through all sectors of the economy. However, this axis of innovation is of little value without an engine to drive that axis. Another

crucial element is the transfer between the axis and those parts (sectors) that must be set in motion [19]. Hence, to gain maximum benefit from all opportunities generated by ICT, both smarter applications of available ICT as well as good research are needed while the development of new opportunities must not be forgotten.

This is the only way to keep the axis turning. The connection between ICT and the application fields is essential, and leads to new challenges and ideas. This requires intensive interaction among all of those involved in the innovation process: researchers, end users, ICT companies, businesses and the users of ICT solutions. This innovation eco-system forms the basis for successful ICT fuelled innovations in products, services and processes [20]. The main messages are:

- Digitization and the on-going penetration of ICT into all areas of professional and private life will be even more all-embracing in molding the information society in the future
- Acceptance and trust in using ICT is the foundation for developing a modern and open information society
- A high performance communications infrastructure is a vital precondition and a strategic success factor for an open and competitive information society
- The mobile use of the internet and its services will have a lasting impact on the information society and create independent new areas of application
- Dynamism in ICT based technologies will drive innovation processes and have a serious impact on all key industries in the economy.

Since the dynamism in digital technology uptake and progress is huge, research and innovation remain essential in the coming decades to enable companies to identify and grasp business opportunities that realise economic growth in this sector for the coming decades.

Many innovative companies have grasped the opportunities emerging from the convergence between digital technology and other sectors, building new businesses on adaptive consumer behaviour. Predicting the social and economic impact of digital technology is extremely difficult and recent history has often proven such predictions to be wrong. Examples can be found, especially in the mobile phone industry, where Apple and Android revolutionised the smartphone market with significant consequences, even for telecom network providers. The only way to keep up with this revolution is to continuously invest in research and development. Another example of such transformations driven by digital technology is observed from the internet of things which implies that interaction will be strengthened between the physical world and the virtual worlds of digital technology. Physical entities will have digital intelligence and are also represented in the virtual world of internet. Things become context aware and will be able to sense, communicate, interact and exchange data, information and knowledge.




MEGATREND	KEY TREND	DESCRIPTION
Flexibility 	<ul style="list-style-type: none"> Cloud Computing Flexible Sourcing 	<ul style="list-style-type: none"> Virtual infrastructure and services solutions offered through cloud increases flexibility and reduces fixed cost Virtual sourcing network enhances speed when sourcing products/ services
Mobility 	<ul style="list-style-type: none"> Enterprise Mobility 	<ul style="list-style-type: none"> Smartphones and tablets increasing connectivity on the go and giving access to relevant data
Collaboration 	<ul style="list-style-type: none"> Virtual Collaboration Open Innovation 	<ul style="list-style-type: none"> Virtual Collaboration enhances knowledge sharing and cooperation across countries or organizational boundaries Open Innovation to reduce time-to-market and R&D cost

Figure 3. Key trends in digital technology impacting productivity-1




MEGATREND	KEY TREND	DESCRIPTION
Ubiquity 	<ul style="list-style-type: none"> ▪ Embedded technology ▪ Internet of Things 	<ul style="list-style-type: none"> ▪ Strong increase in the usage of embedded technology outside of typical ICT industries ▪ Growing importance especially in manufacturing, e.g. automotive and production in line with automation ▪ Internet of things enhances process efficiency
Cybersecurity 	<ul style="list-style-type: none"> ▪ Chip security ▪ Network protection 	<ul style="list-style-type: none"> ▪ Increased dependency on IT infrastructure strengthens fear of espionage or terrorism ▪ Utilisation of tamper protection to avoid invasive attacks
Data-driven businesses 	<ul style="list-style-type: none"> ▪ Real-time data ▪ Big data 	<ul style="list-style-type: none"> ▪ Growing need for real-time data in new markets (e.g. healthcare, transportation and logistics) ▪ Strong importance of mobile solutions ▪ Underlying big data solutions drive need for storage and bandwidth

Figure 4. Key trends in digital technology impacting productivity-2

Among the key trends identified for all these digital technology domains, the recently released report global market for digital technology; to flexibility, mobility, collaboration (Figure 3), ubiquity, cybersecurity and data driven business (Figure 4). In summary, the report expresses the expectation that the importance of digital technology is set to increase further as technology becomes increasingly complex and gains a strong footprint outside of traditional areas of use [21, 22]. The demand for mobile solutions and unlimited connectivity will drive hardware spending, while cloud computing and big data are likely to have a strong positive impact on information technology (IT) services.

D. Contribution to Turkey's Economy and Sustainable Development

Through the use of intelligent software applications, appropriate rapid responses can be given to physical phenomena, based on the very latest information collected about physical entities and consideration of patterns in historical data, either for the same entity or for similar entities. These create new opportunities to meet business requirements, create new services based on real-time physical world data, gain insights

into complex processes and relationships, handle incidents, address environmental degradation (pollution, disaster, global warming, etc.) [23], monitor human activities (health, movements, etc.), improve infrastructure integrity (energy, transport, etc.) [24] and address energy efficiency issues (smart energy metering in buildings, efficient consumption by vehicles, etc.) [25]. The ubiquity and pervasiveness of embedded intelligence systems prompt expectations of constant availability and absolute zero risk of failure. In the past, design complexity was limited to that of single, dedicated systems in isolation. Networking such systems forces the design to embrace the behaviour of many interconnected systems, consequently with a manifold multiplication of the complexity issues.

There are many developments such as meeting energy requirement with new and renewable energy sources instead of exhausting fossil fuels, turning to high technology in production process in using fossil fuels, recycling waste, building raw materials with generic technologies such as biotechnology, or controlling agricultural production processes. However, it is also clear that technologically outsourced and underdeveloped developing countries are a major obstacle to the access to technology.

- Turkey is located on energy corridors due to its special geographical location; it has the potential to increase the share of new and renewable energy resources in primary energy [3].
- Natural resources are not irreversibly contaminated.
- Available water is available in sufficient quantity and has a significant market power in this regard.
- Know-how and technologies for preventing and eliminating contamination are known at large.
- The industry established for new technology transfers also transfers the environmental and international production standards to the country.

- Has the human power to grow the environment and the protection of historical/cultural heritage.
- The young population in the country is more and more environmentally conscious in this group.
- The regional differences of the country present a great diversity in terms of historical environments.

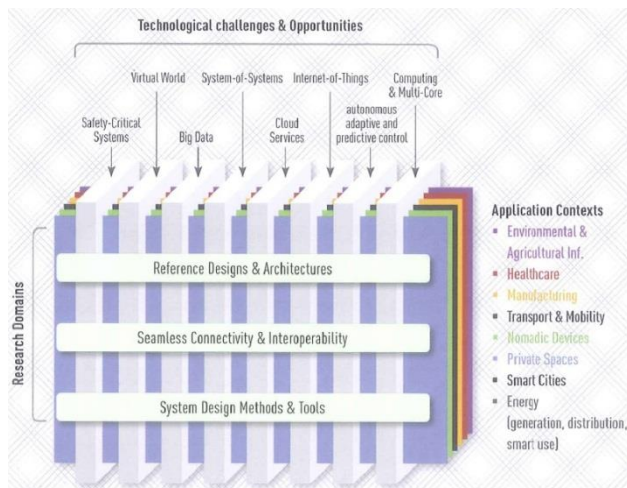


Figure 5. Technological challenges and opportunities

Real-time connections between sensors, embedded systems and large information systems will create cyber-physical systems that open up new functionality and contribute to addressing the challenges imposed by the seven areas of major change (Figure 5).

III. RESULTS AND DISCUSSION

Sustainable development appeared as a result of the searches to find solutions to the problems grown out of the relationship between environment and development has been described as meeting the needs of present and that of coming generations. Sustainable development approach is a result of taking environment into consideration while making economic decisions. The supply of sustainable development depends on the continuity of resources [26].

Business ethics practices and organizational performance in human resource management. There

was a strong relationship between business ethics practices and organizational performance. The findings of this study found that there is a significant relationship between ethical practices of organizations and their corporate performance. Future researches could broaden the scope of the study by focusing on the dynamics of organizational environment and how it relates to business ethics. 2016 has brought many challenges for the global and Turkish economy. With the global stagnation in its seventh year, Turkish economy has seen a recession in the third quarter of 2016 after 27 consecutive quarters of growth. Nevertheless, the fiscal discipline in place since 2002 and stable implementation of macroeconomic policies are among the key elements which increase the resistance of Turkish economy against external shocks. Turkey is fourth industrial revolution: industrial digital transformation platform founding member [27, 28].

As the neural system of society, embedded and cyber-physical systems should no longer be considered only in isolated application contexts but in relation to what they can offer in addressing today's and tomorrow's and societal challenges (Figure 6) [29].

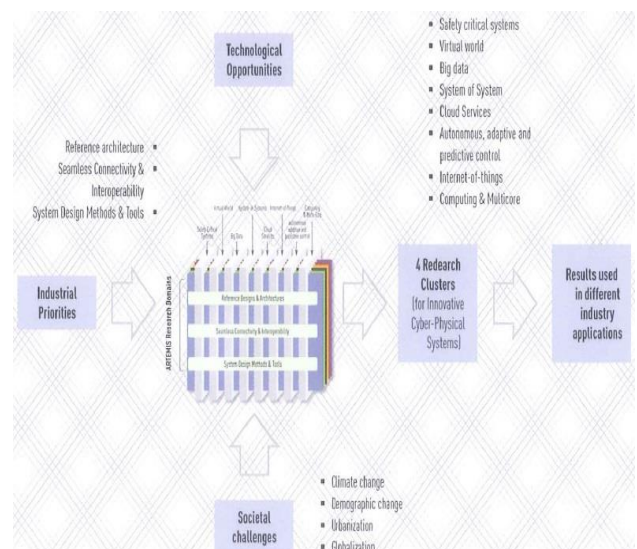


Figure 6. The global digital technology sector [26]

As research, especially performed by the Groningen growth and development centre (GGDC), indicates,

digital technology has a strong positive impact on overall factor productivity, namely labour productivity. Investments in digital technology allow the economy to realise a so-called "ICT dividend" through an increase in factor productivity. Key drivers for productivity gains from digital technology are investments and intangible factors such as improved process design and easier access to information. Data show a strong investment gap between the USA, the UK and continental Europe, allowing the USA and the UK to realise significantly higher productivity gains from digital technology compared to continental Europe [30].

Stronger and better integration between the research and innovation dimensions but education should not be neglected; joint policymaking will be needed to achieve effective linkages between research and innovation, thereby shaping productivity, competitiveness and employment. The mix of funding measures should strike a balance between bottom-up and top-down approaches to research. Effective instruments are needed to achieve effective research coordination between the Member State and EU levels objectives, integrating the research base by overcoming fragmentation in research is vital, while simultaneously achieving a sharper division of labour between what is done at EU level and what is undertaken in national programmes; European research and innovation efforts must concentrate on themes where critical mass is vital for success and where breakthroughs require cross-border solutions, while also allocating sufficient resources to research and development topics which promise radical innovations.

IV. CONCLUSION

In summary, the main messages are; digital technologies, spanning the entire scope of semiconductors, embedded systems and services, are set to increase even further as technology becomes increasingly complex and gains a strong footprint

outside of traditional areas of use. Digital technologies provide a vital e-infrastructure and are a driver of innovation. Digital technologies are both a solution to existing problems and a disruptive/intrusive force in itself [31]. Today's systems based on digital technology are so complex that no single organization or company can oversee all the aspects or connections. With tomorrow's even more complex interacting systems of systems, the visibility of a single company will be reduced even further, highlighting the relevance of cross-border innovation eco-systems that foster open innovation. These eco-systems are essential to enable European organizations, including SMEs, to keep up with the fast changing reality in digital technology, its increasing complexity and to remain at the forefront of innovation.

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