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Challenges for the Workforce in the Fourth Industrial Revolution

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Abstract: There was a dilemma that accompanied the three previous industrial revolutions, and it came back strongly to the beginning of the fourth: in the new economy, will people be replaced by the machinery or not? It is an issue that we intend to approach in terms of qualitative analysis of previous episodes and assumptions outlined for the fourth industrial revolution. The economic evolutions of the last two centuries have called for a steady increase in the workforce, both numerically and qualitatively. Soon, automatic and robotic learning will change almost all sectors of employment. Starting from these premises, the article aims to respond to the following questions: Will billions of people be laid off in a decade or two?, Is automation, on the long term, going to generate new jobs and prosperity for all? Considering that the volatility of the labor market and individual careers would increase, are people able to cope with them? Fears regarding automation, as this would lead to massive unemployment are present since the XIXth century, and so far have not materialized because for every job lost in favor to machinery it was created at least one new job and in the same time the standard of living has increased. The challenge launched by the 21st century is undoubtedly much greater than the challenge launched in the past by steam engines, railways or electricity. No one can know for sure how the impact of automation on different professions will be in the future, and it is also extremely difficult to estimate the order of transformations because it sometimes depends not only on the political factor but also on the technological developments. Therefore, creating new jobs and the professional reconversion of people to their employment will not be a singular effort.

Keywords: *fourth industrial revolution; machinery; job; robotics; artificial intelligence.*

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1. Introduction

In the last decades, the industry has successively gone through a series of breakthroughs and restructuring processes, which, although they may not have seemed obvious, it have generated consequences at several levels - economic and social, industrial landscape, loss of competence, etc. The statistical indicators failed to capture these transformations, and the patterns were largely outdated.

Industrialization essentially has represented a historical stage in the development of an economy, a process of deep changing the economic structure, by significantly increasing the share of industry in the total value of production. The industrial revolutions, which they have known and are known to mankind, have an essential role in the evolution of the industry and of the social life in general, determining, not least, the course of history.

Thus, the industrial revolution can be defined as a complex process with a dual nature, technical and socio-economic. As far as technical nature is concerned, the industrial revolution implies important changes in the ways in which goods and services are produced. Moreover, the object of work is transformed, the evolution starting from resources that can be physically retrieved in nature (minerals, plants grown for yarns for fabrics, animals grown for food and clothing production), to intangible goods (computer data obtained through reality digitization).

Society benefits from technological progress, people's life quality is growing steadily. With the advent of the fourth industrial revolution, companies are leveraging new emerging technologies to achieve high levels of production and consumption efficiency to expand into new markets. Thus, business leaders of the Fourth Industrial Revolution will be called upon to draw workforce strategies ready to meet the challenges of this new era of change and innovation. Technological breakthroughs go fast, the boundary between work tasks performed by humans and those by cars will undergo rapid changes. These transformations, if managed wisely, could lead to a new era of good workplaces and improved life quality for all, but if they are badly managed, there will be a risk of increasing skills discrepancies.

This article describes the potential of new technologies to create new jobs and change the existing ones while improving the quality and productivity of employees' work. The increase in the number of jobs that emerged as a result of technological progress can, at present, relieve workers of most of their data processing and information search tasks, and soon,

tasks such as reasoning, decision-making and, why not, artistic creation and not only.

Changes occurred by using new technologies hold the potential to expand labor productivity across the industry and change the focus of competition between companies, from focusing on reducing labor costs based on automation, to the ability of using technologies as a tool of completing and improving human labor (Kissinger, 2015).

2. Industrial Revolutions and Structural Economic Changes in the 18th-20th Centuries

So the history of industrialization shows us that the economic development of the states has crossed a series of stages, these being called as the four industrial revolutions, differentiated by the type of energy and the used technology. Each industrial revolution is driven by scientific, technical and organizational progresses.

2.1. Therefore, ***the first industrial revolution took place between 1710-1870***, it represented an important moment in the history of humanity, radically changing its economic development and generating new economic structures. The starting geographic point of the revolution was England, the country that managed to develop trade links with much of the world. After a very short time, based on technologies developed by English inventors, the revolution has spread to Western Europe and to the United States. In France industrialization was slow, and at the opposite pole in the United States it was fast, the starting point of this process being the establishment of Beverly Catton Manufactory (1787) and Slater's Textile Mill (1793). The Industrial Revolution came to Japan in 1870 through the implementation of strong measures for catching up, such as: sending specialists to study in countries with a developed industry, or employing Western experts. The technological plus brought by this revolution was the use of water and steam to produce energy. To the technological innovations in the textile field (the area where industrial revolution was first declared) and energy are added those in the steel industry.

The First Industrial Revolution produced extensive and profound effects, manifested in all areas of the society in that period, for example: "the transition from manufacturing production in small workshops, to the mechanized one, which offers a higher yield, carried out in factories; the emergence of new occupations and professions and new branches and industrial sub-branches; progressive concentration of industrial activity in

urban centers; the rapid dissemination of innovations at national scale and in other countries through study trips, the emergence of technology-related publications and the imitation of cars made by others before them, a process used by the industry business people and technicians; the emergence of new industrial branches and new ways of using raw materials; improving the standard of living of the majority of the population, increasing population, life expectancy, changes in people's habits:" (Russu, 2012).

2.2. ***The second industrial revolution or the technological revolution took place between 1870-1914***, it has been known due to remarkable progress in several areas, such as: production of steel, steam turbines, internal combustion engines, radio transmissions, computing machines, biotechnologies, ammonia production, physical chemistry, microbiology, oil refining, assembly line and mass production.

If the first industrial revolution highlighted significant progresses in the domains of steam, textile and steel technology, the second industrial revolution has focused on the areas of steel, chemistry, electricity, and rail transport. This industrial revolution has lead to a rapid development of the main Western states, deepening the gaps between developed and less developed countries. If in the first industrial revolution, Germany was behind England in terms of technology, in the second industrial revolution, Germany successfully overcame England, allowing itself to adopt the latest technologies, knowing the most spectacular developments in the chemical, energy and engine industries.

Around 1900 the United States became the world's first economic power, developing the most in the mining industry, rail transport, heavy industry. Due to the major implications in research and development, giants as: Standard Oil Company, United States Steel, General Electric have emerged. Therefore, significant technological progresses have been made at both economic and social levels, for example: "increasing the density of transport networks and the quality of transport means; enhancing international trade, positioning countries and firms on the international market; the rapid integration into the current life of the great inventions recorded during this period, which provided the necessary premises for the realization of the second industrial revolution " (Russu, 2012).

2.3. ***The third industrial revolution appeared after the 1960's*** and assumed the transition from the traditional industrial society to an informational post-industrial society, characterized by the generalized computerization of society. The third revolution "determined the emergence

of post-industrial society - where information and knowledge become the most valuable assets that predict the knowledgeable society, focused on the production of intellectual values capable of enhancing the economic force" (Russu, 2012).

The third industrial revolution comes and changes the way goods are made, where and when they are produced and distributed. It focuses on reducing the quantities of raw materials and energy, but also on the carbon emissions from the manufacturing process. It changes the social relationships, it destroys or makes the existing jobs irrelevant simultaneously with the emergence of new jobs. The world no longer seeks standardized mass production items, but custom-made products to meet the individual needs requirements. The world economy is transformed, offering new opportunities to both the developing world and the developed world (Burrows, 2016).

Jeremy Rifkin (2011) highlights the fact that the third industrial revolution is spurred on five pillars that also form the basis for it:

- transition from fossil fuels to renewables;
- the democratization of energy production through the introduction of new technologies (solar, wind) in the construction sector - it refers to the fact that new buildings to function as energy mini-power plants able to collect energy in one place or as close to where it is used;
- developing technology to make hydrogen the universal storage environment for all forms of energy (from renewable sources);
- use of internet technology to transform the power grid of every continent into an energy internet;
- passing the fleet to electric vehicles and combustion cells, which can also generate green electricity in a smart grid.

Similar to the previous revolutions, the third industrial revolution, it has also produced effects already mentioned: "increasing the competitiveness of productive activities by lowering the share of energy consumption; the emergence of completely new and long-term economic and commercial implications for the real estate sector; the conversion of the whole fleet of means of transport into one that uses electricity as a means of propulsion, which will have the effect of reducing the pollution of the environment" (Russu, 2012).

2.4. ***The Fourth Industrial Revolution or the Digital Revolution*** - is based on past technological developments and is characterized by a fusion of technologies that blur the lines between "physical, digital and biological" (Burrows, 2016).

The speed of progress, the scope and the systems' impact are reasons to show that the current transformation is not extension of the third industrial revolution, in the sense that the speed of progress seems not to have an historical precedent. Since the beginning of the last century, the speed of accumulating new knowledge is relatively constant, it has an exponential evolution that has become difficult to manage not by speed but by the amount it has reached out. The huge amounts of information, technologies that allow instant access to a large part of knowledge, require new ways of managing and approaching from the individual's point of view. We are on the brink of a revolution that will fundamentally change the way we live or work, this revolution involves all the interesting parts of the political system in the world, the public and private sectors, academic environment and civil society.

Industry 4.0 combines different technologies: nanotechnology, 3D printing, mobile networks, brain research, the emergence and rapid expansion of electric vehicles, the major impact of the Internet, making these things which recently seemed impossible, possible. Nowadays, everyone has access to technology, therefore, cheap and fast products can easily be created and the business model of each industry can be changed (Burrows, 2016). The elements of industry 4.0 highlight the importance of the fourth industrial revolution as follows:

- ***"Internet of Things"***

The economy built on the patterns of the first three industrial revolutions is gradually being replaced by industry 4.0, the convergence between the elements of the fourth revolution radically changed the concept of the factory and the industrial platforms of the past. David Cameron said the world is on the brink of a "new industrial revolution", where the internet will allow ordinary objects to communicate with each other. The construction of the Internet of Things infrastructure by some of the most important IT companies is forecast to take place in a near time. Kevin Ashton launched the "Internet of Things" in the 1990s to name a vast network of computers capable of gathering and processing data from objects that are endowed with the property of providing information without the need to turn to human operators to enter this data (Stanescu, 2013). The positive effects of the Internet of Things have led to the improvement of people's lives.

- ***"Artificial intelligence"***

The impressive progresses made in recent years have been driven by an exponential growth in computing power and the availability of large

amounts of data. The technology has made possible the existence of products and services which increase the efficiency and the pleasure of our personal life. Therefore, those who have had the most to gain were the consumers able to access the digital world by calling for ***"Artificial Intelligence - IA".*** Drones can inspect remote equipment and operations and, at the same time, minimize human exposure to hazardous conditions. Digitization has both a horizontal and a vertical impact on the value chain, which implies: companies need to integrate and digitize their vertical data flow, from product development and acquisition to processing and transport logistics; horizontal collaboration with key suppliers, customers and other value chain partners.

Nanotechnology, genetic engineering and biotechnology have grown spectacularly and are able to provide new products and services. New automation and production technologies have the potential to completely transform the labor market, basically for the better, but the immediate impact could also include adverse effects such as the abolition of a significant number of jobs. Fears that automation will generate massive unemployment have not materialized so far, so for every job lost in favor of a car, at least a new job has been created, with the living level increasing significantly. People have two types of abilities, on the physical side - in industrial revolutions cars have made people compete only in terms of physical abilities -; and on the other hand, cognitive side - people are getting a big advantage over cars (the knowledge). Therefore, as manual work in agriculture and industry has been automated, new jobs have emerged in services that require people's cognitive abilities such as: analyzing, learning, communicating, understanding people's emotions (Harari, 2017).

Artificial Intelligence has specific non-human abilities - interconnection and updating - , which fundamentally differentiates it from human possibilities and opens up a barely envied universe.

- ***"Robotics"***

Another aspect that characterizes the fourth industrial revolution is "robotics", so it is unlikely that it completely eliminates entire industries, it is obvious that jobs requiring specialization in a limited range of routine activities will be automated (replaced with robots).It will be much more difficult to replace people for those jobs involving less routine and involving the use of a variety of abilities and the ability to cope with unforeseen scenarios.

Therefore, the first generations of robots are more rigid, they can move at fixed speeds, designed to do many repetitive operations or to

manipulate objects of an uniform size, are specially built for repetitive activities. Currently, a modern robot can work in a completely new environment and does not require preset settings, so he can even learn what he has to do. The modern robot has greater freedom of movement and can execute more complex movements, can apply logic in making decisions and then transmit it to other systems. They are built to interact with people, have sensory and mechanical ability sometimes better than humans.

- ***"3D Printing"***

3D printing or additive manufacturing or "fast prototyping" (Comper, 2012) - replaces conventional mass production, focusing on short production cycles or when mass customization is cost-effective. This basic printing technology was invented three decades ago, but it was only fully exploited when combined with prototype technology CAD "computer-aided-design" (Burrows, 2016).

Through 3D printing, geometric complex objects can be created, with cavities or parts moving inside an object, things that traditional machines cannot produce. Additive manufacturing can lead to the emergence of a large number of micro-factories, similar to the "craftsmen's guilds" during the pre-industrial revolution, but currently possessing modern production capacities (Burrows, 2016). These micro-factories that may appear can create significant quantities of products, especially goods whose transport costs are high or whose delivery takes a long time.

People will always be at the center of automation, new technologies are key to improving work productivity. Therefore, this new wave of change will change the current job profiles, meaning that some workers will be re-qualified in the field in which they operate or will change their field of activity. New emerging technology can create more performing and better paid jobs.

It is important to note that there will not disappear jobs that require creativity, and by this it is understood what people will do in addition to a robot plus the value to what unequipped with artificial intelligence car can do. Places where taxes or insurances are paid will be replaced with digital structures. It is possible that there are no more jobs to work in for 40 years, because it can be transformed, and people have to retrain or find a new job (Randers, 2018). The people who will find their job quickest will be those who have the most complex knowledge and skills in various fields.

The University of Knet, Great Britain suggests a map of future jobs as: steroid mining, alternative energy developer, exobiology, virtual architecture, virtual teachers(jobs that will appear over 50 years);computing

techniques developer, space clinician, sustainability consultant, space travel pilot, civilian drone controller, shale gas engineer, genetic counselor (over 25 years); personal fitness entrepreneur, professional player, dietician / nutritionist, digital image consultant (Paul, 2018). From the above-mentioned professions, it is noticeable that they are mostly related to Computers, Robotics, Space Research, Energy and the Environment, Health, Business, Social Media and the Internet (Till, Ratcheva, & Zahidi, 2018).

In the medical system jobs such as: nurses, occupational therapists will be replaced by medical robots, biomedical engineers will produce organs from stem cells. There is the possibility that technology can create addiction or fear, so it is necessary to have specialists in technological detoxification, but also occupational therapists. Virtual social assistants will appear in social networks to help people in their virtual existence on the Internet. In terms of space exploitation, space tourism will appear with all occupations around it, doctors who will specialize in space-related issues. There will be banal occupations like drone controllers, people who will work in programming, surveillance and maintenance of robots. With regard to energy and the environment, the number of those working in unconventional energy plants such as solar, wind and algae farms. Waste recycling companies will operate everywhere, including seas and oceans. Biodiversity, genetic research of species will create new forms of life and food. At the level of education, virtual learning supported by virtual teachers will become commonplace, structures for the development of educational materials will appear. Artificial intelligence will create a new momentum of reaction in the financial and legal markets. There is the possibility of emerging robots specialists or genetics ethics.

However, there are also jobs that are not endangered, and these are in the following areas: health care, dental services, theater, film, music, education, hairdressing, car repair, etc. These involve difficult automation interactions.

The future in terms of the fourth industrial revolution means the partial or even total disappearance of the production factories. The largest IKEA packing factory in Sweden is fully automated and has a single operator, also Nike and Adidas have built fully automated factories. Industrial robots can be rented and displaced anywhere on demand for use. The number of industrial robots continues to grow, INACO's forecast would be 3053 robots in 2020, so the auto industry's percentage of robotics could easily exceed 33% of the current. The United States, China and Israel have already introduced intelligent military robots on the battlefield,

becoming increasingly robotic and technological. Since 2017, tractors / self-propelled tractors without driver have been introduced in agriculture; they are supervised by an operator who can coordinate dozens of agricultural machines from the computer. "Case IH Magnum Autonom"is such a tractor that by using LiDAR[1] technology and the dashboard, can detect obstacles and it will stop to notify the operator through visual or audio alerts,also it will stop even if the GPS[2] signal is lost. Big farmers are investing more and more in the construction of such robots.

Robots and computers do not have consciousness, although they have countless abilities, they do not feel anything, and they do not care for anything. A robot can implant an energy sensor to transmit to the central processing unit when it is about to discharge the battery. A human being lacking in energy feels when he is hungry and wants to end this unpleasant sensation. People are hungry and exhausted while exploiting robots until they discharge batteries does not require any moral approval.

We can not really predict the future, because technology is not deterministic. The same technology could create very different types of society. Progress in IA and biotechnology will definitely transform the world, but it does not have a binding result.

3. Challenges

Both first and the second industrial revolution triggered the prosperity process on an unimaginable scale, but it also deprived many craftsmen and contributed to the strengthening of the social class system in the UK of the nineteenth century. The third and fourth industrial revolution, especially 3D printing, has attracted the attention of public opinion, following some information that some people have printed weapons and high-capacity cartridges for assault rifles. Drones have proven to be highly controversial because of their ability to be used to target certain terrorists. There are already robotic weapon systems equipped with the ability to automatically "decide to kill".

Synthetic biology has a great potential to do well, but also the greatest potential to be extremely dangerous. We will be able to modify DNA as we modify a software on a computer. Synthetic biologists are able

[1] Light Detection And Ranging - Using high-density dot clouds to perform precision measurements.

[2]Global Positioning System -is a global navigation satellite system and radio waves

to "design a genetic code to determine a specific function, to test the code for functionality using computerized modeling, to order the relevant genetic material at a commercial gene synthesis facility or an open source and to place the material in the body of a cell to test functionality in the real world" (Burrows, 2016). However, there are fears that amateur biologists might mislead dangerous materials on the market. Strong regulation of internet use could stifle scientific progress, amateur hackers and electronic gaming consumers play an important role in developing the internet and its applications.

Many other technologies are far less dangerous, but raise other issues, the need for substantial initial government investment to become commercially viable. Genetically modified organisms are severely disputed by environmentalists, despite the fact that they are sometimes indispensable.

Another challenge that industrial development brings is keeping intimacy (Andone & Safta, 2017). Governments could create new technological means to increase control of populations, through ubiquitous monitoring systems and digital infrastructure coordination capacity.

Some of the declining jobs will not disappear completely but will be less and more automated, it is important to mention that cars need people to be created, repaired or supervised, always man will do something in addition to a machine.

4. Conclusions:

The new labor market, which is formed after the fourth industrial revolution, holds both challenges and opportunities, because companies are starting to formulate strategies for business and labor transformation - simultaneously increasing creativity and productivity.

Technological changes with implications on the labor market and occupational structures transforms demand for skills faster than ever. As this new labor market is created, businesses and individuals will face a new set of challenges. They must take personal responsibility for their own lifelong learning and career development, it is very clear that they will be supported during periods of job transition and also in re-qualification stages. Lifelong learning becomes a rich area of experimentation, several industries are looking for the right formula to encourage individuals to voluntarily undertake regular skills enhancement.

Finally, the central objective must be to ensure that future jobs are paid fairly and also to provide a realistic space for growth, development and personal fulfillment.

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