THE FUTURE OF EDUCATION AND THE LABOR MARKET IN THE CONTEXT OF INDUSTRY 4.0

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Abstract: The article presents an overall picture of the latest technological trends altogether referred to as the Fourth Industrial Revolution (Industry 4.0), their impact on the education and on the changing structure of the labour market, the demand for prospective skills, as well as emerging policy challenges. In order to prepare graduates for the future life and work done by Industry 4.0, where intelligent robots will replace people in certain divisions of activity, education should use relevant information and skills that cannot be replaced with robots. The paper analyzes the main trends in the labor market and formulated conclusions for future systemic approach to education, labor market and major technical and technological changes.
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1.   Introduction

At the beginning of the 20th century we together are witnesses of fundamental changes to the labor market. Automation of professional tasks, robotics and artificial intelligence totally change companies' activity. As cardinal changes to the company's expectations of employees, these changes pose new challenges for human resource services, stimulates unexpected decisions and forces companies to work under unprecedented risks. The pace of change is continually increasing, as well as a fierce competition in the fight for "talent". Moreover, the meaning of the word "talent" and "valuable employee" means much more than skills required 5 -10 years ago, it means knowledge and professional roles of tomorrow, today unknown exactly by anyone, but needed to be anticipated, discovered. In this context, there are several questions to which we must find an answer? How can the business environment prepare for an uncertain future? What is the role of vocational and higher education institutions in the context of preparing the new workforce? How will staff management change: attracting, developing, retaining, motivating employees? Which information technology will be used to form human capital?

It is certain that there is no time to track from a distance the continuous transformation of the labor market and to expect answers to be generated. Technological development is an ongoing work that profoundly changes today's way of life. Ensuring people's employability (ability to find, keep or change a job using skills and abilities required by the labor market) in a society where robots, drones and 3D printers take a large part of repetitive tasks traditionally performed by people, creates new challenges and opportunities (Kergroach, 2017). Artificial intelligence and cyber security are key areas because these technologies are necessary for the proper functioning of robotic systems. They must be part of the knowledge base of all future employees.

2. What is Industry 4.0?

In industry 4.0, the ultimate objective is to create 'smart factories', which indicates on the automation of industrial processes, the use of intelligent systems throughout the

production cycle, from the beginning of the value chain to end of (Gert, 2017). This is possible through advances in data collection techniques that have increased and will continue to grow in the near future. The exponential increase in the volume of stored data illustrates the importance of data creation, collection and handling.

There are four main features of the Industry 4.0: vertical integration, horizontal integration, engineering integration and technological integration.

Vertical integration requires an increased connection in the Smart Factory chain, allowing manufactories to react quickly and adequately to variables such as demand levels, stock levels, machine defects or unexpected delays. Intelligent vertical integration systems can predict when machine or equipment failures will occur.

Horizontal integration facilitates value-adding networks such as business partners and customers around the globe. For example, a delivery of goods is scheduled to depart from an airport. While goods are transported from the factory to the airport, the airport closes urgently. Through advanced technologies, the company receives the information and immediately implements "plan B" - goods are quickly redirected to the next nearest airport and distributed on time.

Engineering integration means that companies no longer look only production or isolated aspect of the production process, but rather look at a product from the beginning of its manufacture to its production and final delivery. For example, a clothing company that was previously achieving its goods through intermediaries, with these technologies, now controls the process on the entire value chain and distribute clothing items in the final market.

Technological integration refers to the use of new, advanced and improved data collection technologies, which form an integral part of the fourth and final feature of Industry 4.0. The clothing company (mentioned above) collects and analyzes consumer data to understand the consumer market, as a result produces the number, quantity and model requested by the customer.

3. Benefits of Industry 4.0

The impact of Industry 4.0 will not affect only production companies. This will affect the entire value chain, including manufacturers, suppliers and employees. The education sector will have to focus on producing talent with the skills sets in necessary in Industry 4.0. Software and technology developers will also need to look at newer, better and larger deals. Governments, on the other hand, are expected to do their part, especially when it comes to infrastructure needed for a successful and smooth function of systems. A special note are smart infrastructures, which include those involving smart mobility and smart logistics.

In this context, main benefits of the Industry 4.0 relate to the following (Cleverism, 2015):

a) *Enhancing the competitiveness of enterprises*. In fact, the implementation of industry 4.0 leads to increase organizational, national and global competitiveness. In this view, even those countries known to have low labor costs and wages will be analyzed by large industries as areas of their production.

b) *Augmentating productivity.* Increasing efficiency will generate productivity improvements in manufacturing sectors. Feasibility studies carried out in Germany show that productivity in the manufacturing sector will grow by over 60%. In fact, with the full implementation of Industry 4.0, in the automotive industry, productivity is expected to increase by 10-20% .

c) *Increased incomes.* Industry 4.0 is seen as one of the main factors in increasing revenue levels, even if its implementation will also require significant investment from

businesses. The cost-benefit analysis will show later that revenues will grow faster and higher than the costs incurred in automation and digitization of the manufacturing process.

d) *Increased employment opportunities and increased management of human resources and IT resources.* Employment rates will also grow with increased demand for talent and labor, especially in the field of engineering and mechanical work. But it will not be limited to the field of mechanical engineering, because, depending on the industry or manufacturing sector, many types of skills will be required.

e) *Optimization of manufacturing processes.* Using computerized systems in the production process will simplify the working procedures and there will be increased a cooperation between producers, suppliers and other stakeholders along the value chain. The time required to produce a unit of product will be visible shortened, as the process will be streamlined without compromising quality, and decision-making will be made in real time.

f) *Development of exponential technologies.* Industry 4.0 will serve as a foundation for the development of future technologies. For example, companies that adapt the use of 3D printing technology. At their turn, developers are focused on creating enhanced 3D printing technologies.

g) *Delivering a better customer service*. Monitoring and feedback mechanisms, traditionally takes time. Through Industry 4.0 methods, logistics and statistics will be automatically generated and collected, so the answer will be faster generated. The company will immediately know, if it is necessary to make any adjustments, and will respond more quickly to customer needs.

4. Challenges of the Industry 4.0

Any automation process is free of obstacles that need to be overcome in order to be fully, operationally and successfully implemented. Industry 4.0 is facing a number of key challenges that need to be addressed and adapted to the manufacturing sectors around the globe.

1) *The Implementation of industry 4.0 requires large investments.* For example in Germany, manufacturers have to invest EUR 250 billion over the next ten years, as they adapt the manufacturing process to industry 4.0.

2) *Demand for a modernized workforce.* Manufacturers and other enterprises in the manufacturing sectors will need to take a closer look at the workforce training, especially knowledge and skills they demonstrate. It is necessary a strategic workforce planning with increased emphasis on IT skills

3) *Lack of skills needed to implement Industry 4.0:* Vocational and higher education institutions should revise curricula to address this issue and to form the skills needed for future employees.

4) *Some jobs will disappear, some new ones - will be created.* The new jobs will be related to technology and digitization. Labor factor will be replaced with capital factor. Employees will have to show a lot of creativity and flexibility to adapt to new labour market requirements.

5) *Considerable differences will arise between employees of generation X* (birth years 1966-1976), *generation Y* (birth years 1977-1994), *generation Z* (birth years 1995-2012) and *Alpha generation* (birth years 2012-present), due the specific of each category [4]. Differences can be viewed in the infographic in Figure 1.
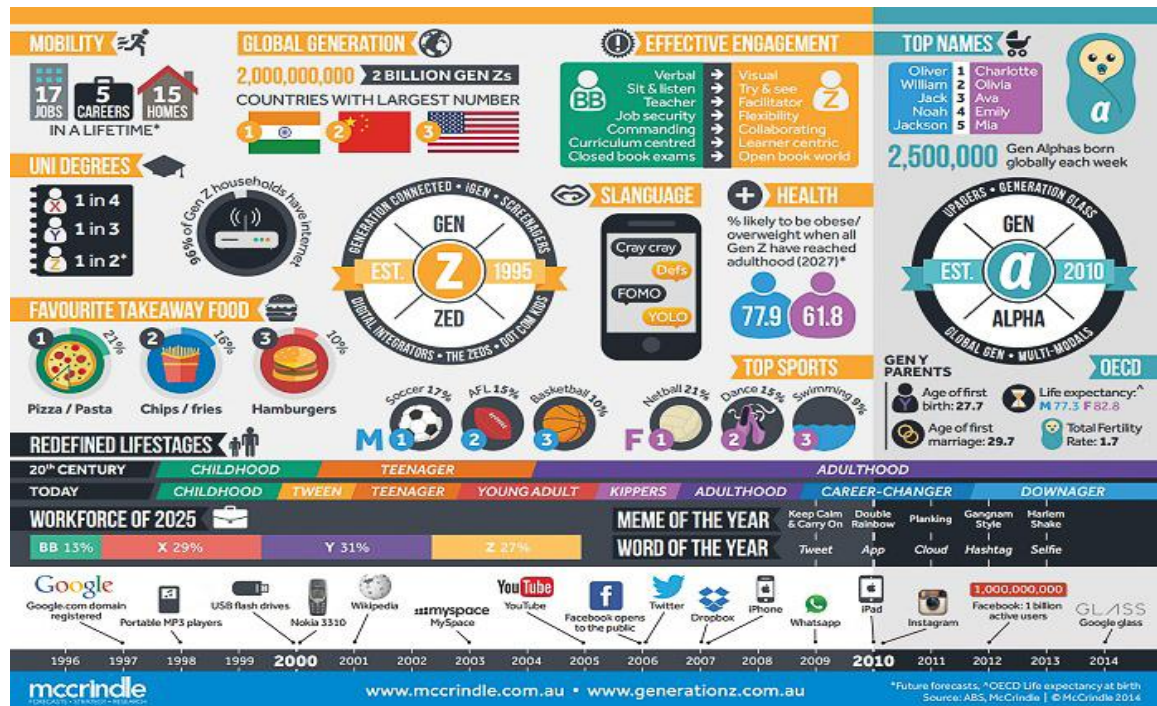
Figure 1. Differences between X, Y, Z and Alpha generations

Source: McCrindle, M. and Fell, A., 2019. *Understanding Generation Z: Recruiting, Training and Leading the Next Generation*, McCrindle Research Pty Ltd. Available at: <https://generationz.com.au/wp-content/uploads/2019/12/Understanding_Generation_Z_report_McCrindle.pdf>.

6) *Demand for systems and machines compatible with industry 4.0.* Suppliers and developers of manufacturing systems need to intensify their work to keep up with demand for specific Industry 4.0 machines and systems. This means that current suppliers and developers have to reconfigure their production processes.

7) *Standardization in industries.* While it is true that not all industries are the same, a certain degree of standardization is needed. A global connection of Industries 4.0 is required. The first steps towards standardization have already been taken by Germany through the creation of Plattform Industrie 4.0, followed by Dialogplattform Industrie 4.0. The United States created the Industrial Internet Consortium (IIC), which brought together telecommunication and IT companies, manufacturers and suppliers of manufacturing systems.

8) *Data security risks.* Since the Internet of Things is used on a global scale, there are certainly great risks to data security. Cybersecurity providers need to increase their vigilance and develop high-performance security systems to protect Industry 4.0 from potential viruses and other cyber attacks.

9) *General reluctance to change.* Although changes in the production process are geared towards achieving higher profits or increased productivity, not all companies will adapt quickly and easily to changes. Thus, convincing all manufacturing sectors to automate their production processes will not be an easy process

5. Education 4.0

The impact of Industrial Revolution 4.0 on the major industries is undoubtedly also affecting the jobs. This implies that Industry 4.0 will not only affect the industries, but,

consequently, it will transform the way we perceive education and professional integration. This will require educational institutions to produce workforce adapted to technological changes (Futurereadyedu.com, 2020). In addition, it will also require the current workforce to improve their skills and knowledge to fit these new professional roles. Therefore, a revolution in education is essential to enable people around the world to take advantage of the opportunities created by the emergence of these technologies.

Education 4.0 is a response to Industry 4.0 requirements. In the learning process, human and technology are correlated in skills and knowledge that are needed, but also determines them to identify the reason for learning these skills and knowledge (Fisk, 2016).

Education 4.0 has the following features:

a) *Accelerate Remote Learning.* Education 4.0 will allow learning anytime, anywhere, as e-learning tools and applications will provide opportunities for distance and self-paced learning. Classrooms role will change considerably. Theoretical knowledge will also be offered outside the classroom, while practical or experiential knowledge will be offered face to face.

b) *Personalized Learning.* Education 4.0 will also allow personalized learning for students, according to their capacities. Thus, there will be individual learning programs for each student. This fact will certainly have a positive impact, as it will allow students to learn at their own pace, as result will produce better effects according to their own pace of knowledge assimilation. At the same time, this method will help teachers to identify each student's strengths and weaknesses and to guide them.

c) *Choice of education tools.* Education 4.0 will be achieved through modern technologies / devices. Techniques such as blended learning, BYOD (Bring Your Own Device) and flipped classrooms are just a few examples.

d) *Project-based learning.* Independent economy is growing and will continue to do it. This means that today's students will have to adapt to project-based learning and working styles. Next, they will improve their skills and learn how to apply them and shape them according to the situation. This part of Education 4.0 will learn organizational management, time management and collaboration skills, which they can still use in their educational and professional career.

e) *Field-specific Experience.* As the integration technology into specific fields generates higher results; curricula will form more skills that require human knowledge and personal interaction.

f) *Data Analysis.* Various information software will be used for data storage and analysis, these ones will facilitate statistical processing, generate interpretations of the data and develop forecasts. Education 4.0 will train students to apply theoretical knowledge and to use human reasoning for examining models and predicting trends.

g) *Changes in Pattern and Assessment Exam.* Current models of student assessment based on tests and exams will be replaced by practical or experimental projects based on learning or working in the field. Impact of technology on education industry will not only transform the way of teaching, but also learners' manner of perceiving education. Education 4.0 or the future of education, as many call it, will change teaching-learning methodologies in order to make ready future students. This will create premises for a progressive, intellectual, knowledge-based and future-ready world.

6.   Labour market 4.0

Progress in the field of robotics and artificial intelligence will inevitably result in the automation of production processes and will generate changes in the structure of labor demand [8]. However, automation will no longer be limited to physical or manual tasks,

but may endanger many intellectual, cognitive or analytical jobs, starting with transportation, office assistance and various services. The OECD has estimated that 9% of jobs in OECD countries could be automated and 25% of jobs could change significantly as a result of the automation of 50% -70% of the associated tasks (Arntz, Gregory and Zierahn, 2016).

Reflecting on the future of work, we inevitably ask ourselves about the place of the human being in the context of technology, automation and artificial intelligence (AI). The image of a future employee is formed as a result of the complex effect of the influence factors (OECD, 2019). The specific character is determined by the way that the people will respond to the challenges and opportunities that the global trends of Industry 4.0 bring. We can identify 4 possible situations:

1) Collectivism vs. individualism. The analysis of this model will determine what prevails in society: the principle "I am the principal" or the collective responsibility.

2) Integration vs. fragmentation. Technology has opened small companies with access to a huge volume of information, professional and financial resources, which were previously only available to large companies. Due to the use of technology, small businesses become powerful. At the same time, large companies manage to significantly reduce internal and external costs.

According to the research "The future of the labor market", by 2030, the professional environment will know 4 dimensions:

Fragmentation	
The yellow dimension - the central value is the human individual. Social entrepreneurship is booming. Collective financing and crowdfunding with high ethical principles and impeccable reputation are practiced. Great importance is given to the individual's debt to society. Many craftsmen appear. Human qualities are highly appreciated.	**The red dimension - the central value is innovation** Companies and individuals compete for consumer attention. Regulatory processes are slower than the pace of innovation. Digital technologies provide elite circles with unlimited access to the information and modes of influence. Niche services are in high demand.
Colectivism	**Individualism**
The green dimension - the central value is social responsibility The topics related to social responsibility are on the agenda, along with the demographic, ecological and climatic problems, constituting the driving force of the business.	**The blue dimension - the central value is the corporation** As the size of the company increases, individual needs become a priority over social equity.
Integration	

Figure 2. The dimensions of the labor market of the future
Source: developed by the author according the source (PWC, 2020).

In a survey conducted in 2017, about 37% respondents worry about their job because of the increased pace of automation.

About 60% of respondents believe that very few people will have a stable and long-term job in the near future.

About 70% of respondents say they will not refuse to take drugs to stimulate physical and mental activity if this will increase their prospects for employment in the future.

To the question „What I feel when I think about the future professional environment?", the answers were distributed as follows:

a) 37% - azart - I see many opportunities;

b) 36% - safety - I am sure that I will be successful;

c) 18% - restless - my future is uncertain;

d) 8% - indifference - I do not make any plans for the future.

These opinions are due, on the one hand, to the technological and digital transformations of the industries, on the other hand, the specificity of the workforce is also determined by the characteristics of the Z generation and the Alpha generation that has recently left or is about to exit the labor market.

7. Conclusion

All industrial revolutions have had a profound impact on global society, and Industry 4.0 is no exception. Education and the labor market are undergoing dramatic changes and must adapt very quickly to these changes. To meet the challenges of Industry 4.0, mankind must have a successful strategy. Developing technologies such as big data and AI will replace most processes. The next generation is more attracted to the use of smartphones and applications. New technologies are transforming our lives, and with that, generations of people are transforming.

In the 21st century, the advanced skills, for example Artificial Intelligence (AI), the huge information and examination, distributed computing and portable arrangement, online networking, the Internet of Things (IoT), Virtual Reality (VR) and Augmented Reality (AR), must change the flow of education into a new computerized teaching method and smart classroom.

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