THE FOURTH INDUSTRIAL REVOLUTION AND SUSTAINABILITY

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ABSTRACT

Whether we like it or not, the world is currently experiencing a series of extremely disruptive technological changes, with tremendous effects on our social and private lives, the so-called Fourth Industrial Revolution. The whole world is adopting and implementing spectacular innovations of great depth and magnitude, in three main domains: physical, digital and biological, which make the limits between these spheres to become blurry. Although the benefits of the Fourth Industrial Revolution for the economic and environmental dimensions of sustainability might be easily measured and quantified, its effects on the social dimension, or the welfare of all individuals, which is ultimately the target of sustainable development, might not as positive as expected. The paper mainly emphasizes the impact of the Fourth Industrial Revolution on the labour market, being focused on the negative aspects of jobs reduction on the social identity of individuals and the "prosperity for all goal of sustainability.

KEYWORDS: *Industry 4.0, megatrends, 4IR challenges, 4IR principles, precariat, robotization, sustainability, workforce*

1. INTRODUCTION

In his two famous books dedicated to the subject, economist Klaus Schwab, the "architect" of World Economic Forum, argues that humanity has entered in a new phase of its social development, a new era of radical and spectacular changes of the economic environment, of the way people live, work and relate to one another that together created a phenomenon that is happening right now, under our very eyes, aptly named the "Fourth Industrial Revolution" (4IR, or Industry 4.0). This is a phrase initially invented for describing the future developmental phase of German economy, but subsequently used by many economists to name the general ongoing technological transition to a new world and society, where individuals and organizations already began to travel back and forth between the material reality and a multitude of virtual, digital worlds, freshly opened for economic action and development, but also for activities belonging to private life (Schwab, 2017, 2018). The magnitude and speed of these revolutionary changes that will bring a blurring of the borders between the physical, biological and digital realms, are not to be ignored, as they are very likely to determine radical shifts of power, knowledge and wealth, that we do not yet fully understand, and to raise new problems concerning the sustainability of economic development (Lanteri, 2019; Xu et al., 2018).

Based on an extensive literature review, the paper emphasizes the main characteristics of the Fourth Industrial Revolution, primarily considering its domains of action. In general, the advantages of 4IR are highly praised, therefore the ratio of scientific concerns for its advantages and disadvantages to sustainability is not equitable, with the balance tilted in favour of benefits and gains. The paper

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briefly presents some of the challenges of future robotization of the workforce, focusing on the newly emerged social class of the precariat.

2. THE FOURTH INDUSTRIAL REVOLUTION

2.1. A short history of industrial revolutions

As the name suggests, this is not the first revolutionary change that affected the world society and economy in the past, as it follows the path of other three radical rearrangements of humanity's life courses and fundamental structures.

As it is universally acknowledged, the "First Industrial Revolution" has started in the Great Britain around the middle of the eighteenth century, with the use of coal, a high-energy intensive fuel, the invention of the puddling process (of turning pig iron into wrought iron) and of steam engines that could be used to replace human and animal power in economic activities. All these changes together made possible the transition from an agricultural and farming society to the world of manufacture and industrialization. The large-scale use of steam power increased the efficiency of production, transportation, distribution, commercialization and consumption of goods and services, introduced some measure of automation through machinery and developed better connections between people through building of railways, channels and bridges. As manufactures increased in size and productivity, it became possible to produce standardized goods in large quantities, and so reduce the production costs, therefore lowering their price on the market and making them available for ever greater number of people. As industrial production gained momentum, factories began to appear everywhere and greater numbers of people migrated from countryside to cities to find better employment here. This increase in size of production facilities meant that a new form of organization was needed, with new kind of administrative and management positions, and so the whole way of making business changed in a radical way, starting the process of economic development that caused and amplified the great divergence in economic development between the East and West (Lanteri, 2019; Park, 2018; Schwab & Davis, 2018).

The second industrial revolution began towards the end of nineteenth century, and was generated by other radical technological innovations, the large-scale introduction of petroleum use, an even more efficient energy source, and also of electrical power, made possible by great inventions backed by new methods of production, transportation and consumption of electricity. It was also called the "Technological Revolution", and brought automation development, mass standardized production of myriads of consumer goods, a spectacular increase in the size of factories and the invention of industrial production lines, where the assembly of products was based on a strict and complex labour division. Standardization included not only production of goods, but also their transportation (with shipping containers), production became "scientific", and consequently a new kind of position emerged, namely the scientific manager, whose role was to organize the industrial production processes in a new, scientific manner. This new approach meant that everybody tried to identify and use the most efficient fabrication technologies, the incentive to innovate increased, and the ideal to be achieved was the real industrial scale production. These developments also imposed the introduction of new institutional and legal measures for the protection of intellectual property, such as copyright laws and other similar measures, destined to stimulate innovation and creativity trough substantial financial rewards (Lanteri, 2019; Park, 2018; Schwab & Davis, 2018).

The third industrial revolution emerged in the 1950s, when the invention of electronic components, transistors and, eventually, microprocessors facilitated construction of ever more powerful computers. Then, computers were first connected together through ARPANET and then by Internet, enabling the further development of electronic and informatic technology, of hardware and software industry and a widespread sharing of knowledge and information. The third revolution was also called the "Digital Revolution" and it brought great improvements in acquisition and communication

of information, automation of production and a spectacular development of knowledge economy, generated by the progression of computing power according to Moor's Law (hardware advancement generates a doubling of computing power every two years). Since the capacity of digital information management was paramount for survival in this new context, some new socio-economic roles emerged, such as those of project manager and strategic planner. (Lanteri, 2019; Park, 2018; Schwab & Davis, 2018).

So, what can be said about what comes next? According to Klaus Schwab, the foundations established by the "Digital Revolution" laid the basis for building the current "Industry 4.0", a name first heard in 2011, at the Hannover Fair, to describe the future world in which old and new systems of production, both physical and non-physical, will fuse to create new models of operation and completely customized products and services (Schwab, 2017). The world of 4IR, which is now in the process of development, will be dominated by a blending of different technologies that will erase the clear boundaries between the physical and the computerized domains of action (Schwab, 2015).

2.2. Industry 4.0

Although the changes brought by the Fourth Industrial Revolution would be very tempting, Schwab (2015) prevents us to not think of the 4IR as being merely a final phase of the "Digital Revolution", although it is true that it builds on the all three previous revolutions, and advances three reasons proving that what is happening right now, before our very eyes, is a radically new and different phenomenon: its speed, its scope and its systems effect. First, we are witnessing remarkable advancements taking place with an unprecedented rapidity, a situation which is totally different from developments of all past industrial revolutions. Second, the changes brought about by 4IR all over the world are far more disruptive in almost any field of action that any previous changes. Third, the extent and magnitude of these transformations in the economic, social or political fields might completely change the old organizational structure of society.

Concerning the depth and magnitude of this last industrial revolution, the views are far from being unanimous: there are, on the one hand, the pessimists, who believe that it does not have the same momentum and growth potential as the previous three revolutions, and on the other hand, the optimists, who believe that it will have an impact on our economic and social lives stronger than ever before, given that is accompanied by the ongoing digitalization of technological innovation that will surely generate tremendous economic growth (Park, 2018).

According to Schwab (2017, ch. 2), who is the first among the optimists, 4IR is greater in magnitude than everything we have seen before, as it is powered by three major drivers of change, or "megatrends", namely a physical drive, a biological drive and a digital drive. All these drivers have one common basic characteristic, which pertains to the potential of computerization and robotization.

The physical drive is probably the most visible and best known, since it has the most noticeable achievements, the broadest perspectives of application and the most rapid rate on implementation (Li et al, 2017). Its main physical manifestations, easy to observe given their concrete and tangible character, are: (i) the autonomous vehicles (the driverless cars, drones, submersibles); (ii) 3D printing, or additive manufacturing technology (creating physical objects starting from a digital model by adding successive layers of material); (iii) advanced robotics (more adaptive and flexible robots, with designs inspired by biological features, that will make possible a better integration of human and robotic activities); and (iv) the invention of new, lighter, stronger, adaptive and recyclable materials (such as graphene and other nanomaterials, thermosetting polymers and so on) (Schwab, 2017, ch. 2.1.1).

The digital drive is unarguably the fundamental megatrend or driving force of 4IR, as virtually all the new innovations and technological advances are due to a general enhancement of digital power.

The four main manifestation of this megatrend are: (i) the Internet of Things (IoT), which "can be described as a relationship between things (products, services, places, etc.) and people that is made possible by connected technologies and various platforms" (Schwab, 2017, ch. 2.1.1) and its main principle is to allow the digital devices (such as identification and tracking instruments, sensors, communication devices, actuator networks) to exchange information between them and so to make possible public security, smart homes, personal health checking, industrial production monitoring, traffic logistics, environmental protection; (ii) Artificial Intelligence (AI) and machine learning, a technology intended to simulate human thinking and behaviours (reasoning, deciding, planning) by building intelligent systems and machines that copy the structure and functions of human brain; (iii) Big Data and cloud computing, which were made possible by great improvements in the data storage and manipulation technologies, but also machine learning, which allows the computing services to be delivered over the Internet, therefore reducing the need for storage and computing power; (iv) digital platforms, such as Blockchain, that use digital algorithms to secure and transact with great speed, reliability and secrecy, thus making possible the on-demand (or sharing) economy (Li et al, 2017; Schwab, 2017, ch. 2.1.2).

Finally, the biological megatrend consists of important innovations in the biological sciences, especially genetics and neurotechnology. The progress in human genome sequencing and genetic engineering made possible by the advances in computing power is only the first step towards synthetic biology, that will provide us the capability to design and customize organisms (of other beings, but of humans as well) by re-writing their DNA code. 3D editing will be used together with gene editing procedures to make living tissue and organs by bioprinting. Finally, neurotechnology allows us to study and monitor brain activity and improve is performances by connecting it with robotic machines and other digital devices (Schwab, 2017, ch. 2.1.3).

Of course, the number of technological innovations that together are powering 4IR is far greater, and various attempts were made to identify the most important ones. One such classification can be found in a 2017 Pricewaterhouse Coopers (PwC) report, *Innovation for the Earth: Harnessing technological breakthroughs for people and the planet*, the ten most important technologies of the present being listed in Table 1.

Table 1. The ten most influential technologies of 4IR

Megatrend	Technology	Main features and functions
Physical	High-tech materials	Technologically improved materials in terms of their performance and utility, which are more durable, highly conductive, or with a lower weight.
Physical	Self-driving transport machines	Autonomous machines used for any type of transport, which can operate or function autonomously, with a small or no human intervention and guidance.
Physical	Advanced robots	Machines operated electrically or mechanically, as well as virtual assistants, which can robotize, improve, or sustain various activities, either in an autonomous or a guided way.
Physical	3D printers	Devices using specific techniques for manufacturing three dimensional goods by "printing" the constituent parts layer by layer.
Digital	Cloud computing technology and big data	Novel technologies that make possible the delivery over the Internet of a complex mix computer applications and services, thus diminishing the need for computers endowed with a big storage capacity or processing power, as well as increasing the capability of operating with big data.

Megatrend	Technology	Main features and functions
Digital	Virtual Reality (VR), as well as Augmented Reality (AR)	Technologies able to create "imaginary" worlds or simulate real environments (VR), as well as technologies capable of amplifying the elements of the real world using computer-generated inputs (AR).
Digital	Artificial Intelligence	Devices using software programs to execute assignments usually pertaining to human intelligence, such as recognizing speech or images, as well as making decisions.
Digital	Blockchain	Software programs used for electronic accounting books, which make possible the registration and verification of transactions with accuracy, security and anonymity.
Digital	Internet of Things	The extensive use of Internet to connect together devices, services and systems, thus forming a "network of objects" and enabling the collection and transfer of data.
Biological	Synthetic biology	The new inter-disciplinary field of biology, which utilizes principles and axioms of engineering to biological systems.

Source: adapted from PwC (2017), p. 7

As Klaus Schwab pointed out, all these ideas may seem somehow abstract, but at a closer look, it is easy to see that they do manifest themselves in some very concrete, practical applications and developments, as it is argued in a 2015 World Economic Forum Report, where no less than 21 'tipping points' (when people start using an innovation) are identified and described. Some of the most relevant of these, expected to happen by 2025 are: the penetration rate of the Internet will extend to about 90% of the population, the use of smartphones will reach over 90% of the population, the emergence of IoT will make possible the connection of over one trillion of sensors to the internet, the first car will be manufactured using 3D-printed, people will be clothed in apparel connected to the Internet, the first implantable mobile phone will be available on the market, the first AI machine will assume the role or even completely replace the board of directors in a corporation, AI will carry out over 30% of corporate audits, more than 50% of Internet traffic will be used by "intelligent homes" for operating appliances and devices, governments will start to collect taxes via a blockchain, over 80% of the population will have a "digital presence", and so on (Schwab, 2017, ch. 2.2; WEF, 2015).

All these developments can seem positive and beneficial, but there are also some very important precautions that have to be taken, as Schwab prevents us in his second book: "The Fourth Industrial Revolution is evolving and emerging in ways that are creating new challenges and concerns for the world at a time when concerns about inequality, social tension and political fragmentation are rising, and where vulnerable populations are increasingly exposed to economic uncertainty and the threat of natural disasters." (Schwab, 2018, ch. 1). There are three very important and pressing challenges to be faced: (i) We should take all the necessary measures to ensure that the benefits of 4IR are fairly distributed; (ii) We have to carefully and responsibly manage 4Ir's externalities, to minimize the risks and damages it will certainly cause; (iii) We must make all the necessary efforts to ensure that 4IR is and remains human-led and human-centred, built on human values that must not be thought of as instrumental (useful for financial gain), but intrinsic values. Accordingly, Schwab identified four main principles of future action that will allow us to successfully meet and solve those challenges: (i) Focus on systems, not on technologies; (ii) Chose to empower humans,

not to subdue them to technology; (iii) Think about society in terms of designing it, not accepting it as it is by default (iv) Consider values as a feature of the system, not as a bug (Schwab, 2018, ch. 1). In the following pages, we will focus on some of those challenges which we believe are relevant for the problem of sustainability and sustainable socio-economic development.

3. CHALLENGES OF 4IR TO SUSTAINABILITY

3.1 Challenges to the social dimension of sustainability

The most commonly used definition of sustainability refers to the well-known "triple bottom line" of sustainability (Elkington, 1997), clearly implying that there is no sustainability without economic growth, social welfare and a healthy environment. The three interdependent areas of action, namely economic, social and environmental, need to be tackled simultaneously and optimally, as the failure to consider any of the three domains properly will eventually lead to the unfulfillment of the sustainability goal. For example, economic growth without concern for the environment can generate additional costs to counteract the environmental effects, thereby reducing and even annuling the economic benefits. Similarly, economic growth without consideration for the human capital, such as wages or working conditions, can have a serious impact on the social development, raising ethical issues.

The interconnection of the three fields of action is also reflected in the fact that the environmental dimension is the necessary basis for sustainable development, as nature provides the necessary resources or the raw materials for economic growth. At the same time, the economic dimension constitutes the tool for achieving sustainable development, as economy ensures the transformation of raw materials into various usable goods. Ultimately, it is the social dimension, echoing the slogan "better life for all", that matters most, as the social development, or the welfare of the people, is the target of sustainability (Hitchcock & Willard, 2009). A better life for all individuals, including here the individuals of future generations, is therefore the ultimate purpose of sustainable development.

Sustainable development can only be accomplished by and through individuals who feel that they will enjoy the benefits of sustainability and have access to a fair share of resources and prosperity, that they are safe and healthy and that they are empowered to participate in decision-making processes and actions at different levels. Moreover, the social dimension of sustainability also includes the struggle to reduce poverty through employment, support for sustainable subsistence means, anti-discrimination and social security for all, and the fulfillment of human basic needs, in general. Although in terms of human needs culture play a very important role, a classification of universal human basic needs would be as follows: subsistence, protection and security, affection, understanding, participation, leisure, creativity, identity and freedom (Max-Neef, 1991, 32-33). To these fundamental needs, one could added many others, such as an adequate education system; a secure and satisfying job and workplace; access to an efficient health system; the lowest possible level of poverty; security and the absence of crime; equal rights and non-discrimination (Hitchcock & Willard, 2009, 19).

The importance of the social dimension is also reflected in the words of Klaus Schwab (2015), who states that the ultimate goal of the Fourth Industrial Revolution should take into account "people and values", by constructing a future world in which humans are empowered and their lives improved. Although Schwab admits that this new revolution has the potential of robotizing the humanity and depriving humans of their "heart and soul", he also expesses his optimism, or rather his hopefulness, that the changes brought about by 4IR will enhance the essence of the human nature and will lead to the emergence of a new type of solidarity, based on a sense of common values and goals (Klaus Schwab, 2015).

Nevertheless, it is not clear how a "robotized" humanity will advance both economic development and standards of life of both current and future generations, while seeking to protect the earth's ability to sustain diversity of life, will boost democratic regimes, the rule of law and promotion of fundamental rights, including freedom, fair chances for all and cultural diversity, and will endorse a higher level of employment by putting an emphasis on learning and educational improvement, innovation, cohesion at a social and territorial level and the preservation of the environment.

3.2 Challenges to the workforce and social identity of individuals

When it comes to the social dimension of sustainability, the Fourth Industrial Revolution will touch upon all the elements that are directly related to our self-identity and social identity, altering not only the 'what' and the 'how' of people's identities and the way they do things and live their lives, but also the 'who', meaning that individuals will be faced with the difficult challenge of adapting to an increasingly impersonal environment and redefining themselves.

In terms of 'who' we are, the answer to that question usually appeals to the social identity of an individual, or the set of social statuses occupied by a person at a certain time, by social status meaning the socially defined position of an individual within a group or society (Kendall, 2012, 107). For a long period of time, the master status has been the professional status, given that in a merit-based society it is the profession of individuals that primarily refers to their achieved statuses and convey information about their level of education, income, or abilities (Kendall, 2012, 109). The Fourth Industrial Revolution is going to change this state of things, as many jobs will be automated and, eventually, disappear in the future.

The famous American theoretical physicist and futurist Michio Kaku (1999, 2018) has 'warned' humanity, long time ago, that many jobs will disappear in the future, certain types of productive activities being completely taken over by robots. It has been predicted for decades now that, given the digitalization of many economic sectors, mainly three categories of professional positions will be directly threatened, namely the repetitive jobs, inventory control jobs, and middleman jobs (Kaku, 1999), while at the same time new jobs be created. Although the disappearance of entire categories of "dangerous, dull and dirty" jobs (Kaku, 2018) might be looked at from a rather optimistic point of view, it is not certain whether the new jobs that will be created, especially in sectors related to the design, repairing, or maintenance of robots and computerized devices (Kaku, 2018), will be enough to compensate for the big loss of the labour market and to bring back to work millions of people that will be displaced in the first stage of the "robotization revolution".

Moreover, the enthusiastic confidence in the benefits of the Fourth Industrial Revolution seems to be questioned nowadays by numerous studies indicating that robotization will not only replace "dangerous, dull and dirty" jobs, but will have a great impact on all occupations, especially those in the tertiary sector of the economy (McAffee & Brynjolfsson, 2017). For instance, it is estimated that in the USA alone, in the next two decades, up to 50 percent of the current professions will be computerized and robotized (Avent, 2016, 1-4), a similar trend leading to a significant decrease of the workforce worldwide (OE, 2019), thus bringing about a complete reconfiguration of the work market.

In the manufacturing sector alone, it is estimated that 1.7 million jobs have been lost worldwide in a six-year period, during 2000-2016, due to the installation of industrial robots (OE, 2019), the biggest "losers" being the US, with around 2% of the total manufacturing labor force (more than 260,000 jobs lost), the European Union, with 1.5% of today's manufacturing labor force (around 400,000 jobs), and China, with around 1% of the manufacturing labor force (about 550,000 jobs). At the same time, a short-term prognosis (OE, 2019) indicate that in only a decade, by 2030, other 20 million jobs will be wiped out in the manufacturing sector, or the equivalent of approximately 8.5 percent of the global manufacturing work labor, with China losing more than 12 million jobs,

European Union losing almost 2 million positions, USA losing almost 1.8 million jobs, and the rest of the world counting for about 3 million jobs lost to automation.
Although economists are rather praising the gains of the "robotization revolution" that will bring a "creative destruction", mainly talking about the productivity increases and the overall economic growth (OE, 2019), it is worth mentioning that the dream of sustainability, translated into "prosperity for all", might not come true for millions of individuals, who will find themselves unemployed, with no means of ensuring their subsistence and, perhaps even most importantly, with no elements of defining their social identity.
The "survivors" of the future automated world will definitely be the specialists in the yet-to-be-created industries, which will be the few "knowledge workers" and "innovation workers" (Johannessen, 2019, 2), yet the vast majority of people will form what is called the "precariat", which is an emerging social class, consisting of individuals with many and insecure jobs, struggling to find their place and social identity in the new world (Standing, 2014a, 1-4), or the "working poor", a social class formed mainly of extremely low-paid workers and people living on welfare benefits (Shipler, 2005).
With regard to the social component of sustainability, one could not help but wonder what could possibly be the benefits of the vehemently proclaimed economic growth and productivity increment to the working poor or the precariat, the newly formed social classes, which will slowly include the vast majority of people. The problem becomes even more complicated when taking into account the characteristics or defining elements of the newly emerged groups of people, briefly indicated in Table 2, with an emphasis on the ones with a negative impact on both the individuals and the society as a whole.

Table 2. Characteristics of the precariat and the insecure social classes

Defining characteristic	Negative impact
Relations of production, where the norm is rather job instability	- jobs insecurity and even unemployment, or both situation intermittently - precarious fulfillment of basic needs, such as housing or even food - lack of basic rights, such as right to work or labor protection rights - professional status becoming devoid of any meaning, as labor becomes instrumental, instead of self-defining
Relations of distribution, with "social income" incorporating all types of benefits	- wages, when existing, remain the only form of income - no access to non-wage incomes and other benefits, such as medical insurance and pensions, paid vacations and education, as well as profit or rent - disappearance of state-guaranteed benefits, leaving everything "at the mercy" of the patrons - lack of access to public services and social amenities - the disruption and replacement of the norms of reciprocity and responsibility
Relations to the state, seen as a conglomerate of institutions responsible for defining the social structure and social order	- people lose their status of "citizens" and become "denizens", or individuals who are rather "tolerated" on a territory instead of cared for and valued - the lack of citizen empowerment in all fields of action - complete dependence on the will of various state institutions

Defining characteristic	Negative impact
Loss of meaning of the professional status, which used to be a part of social identity	- the need to retrieve and redefine the master status, as the occupation status loses its significance - losing the occupational identity is a major source of frustration and alienation - the emergence of an anomic state, due to the lack of predictability in terms of social structure and social hierarchy - the emergence of social identity problems, which are the source of various mental health problems
Blurred distinction between work and personal time, as subsistence requires more and more effort	- the emergence of the "tertiary time" phenomenon, where there is no clear distinction between private life and work life - the increasing number of "crowd-labor and "zero-hours contracts", with many workers obliged to be ready to perform their increasingly diverse duties at any our - the danger of having a "precariatized mind", or the permanent fear of having too much to do and not enough time
Alienation from labor, as the work activities are rather leading to a self-detachment	- lack of involvement in labor, as a result of being forced to have many small and insignificant jobs to cover their basic needs, or being forced to do too diverse activities at the workplace - the occupation is not only emptied of any value for social status and identity, but also is also lacking any meaning of life satisfaction
Decreased social mobility, mainly due to the lack of opportunities	- the decreased number of jobs narrows the ability of individuals to move between social strata, except for the few "privileged" knowledge and innovation workers - the concentration of the majority of population into a single social class will make meritocracy obsolete
Over-qualification and the decreased value of education, in a world which will be rather centered on hyper-specialization	- the hyper-specialization of those who will remain employed will make many of their skills useless, thus touching upon their work satisfaction and fulfillment - "education for life", compared with education exclusively for a hyper-specialized work, will gradually disappear, posing the danger of humans becoming more similar to robots
Generalized uncertainty, manifested in various fields of life	- in an unpredictable environment, individuals will be unable to predict the probability of risks and even to identify the "unknown unknows", thus becoming more vulnerable - the insecurity of their jobs and their social position within society will also make individuals less resilient to cope with unpredictable and unfavorable events
Poverty traps, deepened and worsened by the precarity traps	- although the social assistance in the welfare states has, for a long time, created no incentives to take low-status underpaid jobs, individuals are now challenged through coercive measures to accept low-wage positions or even unpaid work, otherwise they are labelled as "parasites", thus decreasing their self-esteem and increasing adversity - accepting low-paid and insecure jobs because of state coercion is not only likely to lower monthly wages, but also to decrease the probability of getting a better job later, and even to diminish the self-esteem and endurance of individuals, as the process of obtaining state benefits is becoming more and more difficult and bureaucratized

Source: adapted from Standing (2014b)

All these defining characteristics and their negative impact on the wellbeing of individuals should be of great concern for any state, institution, or company whose main goal is sustainability. Although such problems are not all new, they are nevertheless posing a serious challenge to sustainability, whose main component should be the social one. Moreover, it becomes even more serious when considering that the precariat will englobe more individuals as the robotization and computerization advance. In spite of the benefits of the Fourth Industrial Revolution, there are voices indicating that, in a not so distant future, even the most "creative" occupations, such as writing, will disappear, while much fewer new jobs will be created compared to previous industrial revolutions (Li et al., 2017, 632).

The impact of new technology revolution on labor market is not, by far, the only concern for the social dimension of sustainability, as the future world, characterized by artificial intelligence and automation, has the potential of generating both cultural lags and cultural shocks in terms of people's "identity, morality, ethics, and relationships" (Lee et al., 2018), as well as of posing completely novel vulnerabilities, such as privacy loss, cybersecurity, or hacking (Xu et al., 2018).

4. CONCLUSIONS

The Fourth Industrial Revolution decidedly has the potential of bringing about unseen before changes and opportunities directly linked to the economic and environmental dimensions of sustainability. Such transformations will, most probably, be reflected in a productivity boost, and ultimately in a remarkable economic growth, as well as in a heightened concern for the environment, through designing eco-friendly technologies and practices. At the same time, with regard to the social dimension of sustainable development, the new technological changes have the capability of improving the life of individuals, in terms of both length and quality, by providing them high-end devices and goods, a personalized, state-of-the-art medical care, or even unprecedented means of communication and entertainment.

Nevertheless, the social dimension of sustainability is not limited to consumption, entertainment and health care, but includes many other aspects, such as the right to work and to labour protection, or the need of social identity and of self-worth. Given that the Fourth Industrial Revolution will also bring a significant disruption in the labour market, with millions of jobs lost to robots, it is not clear whether benefits will compensate for losses, as well as whether the gains will be equitable shared, thus ensuring the achievement of the "prosperity for all" primary goal of sustainability. For the time being, the challenges of the Fourth Industrial Revolution to the most important component of individuals' social identity, namely their occupational status, seem to be extremely complicated, therefore requiring the special attention of all the advocates of artificial intelligence and robotization.

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