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Key aspects of technological leadership within the context of fourth industrial revolution

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Abstract This paper focuses on the key aspects of the technological leadership within the context of the fourth industrial revolution (also known as technology 4.0). Technology (or also "Industry") 4.0 is viewed as having a significant impact on today's world economic and social progress. The fourth industrial revolution is having a significant transformative impact on the global income levels and the quality of life of people all around the world. Nevertheless, in comparison with the previous industrial revolutions, fourth industrial revolution is tackling the physical, digital, and biological aspects of the development of the economy (e.g. biotech technologies). In addition, information technology became a ubiquitous part of human lives with such aspects as smart homes, smart cities and artificial intelligence dictating the pace of the economic growth and development.
We show that it is very important to focus on these aspects of economic growth in order not to miss the breakthrough innovations that would ensure any country keeping up with the technological progress a leading position on the world's market. In general, our results show that poor leadership could be the biggest obstacle to a successful fourth industrial revolution strategy.

1 Introduction

As the latest developments in the world's economy and technological progress showed, technology is the deciding factor in a transformation to the digital world and digital economy. Our paper attempts to show that the pioneer manufacturers know exactly how new technologies would change their products and services. Leaders have more than an occasional relationship with the advanced technologies that drive the fourth industrial revolution. The leaders of today are the inventers and technology entrepreneurs, such as Elon Musk, Sergey Brin, or Steve Jobs.

It comes as no surprise that information technology plays a vital role in establishing and sustaining many of today's initiatives. This technology is a product of 3 previous industrial revolutions that took place within the last 300 years but, most importantly, it is the creation of the 4th industrial revolution (see Figure 1).

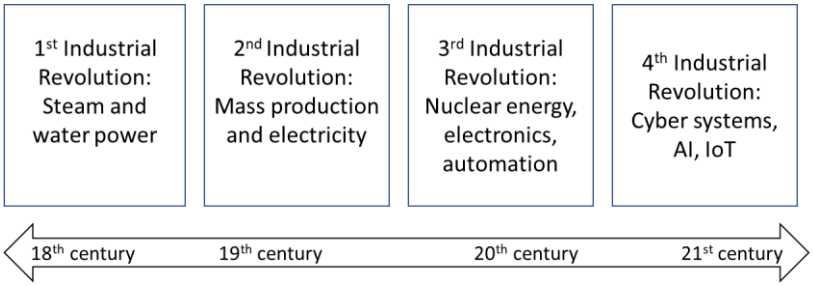

Fig. 1. Four industrial revolutions on a timeline
Source: Own results

The first industrial revolution took place at the end of the 18th century. Most agreed that the crucial event was the development of the first mechanical loom in England in 1784 (Allen 2015). In a broader sense, the period was defined by mechanized production facilities, usually with the help of water and steam power.

The second industrial revolution of the late 19th century was defined by the concept of division of labour and mass production with the help of electricity (Justman and Gradstein 1999). The third industrial revolution is thought to have started around 1969 and was marked by the rise of nuclear energy. It was also distinguished by the rise of electronics, information technologies and automation at everyday work. Things like technology platforms and clusters also were forged during this period (Zlyvko et al. 2014; Shuval-Sergeeva et al. 2017).

On the contrary, the fourth industrial revolution is marked by the rise of disruptive technologies such as the artificial intelligence (AI), Internet of things (IoT), as well as virtual reality (VR) that are used not to dividing the labour but rather by substituting it with the digital services and artificial intellect (Makushin et al. 2017; Romanova et al. 2017; Syam and Sharma 2018).

Connected, intelligent factories are creating new ways of designing and manufacturing products, changing the way companies work, and revolutionizing the role people will play in the workforce. Every company has an incredible opportunity to become the national market leader in implementing Industry 4.0 based on the manufacturing and leading business expertise. The full effect of Industry 4.0 remains to be seen and is rightly a concern of any state (Komarova et al. 2019).

2 Effects of Industry 4.0

The effects of the fourth industrial revolution (of Industry 4.0) are ubiquitous and large-scaled. It is difficult to spend a day without encountering several of them in our daily lives. As mentioned before, the view and concept of Industry 4.0 has clearly globalized and will most likely continue to do so (Ahmada-Lobo 2016).

In the United States, Industry 4.0 has a significant impact on smart manufacturing initiatives, and there is collaboration with the Industrial Internet Consortium. In addition, there are more and more organizations and countries where Industry 4.0 is being introduced. On 23 March 2017, the European Union (EU) alone reviewed the plans to align the 12 existing and 9 upcoming national industrial transformation initiatives. All of those are its prerequisites for the Digital Single Market Strategy (Issa et al. 2018).

There are other examples of the countries fully implementing the principles of the Industry 4.0. For example, Israel has been the land of innovation in recent decades. Germany is known for its technological excellence in the automotive, healthcare and energy sectors. As the fourth industrial revolution progresses, it is not about jobs but about improving the quality of life of humans and animals. Figure 2 that follows reports the share of broadband Internet access in EU28 countries and Turkey over the last 10 years. The progress is apparent even for such less digitally advanced country as Turkey – a gap of 30% it had in comparison to the EU average was quickly widened and is now practically non-existent.

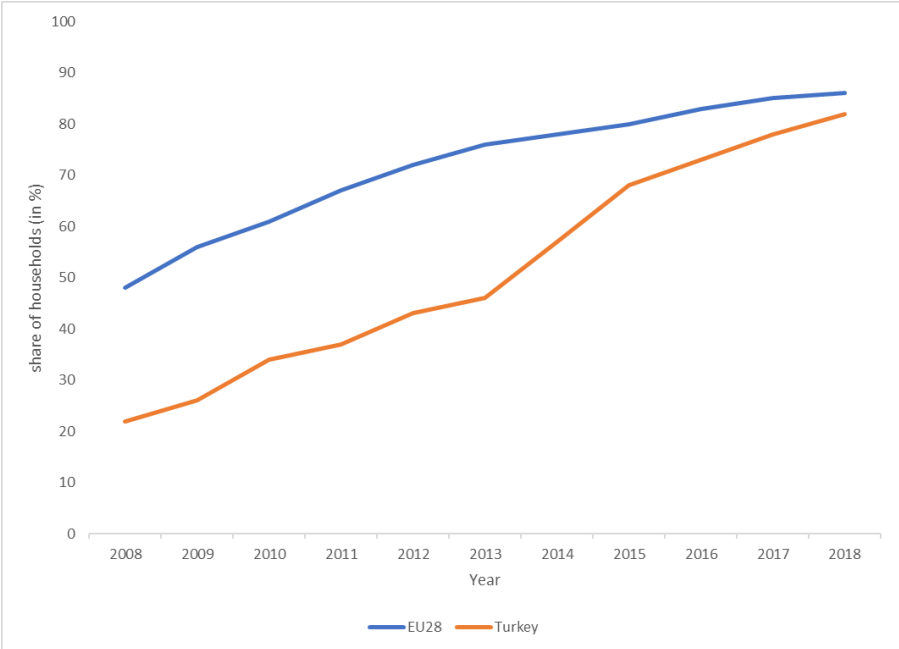

Fig. 2. Households with broadband access in EU28 and Turkey
Source: Eurostat (2019)

The information of Figure 2 shows that technological gaps are becoming smaller thanks to Industry 4.0 and less-developed countries and emerging economies are profiting from it. Internet connection and smartphones are now a must in most of the African or Asian countries and the computing power of an average smartphone is larger than that of the NASA computer that made the dream of sending the astronauts to the moon a reality (Strielkowski 2017).

Many specialists envisage that Industry 4.0 is going to change not only the ways businesses are conducted in many developed and developing countries but also the ways people connect, interact, work together and in groups by helping all of them to connect and to use their respective comparative advantages effectively thanks to the artificial intelligence and optimisation of working processes (Williams 2019).

On many complex industrial platforms that exist today, market intelligence information obtained from the machinery and behaviour of people in the system flows smoothly into product development and manufacturing. The net effect is to bring customers closer to the process, analyse their data to better predict their needs, improve products, and develop new offerings that are often tailored to individuals. For example, some solar module manufacturers have developed innovative yield models that are at the forefront of Industry 4.0 models.

Figure 3 that follows show the prioritised technologies of Industry 4.0. The first and the most advanced one is the Big Data collection and analysis, followed by the Internet of Things (IoT) and robotics. Cybersecurity and mobile networks of the new generation seem to be less prioritised.

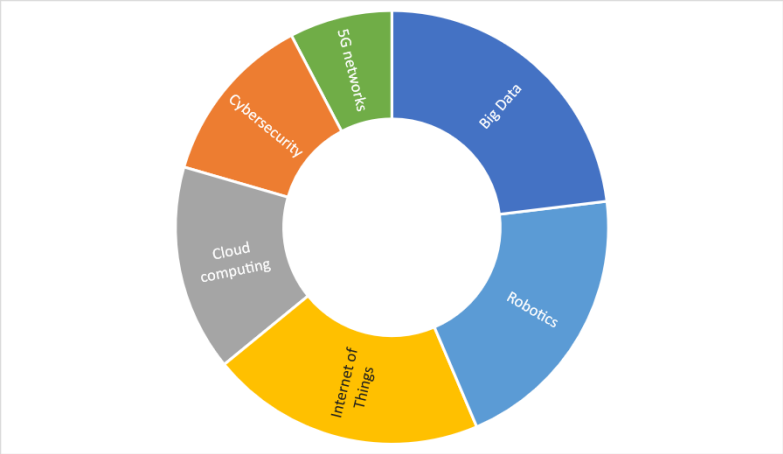

Fig. 3. Prioritised Industry 4.0 technologies
Source: Own results based on Liao et al. (2018)

Industry 4.0 offers a variety of exciting technologies, with a wealth of options and providers attractive to the management, but with high complexity risks for those closer to the company and a dizzying array of vendors and options. The external market forces that drive supply chains towards Industry 4.0 solutions could be mass customization, agility in the face of increasingly variable demand, the use of big data to understand and predict consumer behaviour, and networks for the cloud. Cooperation with suppliers and customers. One of them is the use of 3D printing to produce individual hearing aids within a few hours. This leads to a wider use of 3D printing in medical devices such as titanium knees or spine prostheses (Liaw and Guvendiren 2017).

Last but not least is the important role of education and teachers in preparing personnel for the new economic and social reality shaped up by Industry 4.0. The new economy will exist in accordance with the new rules and will require specialists who are capable of quickly absorbing new information and skills on the go in the work process. An increase the commitment of educators for current use cases and industry trends through applied research. There should be student engagement is raising the awareness among students and parents about career opportunities in advanced manufacturing and rapid transformation of career opportunities through Industry 4.0 disruptions. Raising the awareness of students and parents for career opportunities in advanced manufacturing and rapidly transforming careers choice through Industry 4.0 disruptions.

All in all, effects of Industry 4.0 (or the fourth industrial revolution) can be traced in all spheres of life and in all fields of the economy. The changes it is brining are unprecedented and we need to learn how to cope with them effectively.

3 Fourth Industrial Revolution and leadership

As dramatic as that may sound, the fourth industrial revolution is in some ways even more transformative than the previous three. Like the previous revolutions, the fourth industrial revolution has the potential to increase global

income levels and improve the quality of life for people around the world. At the same time, however, this revolution could lead to greater inequality along the way. Nowadays, the access to technology is very different, so developments like robotics have the potential to drive workers to the very parts of the world who need help to get the most out of them.

In this fourth industrial revolution, a series of new technologies are being developed that connect the physical, digital and biological worlds. Technological innovation is on the verge of bringing about significant change in the global economy, with major benefits and challenges. Moreover, there will be tremendous leadership challenges, as the effects of the technology and the resulting disruptions will result in an exogenous force over which executives have little or no control at times.

The changes brought to us by the fourth industrial revolution will be breath-taking and inevitable. Every change is not voluntary for business leaders and those in the trenches on their way to the fourth industrial revolution.

The good news is that while the prospects for massive technological change may be daunting, corporate leaders with a global mindset or migration mentality are most likely to succeed. While many executives continue to struggle with the complexity of Industry 4.0, some executives are getting it right. Many companies demonstrated ways to improve engagement and innovation through their leadership model. Research has shown that a comprehensive approach to leadership development, their teams and the organization as a whole can have a dramatic positive impact (Day and Harrison 2007).

The most pressing challenges companies face today are related to their ability to adapt policies, processes, regulations, and products to changing circumstances. The distinction between adaptive challenges and technical issues is essential for dealing with disruptive changes and external pressures. The development and promotion of adaptability requires a new kind of leadership, or at least a new emphasis on certain leadership behaviours. To master adaptive challenges, one does not have to exercise authority, but leadership, mobilize discovery, tolerate losses, and generate innovation and new growth capacity. They also threaten to replace well-educated individuals with software algorithms that can perform sophisticated analysis and decision-making processes, such as in medical technology (radiology) or professional services (legal advice). All of the above would present challenges to the job market of tomorrow and hamper with such issues as job satisfaction which constitute one of the main prerequisites of the smooth working process and healthy and balanced conditions at the workplace (see e.g. Čábelková et al. 2015; or Bordea et al. 2017).

In contrast to previous industrial revolutions, the economy may not be able to provide enough new employment opportunities for those who have become obsolete by cyber-physical systems, artificial intelligence , as well as robots. And this is not to mention the artificial general intelligence (AGI) that would replace virtually everyone (including those not replaced in the previous wave).

Traditional skills acquired through repeated practice may not be as valuable as tools such as augmented reality or cyber physical systems can guide employees by seamlessly connecting the physical world with the digital world connect. The future of work is one of the most pressing issues of the fourth industrial revolution.

The changes introduced by Industry 4.0 will be complementing, of course. Some jobs are lost, new ones are created, and all jobs are changed forever by AI. Business and government must work together to expand access to these skills through new education efforts, new partnerships, and new learning methods for professionals.

In order to help the leaders in mastering the pros and cons of the fourth industrial revolution, several action points can be proposed (Afalbe 2019). After all, companies need to treat governments, civil society groups and workers as partners rather than adversaries. Such companies are helping to design and test innovative new approaches to policy and governance in this new era.

4 Conclusions and discussions

All in all, it appears that the fourth industrial revolution interferes with the leadership: the old model, the carrot whip, the poisonous leadership, and organizations based on fear and control are not working. It requires leaders to reconcile innovation and chaos with the stability of organizational processes.

Moreover, it becomes apparent that world leaders should be able to fully concentrate on all of the aspects of the Industry 4.0 in order not to miss the breakthrough innovations that would ensure their respective countries are keeping up with the technological progress and retaining the leading position on the world’s markets.

As more and more companies deal with artificial intelligence and advanced robotics, leadership will be less concerned with people with titles than with organic cooperation processes. This will also make education and especially higher education to lose its former role and importance and to become less robust and more informal. The education of the past was the exchange of information and the information is now abundant with the only problem being assessing and understanding it properly. The importance of relationships and emotional intelligence will continue to be critical to project managers as we promote engagement, motivation and overall enthusiasm in organizations.

In a conclusion, we can say that fourth industrial revolution is brining upon unprecedented changes comparable, in fact, with those imposed by the 1st, 2nd, and the 3rd industrial revolutions of the past. However, it appears that those changes are not going to be technical similar to the previous industrial revolutions. Now, these changes are going to be more data-driven and information-based which will make it more cumbersome to build interactions among people and, therefore, make the role of leadership timelier and more important within this context.

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