

# The Challenges and Opportunities of Era 5.0

Subjects: **Others**

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People are in an increasingly disruptive context, in an Era in which the world presents challenging and growing levels of uncertainty, unpredictability, and complexity. As a result, society is facing, at all levels and in all areas, more and more global challenges, challenging its stability and prosperity, whether at a technological, economic, social, environmental, or educational level. The new Era, Era 5.0, which places the human being at the center of innovation and technological transformation, can and must make its contribution to improving the quality of life, solving social problems, and human well-being, with the support of technology.

Era 5.0

Industry 5.0

Society 5.0

## 1. Introduction

During the last decades of human history, technology has made remarkable progress and growth, especially with the introduction of the Internet [1]. The world is in a new era, in which globalization and the rapid evolution of digital technologies such as the Internet of Things (IoT), Big Data (BD), Artificial Intelligence (AI), robotics, 3D printing, Cloud Computing (CC), Mobile Devices (MD), among others, are pushing for major changes in business and society, and creating an entirely new environment [2][3][4][5].

Since the beginning of the 21st century, humanity has been undergoing complex innovative transformations that provide the Era of a phase transition to a new socio-economic process. Thus, the development of human civilization is related to the constantly changing economic formations, and the current social and economic situation is determined by concepts such as Society 5.0 and the fourth and fifth industrial revolutions [5]. For this, technology and innovation need to be used to help humans in their daily lives and advance society—not to replace the role of humans [6]. Thus, Era 5.0 is not only concerned with how tools, methods, and ideas will add better results to the business, but also how these factors can influence everything around organizations, institutions, and societies, adding a more humanitarian and sustainable vision to their processes of society.

Mihardjo et al. [4], in his questionnaire study of senior leaders of ICT companies of Indonesia, with the aim of assessing the concept of an experience-agility innovation model and supporting the transformation in the context of digital transformation to face Industry 5.0, demonstrates a model of transformation that focuses on exploiting the customer experience and organizational agility concept. This can be a source of competitive advantage in Industry 5.0. Carayannis and Morawska-Jancelewicz [7] argue that digitalization opens new perspectives for universities and can become one of the main drivers of their change, producing knowledge for new technologies and social innovation and incorporating the assumptions of Society 5.0 and Industry 5.0.

## 2. From Industry 4.0 to New Era 5.0

The emergence of the industrial revolution 4.0 as a fully digitized industrial era has been a high point since 2018 in forums, debates, investigations, and studies by academics and professionals from the economic, industrial, and social sectors [8]. The fourth industrial revolution (Industry 4.0) is based on the idea of merging the physical and virtual worlds through Cyber-Physical Systems (CPS) [9] and interconnecting humans, machines, and devices through the IoT [10][11][12]. This is also known as a hyper-connectivity revolution as it provides a real-time interface between the virtual and physical world [11]. This is changing companies' strategies, organization, business models, value and supply chains, processes, products, competencies, and stakeholder relationships [13].

Lasi [14] (p. 214) mentions that: "The term Industry 4.0 collectively refers to a wide range of current concepts, whose clear classification concerning a discipline as well as their precise distinction is not possible in individual cases. In the following fundamental concepts are listed: Smart Factory, Cyber-physical Systems, Self-organization, New systems in distribution and procurement, New systems in the development of products and services, Adaptation to human needs, and Corporate Social Responsibility."

In Industry 4.0, the main components include CPS, Internet of Services (IoS), and IoT [2]. The heart of the Industry 4.0 framework is the CPS, which consists of integrating hardware and software in a mechanical or electrical system designed for a specific purpose [10][15]. Industry 4.0 is the bringing together of robots, interconnected devices, and fast data networks within a factory environment, primarily to make the factory more productive and to perform routine tasks that are better done by robots than by humans [16]. It has therefore brought many advantages, such as cost reduction, zero errors with AI-dependent machines, and timely delivery of individualized products to customers [17]. The concept of Industry 4.0 means connecting production machines in the real world with the virtual world of the internet and IT [18].

In Society 4.0, technology simplified the use of information [11][19] that followed the industrial society (Society 3.0) [20]. Social, cultural, and economic activities are centered around people and on interconnected technological innovations that use ICT and allow for the rapid and accurate flow of information anywhere in the world [19]. The creation of a knowledge society that has transformed information into added value, resources, or real knowledge, allows members of society to improve their human condition and their standard of living.

The dynamic development of the fourth industrial revolution, focused on the implementation of Industry 4.0 technologies, raised fears from governments and society regarding the dehumanization of the industry in the future [21]. However, technology and innovation need to be used to help and advance society, not to replace the role of the human being. It cannot replace human emotional intelligence and critical thinking [22][23].

Although the fourth industrial revolution made it possible to many economic, social, and environmental problems, humanity faces serious challenges: there is a risk that human beings could lose control of the development of AI and technological PHC, as well as the risk of social degradation [5]. Although Industry 4.0 is so far not well developed, the world is looking forward to the next industrial transformation (Industry 5.0), the autonomous

manufacturing with Human Intelligence, which in turn will lead to the emergence of the Super-Smart society (Society 5.0) [11]. Through the combination and continuity between the industrial revolution 4.0 and Society 5.0, it can form a better pattern of social order, so as to improve the quality of people's social life.

## 3. Industry 5.0 Challenges

The term Industry 5.0 was first introduced in 2015 [24][25] in an article published by Michael Rada with reference to the social network LINKEDIN [26]. Industry 4.0 is still in an embryonic stage [27][28], but it can already be envisioned as the new paradigm of Industry 5.0, which involves the permeation of AI in the life of man, its cooperation with the aim of increasing human capacity, and the return of man to the "Center of the Universe" [27].

Industry 5.0 is a visionary concept that will have a profound impact on society, governance, human identity, and the economy. It is considered as a transformation of the information society to a super genius society [29]. The vision of an innovative, resilient, socio-centric, and competitive industry that respects planetary boundaries and minimizes its negative environmental impact has been labeled Industry 5.0. This opens up many new challenges related to technology, socio-economy, regulation, and governance [30]. Industry 5.0, which has its roots in the concept of "Industry 4.0", will have a more transformative vision of growth, centered on progress and human well-being, based on reducing and shifting consumption towards new ways of creating sustainable economic value and circular, regenerative, and equitable prosperity [31][32].

Industry 5.0 also increases added value in production and manufacturing by providing creative and innovative solutions [24]. Industry 5.0 products/services, which collaborate between man and machine, are personalized; called the human touch [33] and where there is individualization of human needs [5]. Products like these can only be made through human involvement. Industry 5.0 is a return to pre-industrial production, but one that is made possible by the most advanced technologies that exist [16].

According to the European Commission [30], the technologies that support the Industry 5.0 concept include: human-centric solutions and human-machine-interaction, bio-inspired technologies and smart materials, real time based digital twins and simulation, cyber safe data transmission, storage, and analysis technologies, AI and technologies for energy efficiency and trustworthy autonomy. Industry 5.0 is a digital transformation of the existing era; it is a future that also means that change processes are directed towards closer cooperation between humans and machines [16][24]. The aim of Industry 5.0 is to enable humans to spend more time planning and on strategic tasks [29]. Industry 5.0 will significantly increase manufacturing efficiency and create versatility between humans and machines, enabling responsibility for interaction and constant monitoring activities. Industry 5.0 is a future evolution designed to harness the creativity of human experts working together with efficient, intelligent, and accurate machines [34].

Industry 5.0 is a concept that was conceived to harmonize the workspace and efficiency of humans and machines in a consistent way. Although Industry 5.0 is in adoption, global norms and policies are still evolving to make it an international standard [34]. This fifth industrial revolution is also more beneficial for society, the environment, the

economy, and the planet. The concept of Industry 5.0 aims to reverse the dehumanization of industry, considering the crucial role of man in society and their needs, being closer to sustainable development [21].

## 4. Paradigm in Society 5.0

The transition to Society 5.0 took place during the fourth industrial revolution (Industry 4.0) based on disruptive technologies [5]. This change in the social paradigm brings the challenge to companies to survive and sustain their business to face Society 5.0 [4]. Thus, Society 5.0 brings an industrial transformation due to technological advances in IoT, a sensor technology; BD, obtained through sensor measurements; and AI, which finds and analyzes correlations in DB [15][35]. In the future, people will work on new jobs using IOT/AI/BD that do not currently exist [36]. However, Mihardjo et al. [4] consider that there is little evidence on how a company could build business model innovation and place the human center as a cultural mindset that allows the company to generate new business opportunities, especially in anticipation of the new Society 5.0.

Society 5.0 is a concept with a more synthetic and eclectic content that follows the four previous descriptions of society [20]. It is based on the information society (Society 4.0) and promotes the development of information networks to create value, focusing on the use of technology and digital transformation around the advancement of a human-centered society [37][38]. This digital transformation will drastically change many aspects of society: aspects of private life, public administration, industrial structure, and employment, using cyberspaces and their integration into physical spaces [19].

Society 5.0 is a society where advanced IT technologies, IoT, robots, AI, and augmented reality (AR) are actively used in the industry, in people's ordinary life, healthcare, and other spheres of activity—not for progress, but for the benefit and convenience of each person, seeking to solve social problems with the help of the integration of physical and virtual spaces [19][39]. The concept of Society 5.0 is not just limited to manufacturing factors, but also solves social problems with the help of the integration of physical and cyber (virtual) space [40], in which they are integrated to support a prosperous and eco-friendly society.

The concept of Society 5.0 and Industry 5.0 is not a simple chronological continuation or alternative to the Industry 4.0 paradigm [7]. The basic principle of the Era of Society 5.0 is the solution to the problems created during the Era of industrial revolution 4.0, including the problem of reduced socialization between communities, employment, and other impacts of internalization [40][41]. Society 5.0 is the 'Imagination Society' where industrialization will be the central factor of transformation and technological advances [11]. Society 5.0 has a special focus of placing the human being at the center of innovation, technological transformation, and industrial automation, stimulated by Industry 4.0. This new paradigm of Society 5.0 will play a predominant role in creating a happier, more satisfied, fulfilled, and consequently more productive society. The use of technology for the benefit of society has promoted a new industrial revolution called Society 5.0 [15]. The motto of Society 5.0 is a "human-centered society" [20].

Society 5.0 and Industry 5.0 both reflect a fundamental shift of societies and economies towards a new paradigm to balance economic development with solving social and environmental problems, creating social well-being and

matching skills, where importance is given to knowledge, to address the challenges associated with human-machine interactions [2]. The objective necessity of the development of modern human civilization is the transition to a new socio-economic formation, including the urgent capacity to reproduce resources and recycle waste [5].

## 5. The Changes Resulting from Education 5.0

Education has been influenced by the new technologies of Society 5.0, which has led to critical structural changes. The technologies of Modern Society 5.0 have fostered digital teaching with videoconferencing and virtual reality tools, thus reaching more students simultaneously without the physical limitations of the classroom [19].

Industry 5.0 can benefit the workforce through a re-skilling of employees from manual to cognitive work, providing value-added tasks at work alongside an autonomous workforce, i.e., collaborative robots (cobots) that will be perceptive and informed about human intention and desire [42]. However, the impact of the collaborative workplace on workers, associated with the concept of Industry 5.0, has not been sufficiently studied [43].

Industry 5.0 promotes more skilled jobs compared to Industry 4.0, as intellectual professionals work with machines. Industry 5.0 mainly focuses on mass customization, where humans will be guiding robots [34][42]. Creating the conditions for social progress is a complex social task and Industry 5.0 aims to solve this problem, aiming at the “personalization” of production and consumption, satisfying personal needs, ensuring their development (the SDGs) [5].

The demand for skills is evolving as rapidly as technologies [32]. Specialists in systems engineering, new training programs, including programming education, will be needed [36]. Industry 5.0 requires social innovation to increase prosperity and promote good quality jobs, along with measures to support education and skills training to enable workers to adapt to a changing labor market [44].

The environment and learning atmosphere in the digital era are changing very quickly. One of the biggest changes is the widespread use of the internet, which is also used in learning [45]. The digital transformation and the generalization of digital technologies have increased the social complexity, with some negative aspects such as security risks (cyber-risks) and implications for the privacy of individuals, and hence, the need for regulation [28][32].

The Education Society 5.0 system promotes the design of training processes that facilitate the development of skills not only for work, but also for the consumption of culture, adaptation to environments in continuous change, data processing, interaction with our environment and with others, along with personal and social development [19]. Education and training have an important role in the improvement of new skills and abilities. Only this way will the so-called 5.0 Society be improved, a society centered on people, in which all citizens are intended to get involved in a dynamic way, introducing digital technologies for the benefit of the quality of life [46]. Technical skills will be far less important in the future, with personal skills (soft skills) becoming more critical. In addition to technology, digital, and data acumen, soft skills (including the art of communication and also the ability to think in a creative and critical manner) are also going to be increasingly in demand [33].

Creating immersive and interactive educational experiences is a real challenge for educators, especially those without technological knowledge and those who do not see the importance of investing in the creation of technology-based educational content [1]. We are experiencing the sophisticated integration of cyberspace, information, and physical space (real world) to be formed by Society 5.0, centered on human beings, on people. This new type of super-intelligent society will be characterized in a society where different occupations are finely differentiated and fulfilled [29][47]. The smart society will be equipped with a new version of Education and Educators 5.0, who are likely to lead the world. Human beings, rather than being replaced, will be equipped with collaborative and cooperative intelligent robots to efficiently perform the tasks undertaken. This new super-intelligent society will be enriched with human touch personalized products [11].

Education 5.0 will enable an individual to master the skills of how to learn, unlearn, and relearn to adapt and embrace the ever-changing environment of the technical world. Education 5.0 would be personalized, which would improve the learning process and prepare students to withstand and face the uncertainties of the future with their enriched skill sets—communication, leadership, resilience, curiosity, understanding, critical, and creative thinking—which will allow for the sustainable creation of new values and services to benefit and balance society as a whole [11]. Some of the requirements for the fifth-generation education transformation (Education 5.0) are 21st century skills: Learning Skills, Literacy Skills, and Life Skills [48]. Students are expected to have the six basic literacy skills (numeracy, scientific literacy, information literacy, financial literacy, cultural literacy, and citizenship) and other skills such as thinking critically, reasoning, being creative, communicating, collaborating, having problem-solving skills, and most importantly, having curiosity, initiative, persistence, adaptability, leadership, and social and cultural awareness [35].

## 6. Conclusions

Era 5.0 is a true revolution of society and humanity focused on quality of life, human, social, environmental, and economic well-being. These topics, after the impact of the pandemic, climate change, war, social divisions, cyber risks, among others, are at the top of the agenda and deserve more attention and concern from politicians, organizations and communities.

Thus, the Industry 5.0 concept is an evolution of the Industry 4.0 concept, which uses emerging technologies and applications to harmonize the virtual and physical world, placing the human value at the center of the problem. In this way, we will have a society (Society 5.0) with technologies and infrastructures focused on the human being and on solving social and environmental problems, that is, a society based on sustainability, human value, and resilience. However, although technology does not stop providing changes in industry, society, and education, it is not enough to promote the expected improvements in humanity. In this scenario of rapid evolution, transformation, and technological change, there is a need for new learning and skills in education. Thus, Education 5.0 emerges, which must develop in the student/training other skills and competences in an integral and human way, focusing on collaboration between peers and the community, relevant to the improvement of people's lives and the social and humanity well-being. And the combination of Industry 5.0 and Society 5.0 can improve the quality of people's social life, forming a better standard of social order.

Future studies may seek to demonstrate, through case studies, the real contributions of different actors in society to a future society centered on human beings, social responsibility, and sustainable development, as well as to analyze whether industry and education, in particular, are moving towards close cooperation in favor of quality of life and economic, social, and environmental well-being, in accordance with the SDGs.

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