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Society 5.0, beyond Industry 4.0. A documentary investigation with a national perspective

Sociedad 5.0, más allá de la Industria 4.0. Una investigación documental con perspectiva nacional

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Abstract

This article offers a contribution to the understanding, structure, and relationship of Society 5.0 with Industry 4.0, emphasizing the implications that these social phenomena have for Mexico. The paper examines multiple perspectives and aims to stimulate further inquiry and discussion, without prescribing specific solutions or recommendations. A qualitative documentary research of a critical and interpretive nature was carried out that reviewed the documents of the last five years regarding three focal themes: Society 5.0, Industry 4.0 and Sustainable Development Goals (SDGs). The findings indicate that Society 5.0 is a Japanese counterproposal to the global implementation of Industry 4.0 and the World Economic Forum's Globalization 4.0 strategy. It aims to achieve technological hegemony through the implementation of cyber-physical systems and the alignment of its social purposes with those outlined in the SDGs by the UN. In the case of Mexico, the development strategy towards the 2030 Agenda does not contain elements of encounter with those delimited by Society 5.0, in addition to which COVID-19 has made the global and national context more uncertain and turbulent.

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Palabras clave:
Industria 4.0, Sociedad 5.0, Objetivos de Desarrollo Sostenible, trabajo, educación.

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Resumen

Este artículo ofrece una contribución a la comprensión, estructura y relación de la Sociedad 5.0 con la Industria 4.0, haciendo hincapié en las implicaciones que estos fenómenos sociales tienen para México. El documento examina múltiples perspectivas y tiene como objetivo estimular una mayor investigación y discusión, sin prescribir soluciones o recomendaciones específicas. Se llevó a cabo una investigación documental cualitativa de carácter crítico e interpretativo que revisó los documentos de los últimos cinco años con respecto a tres temas principales: Sociedad 5.0, Industria 4.0 y Objetivos de Desarrollo Sostenible (ODS). Los hallazgos indican que la Sociedad 5.0 es una contrapropuesta japonesa a la implementación global de la Industria 4.0 y a la estrategia de Globalización 4.0 del Foro Económico Mundial. Su objetivo es alcanzar la hegemonía tecnológica mediante la implementación de sistemas ciberfísicos y la alineación de sus propósitos sociales con los delineados en los ODS por parte de la ONU. En el caso de México, la estrategia de desarrollo hacia la Agenda 2030 no contiene elementos de encuentro con los delimitados por la Sociedad 5.0, además de que la COVID-19 ha vuelto el contexto global y nacional más incierto y turbulento.

Introduction: the global panorama in the face of Industry 4.0

Today, the manufacturing industry is undergoing a significant digital transformation characterized by rapid changes in economy and production efficiency, has far-reaching effects on various aspects of society. Similar to past industrial revolutions, this ongoing technological revolution fundamentally alters human life and work processes, integrating information technology into everyday life through digitization (Ellitan, 2020). Undoubtedly, the prominent influence for this transformation is the German-led strategy known as Industry 4.0. This industrial paradigm focuses on creating value through digitization and connectivity in factories and production networks (Veile *et al.*, 2019). The key aspect of sustainability and development in Industry 4.0 lies within effective information exchange between companies, machines, and individuals (Sarfraz *et al.*, 2021). As a result, organizations are implementing changes to their structure to remain competitive and adaptable to market dynamics.

The implementation of Industry 4.0 has brought along both advantages and challenges for companies. Among the advantages are cost reduction, personalized products, as well as sustainable products and manufacturing processes (Zengin *et al.*, 2021). However, the implementation at the organizational level needs to consider dimensions such as culture and communication, human resources IT and interdisciplinary competencies, company organization and data security, and work safety (Veile *et al.*, 2019). Across the globe, countries influenced by Industry 4.0 have embraced its paradigm in diverse ways, resulting in a geopolitical landscape shaped by technological dominance. Each nation

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has put forth its unique interpretation of Industry 4.0, devising strategies to implement technology and its derivatives within their respective borders.

The success of Germany's proposition can be inferred from the World Economic Forum's Globalization 4.0 initiative launched in 2019 —an indication of transitioning towards globalized structures incorporating new technologies to create an equitable and promising world free from inequality. However, significant challenges lie ahead that must be overcome through concerted efforts driven by the same fervor propelling digital advancements forward.

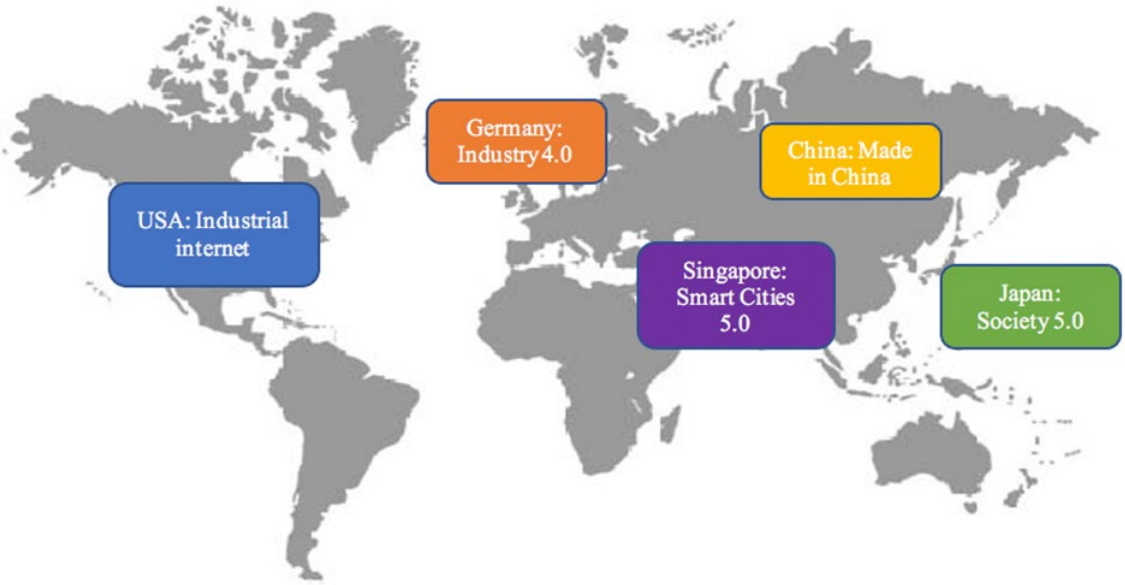

Figure 1. Global digitalization strategies.
Source: Author's creation.

Within this context, the concept of Society 5.0 originates from Japan and presents itself as an alternative proposition that expands its scope to encompass the entire society. It strives to engage with the international community by aligning the goals of Society 5.0 with those outlined in the United Nations Sustainable Development Goals. This innovative socio-technical model was first launched on January 22, 2006, by the Japanese government as a part of the 5th Science and Technology Basic Plan (Deguchi *et al.*, 2020). The concept of Society 5.0 envisions a future society driven by scientific and technological innovation that aims to improve the quality of life for its citizens, foster sustainability, and address societal challenges.

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Given the rapid advancements of these two socio-technological paradigms and their global impact, it is pertinent to explore the potential consequences these changes may have for countries that are considered underdeveloped. Mexico, like many other developing countries, stands at a critical juncture where it can leverage the benefits of both Industry 4.0 and Society 5.0. To achieve this, it is necessary to understand Mexico's position in key areas that are crucial for the integration of socio-technological innovations driven by phenomena like education and infrastructure.

The purpose of this article is two-fold: firstly, it aims to analyze the relationship between Industry 4.0 and Society 5.0 as driving forces of global technological and societal transformations. Secondly, it seeks to provide food for thought on the implications of these paradigms for Mexico, specifically in terms of its current situation and planning regarding pressing societal issues such as education and work. The study at hand does not pretend to give specific advice or solutions to Mexico's social challenges but rather invites to reflect on the changes in paradigm that Industry 4.0 and Society 5.0 are proposing.

This work is organized as follows: the first part addresses the emergence of the notion of Society 5.0, its main configurative elements, and the challenges that the Japanese government has identified during its initial implementation. Secondly, the main meeting points and continuity between this notion and Industry 4.0 are established. Finally, a discussion of the panorama of this last industrial revolution is presented considering the Mexican development of a strategy of technological and social growth, using the Sustainable Development Goals as a focal point of comparison and with a focus on two transcendental issues in which that without a doubt Industry 4.0 has already had consequences locally: education and work.

Methodology

A state-of-the-art documentary research methodology was designed to locate and analyze the scientific literature on these two social phenomena. As a national strategy for the implementation of technological advances, Society 5.0 was presented in 2016, so the literature publication period was delimited to the period between 2016-2023. To address the two central phenomena from the local perspective, documents referring to the Sustainable Development Goals were analyzed as common variables between the three main points of the document, namely: the conceptualization of Society 5.0, its relationship with Industry 4.0 and the perspective national. Therefore, the concepts and themes on which the literature search focused were Society 5.0, Industry 4.0, Sustainable Development Goals (SDGs), Mexico. Regarding synthesis methods, the document is structured by points or thematic sources, as considered necessary.

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Society 5.0: a human-centered super-smart society

What is the Society 5.0?

Society 5.0 was first introduced by the Japanese government as a model to communicate its vision on the future of society and the integration of technological advancements. This concept was developed in response to the recognition that the digital revolution would bring about a disruptive transformation of industrial and social systems, necessitating preparation by nations for these impending changes. This phenomenon of Super-smartification, defined as "a situation where the use of Big Data and other new value-generating processes lead to seismic changes in the very fabric of society" (Gonokami & Nakanishi, 2020, p. 146) is the starting point of the Japanese effort to lead the process of societal change.

Like other countries, Japan faces various complex societal problems that require not only social reforms but also innovative solutions. Hence, social innovation became the purpose of the development of technologies and services aimed at tackling complex social issues. In this sense, Society 5.0 aims to define an ideal development situation for each country to take advantage of the continuous technological transformations for the benefit of all its citizens under the precepts of sustainability centered on the human being. The line of development of human society can be divided into five different stages, starting with the emergence of humanity and its capabilities as hunters, until Society 4.0 or information society, during which the use of data and creation of information are the main means of development.

The development of human societies shows the advancement of technologies and the organization of societies (figure 2).

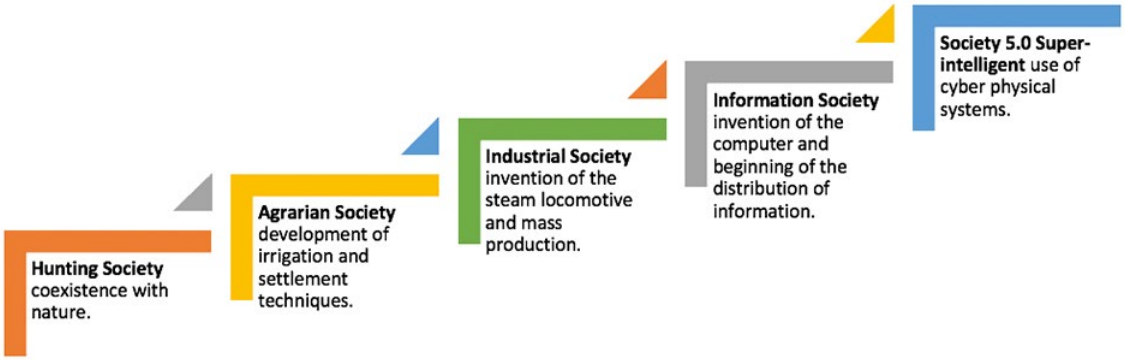

Figure 2. The development of human societies.
Source: Adapted from Harayama (2017).

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In the transition from Society 4.0 to Society 5.0, the purpose is to alleviate the negative impacts of Society 4.0 in search of a better quality of life and well-being, betting on the integration of man with machines through advanced technologies and cyber-physical systems. These changes include passing from efficiency to value creation, embracing diversity, creation of resilience and the focus on sustainability and environmental harmony (Nakanichi & Kitano, 2018).

Key concepts of Society 5.0

The basic technological schema behind Society 5.0 is an "iterative cycle in which data are gathered, analyzed, and then converted into meaningful information, which is then applied in the real world" at a society-wide level (Deguchi *et al.*, 2020, p. 3). This iterative cycle of data gathering, analysis, and application is facilitated by the integration of cyberspace and physical space, allowing for the generation of information that is then applied to real-world environments in real-time. This schema is supported by core concepts such as "human-centeredness", "merged cyberspace and physical space", "knowledge-intensive society", and "data-driven society" (Deguchi *et al.*, 2020), which we will describe briefly below.

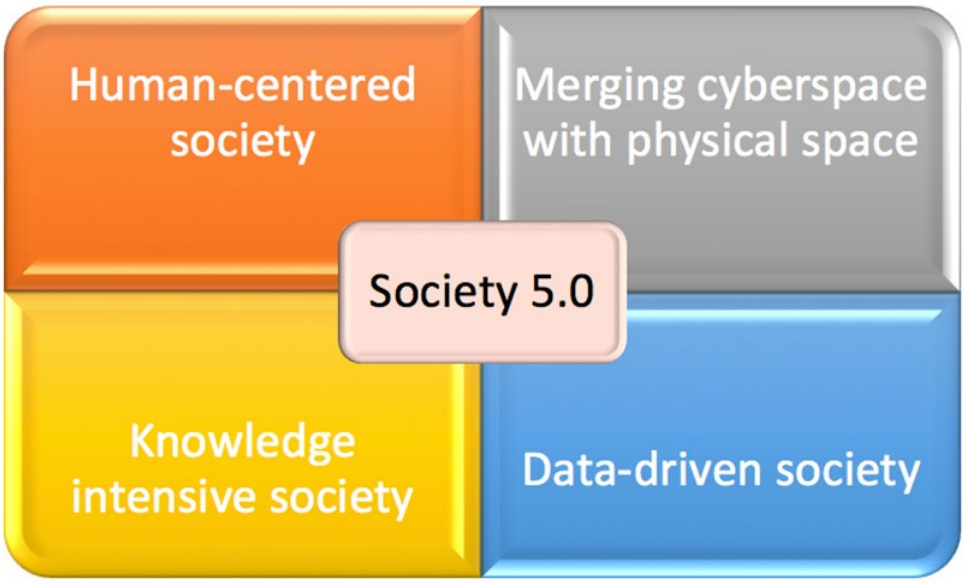

Figure 3. Key concepts underlying Society 5.0.
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- *Merging cyberspace with physical space*: within this framework, the concept of cyberspace expands beyond its conventional definition as a mere platform for the transfer of large quantities of digital information. It encompasses the virtual space formed by computer networks which not only facilitates data analysis but also enables simulation-based problem-solving that emulates real-world scenarios. Hence, "the ultimate objective of Society 5.0 is to incorporate real-world models into cyberspace such that they can deliver highly nuanced solutions to real-life problems" (Deguchi *et al.*, 2020, p. 3). Through this hiper-interconnection of cyberspace and physical space, more sophisticated services, and products with much greater value in the real world can be developed.

- *A human-centered society*: this concept emphasizes the need to balance the best interests of society with the best interests of individuals. In the Habitat Innovation framework, such balance is achieved by following three key performance indicators: structural transformation, technological innovation, and quality of life (Matsuoka & Hirai, 2020).

- *Knowledge-intensive society*: under this paradigm, there are three divers of social innovation: data, information, and knowledge. Hence, value is created from knowledge spaces where data and information are collected, interpreted, and utilized through knowledge (Deguchi *et al.*, 2020).

- *Data-driven society*: in this society, data that is gathered by Internet of Things networks (IoT) are converted into information and then knowledge which then moves (or influences) the real world. It does so in two different ways. First, indirectly through informing and guiding humans in their decision-making processes based on the insights derived from the data. Secondly, without the mediation of human intervention, utilizing artificial intelligence and automated systems to directly influence the physical world.

Elements for the Establishment of Society 5.0

The idea of Society 5.0 arose from the Japanese need to work on social problems specific to their nation, but which could set precedents in their resolution worldwide. According to the United Nations (2021), the population of Japan in the period between 2015 and 2020 decreased by 0.7 million people and is expected to decrease by 22.1 million people by 2050. In the case of the working-age population from 15 to 64 years old, there has also been a decrease since the beginning of 2000. That is, between 2010 and 2015, its population has seen reduced by 4.2 million people and it is estimated that it will plummet by almost a third by 2050. Other less pressing factors, but still significant include the increment in the population concentration in cities and the decrement of the

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population in rural communities; the labor shortage and the low wages; the tax revenue decrement which poses challenges for social security systems; and finally, the shift to renewable energies (Matsuoka & Hirai, 2020).

In alignment with their work culture, the Japanese propose to focus on the root causes rather than trying to alleviate the symptoms. They intend to do so in Society 5.0 by, for example, including the elderly population in the labor field, using their experience by giving them flexible and digital work opportunities, as well as monitoring their health through cyber-physical and Artificial Intelligence (AI) health systems. Another meaningful example is in the field of climate change and disaster management where Society 5.0 intends to develop cyber-physical systems and technologies to be able to predict earthquakes, tsunamis, and climate changes with greater precision and at an earlier stage, and to respond more efficiently when disasters strike (Mavrodieva & Shaw, 2020).

As we have mentioned, the milestones of Society 5.0 thinking are rooted in Japanese culture. The concept of *Wa* is a fundamental cultural value that forms the foundation of this new paradigm. Its meaning can be translated as "harmony" or "peace", and it has deep roots in Japanese culture, originating from Confucianism in Chinese philosophy. From the first Japanese constitution, it was declared that *Wa*, understood as group harmony, would occupy a privileged place in the value system of that society. The Japanese want to promote new science and technology based on three features of the *Wa* concept, which we explain below.

- *Object*: community and society. The focus of science and technology is not on individuals, but rather on society. The participants in this field combine and interact in an organic way, resulting in the discovery of new values that benefit both individuals and the collective entity (Sawaragi, Horiguchi & Hirose, 2020).

- *Objective*: harmony. Create harmony with society, making the best use of people's skills and natural resources. The objective is to solve social problems by incorporating technological innovations and the collaborative economy in industry and social life (Sawaragi *et al.*, 2020).

- *Means*: feedback. Complex feedback structures are composed of many interactions, where data is the lifeblood of learning systems (Sawaragi *et al.*, 2020).

It is also important to examine the implications for working conditions that arise because of the changes brought about by Society 5.0. This analysis is crucial not only because it constitutes a key aspect of social activity, but also because the major transformations resulting from Industry 4.0 have primarily taken place in manufacturing industries and pertain to production organization, encompassing changes in employee

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roles and responsibilities. Thus, Industry 4.0 –along with the COVID-19 pandemic– has had a strong influence on changes in current working conditions, starting, of course, from the transfer from the office to the home.

In this sense, Society 5.0 also represents substantial transformations in work environments to adjust and empower its aging workforce through health initiatives that ensure employees' health. This would be achieved through constant monitoring of health variables at work along with the use of Artificial Intelligence and machine learning. The process begins with the recollection of large amounts of data from people, machines and tasks using IoT and other portable sensors. Then, using techniques such as statistics, it is possible to predict the risk of deterioration of physical function or the lack of adaptation in collaborative work between humans and machines. Thus, it could be possible to make personalized recommendations to workers based on their various abilities, and at the same time improve the machine control system by intervening with people providing personalized recommendations and care (Sawaragi *et al.*, 2020).

Society 5.0 implementation challenges

The Japanese government along their private industry have identified several challenges in implementing Society 5.0. Such challenges have been called walls, as they pose a barrier that prevents the successful deployment of Society 5.0. The five walls for implementing Society 5.0 identify these issues (figure 4).

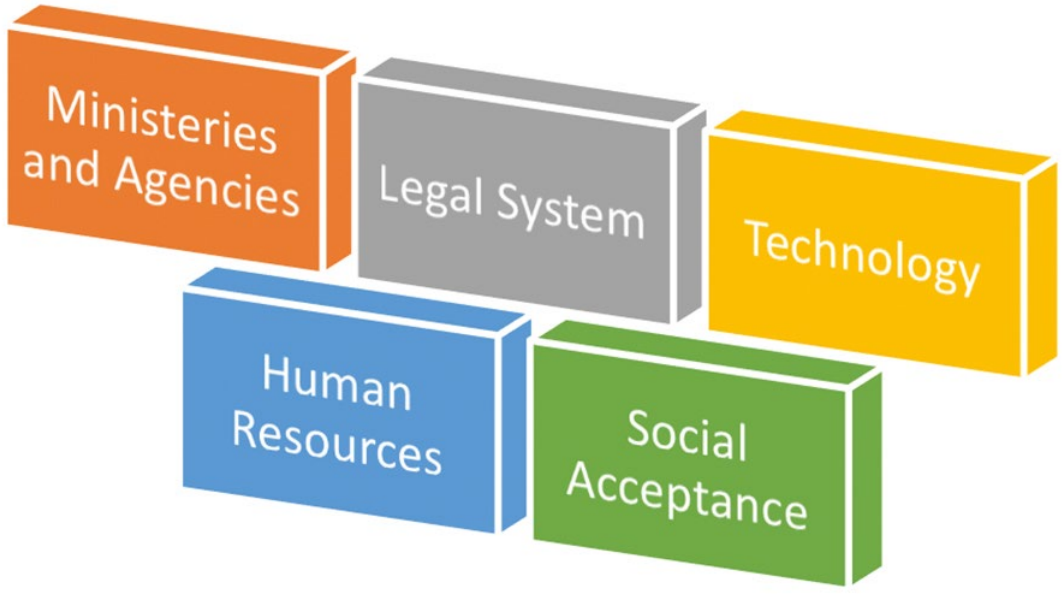

Figure 4. The five walls for implementing Society 5.0.
Source: Nagasato, Yoshimura & Shinozaki (2018).

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The ministry and agency wall identifies the challenges regarding the necessary integration of government ministries and agencies to align their policies and initiatives with the goals of Society 5.0 and to promote national strategies that are flexible and comprehensible (Nagasato *et al.*, 2018). The requirement of strong laws that support the implementation of innovative technologies (Alvarez-Cedillo *et al.*, 2019) is represented in the wall of the legal system. Current regulations hamper innovative technologies from being fully utilized and integrated into society, such as next-generation cars, drones, and robots; therefore, there is a call to take into account the voices of citizens in the promotion of such new laws (Nagasato *et al.*, 2018). The wall of technologies addresses the foundation of knowledge (Alvarez-Cedillo *et al.*, 2019) necessary to continue and expand the scale and topics of innovative government research and development projects as well as to reform the national innovation strategy (Nagasato *et al.*, 2018).

Another key challenge is the wall of human resources, which refers to the need for a skilled and adaptable workforce that can effectively utilize and adapt to the technologies and changes brought about by Society 5.0. The educational topics vary from new values creation to creativity and IT literacy, as well as the necessary training and education for professionals in cybersecurity, data science, and international standardization (Nagasato *et al.*, 2018). The last one, the wall of social acceptance, highlights the importance of gaining public trust and acceptance of Society 5.0. Drawing on the knowledge available in the humanities and social sciences, industry, academia, and government should promote analysis of the ethical, legal, and social implications as techniques are developed (Nagasato *et al.*, 2018).

The challenges faced by Japan in creating Society 5.0 are specific to the nation, but other countries and regions will have their unique obstacles that must be addressed based on their capabilities and resources. It is important to acknowledge that this model has certain drawbacks from the outset. Such drawbacks include the complex technological leap from 4G to 5G, the increment in cybersecurity threats, and the environmental pollution due to the technology and hardware actualization (Narvaez-Rojas *et al.*, 2021).

The Sustainable Development Goals: the pivot for the articulation of Society 5.0 implementation policies

In 2015, the United Nations adopted 17 Sustainable Development Goals, aimed at addressing social issues and improving the quality of life while promoting economic growth and sustainability. These goals where established with the overarching principle of achieving peace and prosperity for all individuals and the planet by ensuring that technological advancement is inclusive. The main purpose of this agenda is to foster collaborative advancement between governments and citizens, mitigating the detrimental effects of

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social inequity. As a result, numerous nations have aligned their investment and research efforts with the objectives outlined in this Agenda, recognizing sustainability and societal development as fundamental pillars. Japan has embraced the concept of Society 5.0 as a way of intertwining technology and society to achieve the goals set forth by the SDGs.

In addition, Society 5.0 provides a blueprint for other countries to achieve the SDGs in a standardized manner. By adopting the principles of Society 5.0 and integrating them with their national contexts, countries may effectively address social issues and contribute to sustainable development. This approach not only promotes economic growth but also harnesses the potential of digital transformation to create innovative solutions that coexist harmoniously with nature and in alignment with each country's culture. Thus, by embracing the vision of Society 5.0, nations worldwide can work towards achieving the SDGs and building a more sustainable future.

The alignment to SDGs has proved to be important in attracting active investment and revitalizing the economy (Gonokami & Nakanishi, 2020), and they play a central role in the establishment of a unified global perspective. Furthermore, SDGs have served as a higher-level vision for students and researchers in the development of their ideas. Business leaders are also increasingly realizing that the challenges related to the environment and energy are fundamentally related to pressing social issues, such as poverty (Gonokami & Nakanishi, 2020).

The Synergy between Industry 4.0 and Society 5.0

The concept of Industry 4.0 emerged as a response to the need for increased automation and digitization in manufacturing processes. It passed as a national strategic initiative to deploy IoT in manufacturing to enable cyber-physical systems (CPS) and create a more efficient and interconnected production ecosystem that can add more value to production activities (Kagermann, Wahlster & Helbig, 2013). Under Industry 4.0 paradigm, to optimize production processes, smart factories utilize IoT devices to collect data at every stage in the physical realm. This information can then be analyzed in cyberspace to derive optimal solutions and then fed back into real-world factory control systems.

Industry 4.0 soon gained global traction mainly due to its underlying principle of deployment of IoT in manufacturing, hence, it is now called the Fourth Industrial Revolution. Industry 4.0 focuses on establishing a cyclical process of data, information, and knowledge exchange within various sectors and organizations related to manufacturing. This includes the collection and sharing of diverse types of data, such as design information, customer data, and supplier-related data. It becomes obvious that there are

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some commonalities between Industry 4.0 and Society 5.0. Comparison between both summarizes the main similarities and differences between Industry 4.0 and Society 5.0 (table 1).

Table 1. Comparison between Industry 4.0 and Society 5.0.

Characteristic	Industry 4.0	Society 5.0
Aim	• Smart factories.	• Super intelligent society.
Area of interest	• Industry.	• Society (including industry as part of the former).
Keywords	• Cyber-physical systems. • Internet of Things. • Mass customization.	• High-level convergence between cyberspace and physical space. • Balance of economic development with the resolution of social problems. • Human-centered society.
Design	• High-Tech Strategy Action Plan for Germany 2020 (BMBF, 2011). • Recommendations to implement the Industry 4.0 strategic initiative (Kagermann *et al.*, 2013).	• 5th Basic Science and Technology Plan (2016). • Comprehensive science, technology, and innovation strategy for 2017 (2017).

Source: Autor's creation.

Both visions prioritize the integration of technology, specifically IoT-related technology, AI, and Big Data analysis. Additionally, both initiatives follow a top-down approach led by the state with collaboration between industry, academia, and the government sector (Deguchi *et al.*, 2020). However, there are also meaningful differences. While Industry 4.0 is effective in the manufacturing arena, Society 5.0 chooses the entire society as its scope. Furthermore, Society 5.0 addresses social issues such as healthcare, poverty alleviation, improved access to resources like water and food, advancement in agriculture practices, and promotion of gender equality. On the other hand, Industry 4.0 aims primarily at cost reduction and enhancing production efficiency within the industrial sector.

Regarding the role of human labor, Industry 4.0 pretends to substitute human work with advanced technologies like sensors, robots, and AI. There is a shift in Society 5.0 where technological innovations can be utilized by society in alignment with SDGs (Zengin *et al.*, 2021). Society 5.0 also aims to address the challenges encountered during the implementation of Industry 4.0 in the manufacturing sector. Some of those issues include the skills gap in human resources, security concerns surrounding communication technology, ensuring the stability of production machinery, resistance to change among stakeholders, and job displacement resulting from increased automation (Ellitan, 2020). Nevertheless, it is important to acknowledge that the full effects of implementing Industry 4.0 and Society 5.0 are still unclear, including the possibility of integrating both strategies to achieve more ambitious objectives.

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Future Perspectives: Mexico in the Era of Industry 4.0 and Society 5.0

One of the challenges in analyzing strategies for technological change, especially at a local level, arises from the disparity of contexts related to fundamental concepts. For example, given the limited level of internet connectivity in Mexico, it becomes challenging to analyze the potential implications that the implementation of cyber-physical systems might have in this context. However, it is essential to examine the impacts that Society 5.0 will have on education and employment. This is crucial because global manufacturing trends have led to the outsourcing of production in various countries with varying levels of development –educational, technological, economic–, giving certain nations like Mexico a competitive edge due to lower labor costs. In this regard, understanding the potential consequences of these interconnected issues –such as the inability to adapt existing skills and abilities to this new labor model– in Mexico presents an opportunity to gain insight into the envisioned landscape of becoming a "first world" nation.

In Mexico, there are 55.7 million people in poverty (CONEVAL, 2021), which makes it a significant problem that requires attention. To effectively address this issue, it is crucial to consider both technical and social aspects. Merely addressing the symptoms of poverty will not lead to its eradication; instead, a deeper understanding of its root causes from a societal perspective is necessary (Gustiana, Wahyuni & Hasti, 2019). Poverty is a multifaceted issue that stems from various factors including economic inequality, social challenges, inadequate education, and limited access to communication and technology. This information highlights the disparities between the context of the country that pioneered Society 5.0 and Mexico, underscoring the inequality in technological advancement. Nevertheless, considering the impact of globalization, technological advancements, and the changes in work conditions after the COVID-19 pandemic, it is unavoidable that our social and work environments will be affected by attempts to implement such extensive technological and social transformations. The most recent *Informe Nacional Voluntario 2021. Agenda 2030 en México* from the Ministry of Economy offers valuable insights into how education and employment matters can intersect with the principles of Society 5.0.

The impact of Society 5.0 on employment in Mexico

According to the SDGs, decent work includes opportunity, income, rights, participation, recognition, family stability, personal development, gender justice and equality (Bagaric & Franca, 2021).

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In Mexico, having a job does not guarantee that people can escape poverty. The continued lack of decent work opportunities, insufficient investment and underconsumption has made difficult the advancement of all members of society, creating inequities that increase continuously. The country will continue to face difficulties in creating high-quality jobs. This challenge is further complicated by the existing disparities in infrastructure, research and development in science and technology, as well as low levels of education. The emergence of Industry 4.0 and Society 5.0 adds another layer of complexity to this issue. Mexico, in line with "SDG 8: Decent Work and Economic Growth", has established the National Network of Nodes to Advance the Social and Solidarity Economy.

This initiative aims to implement public policies that promote and foster the social sector of the economy, ultimately contributing to the creation of an economy that serves people's needs and promotes the common good (Ministry of Economy, 2021). This approach aims to establish partnerships among academic institutions, local governments, and Social Sector Organizations of the Economy. These alliances create a network called Nodes for Promoting the Social and Solidarity Economy. The National Network currently consists of 167 allies spread across 40 NODESS in 23 states across the country. This network is composed of 55 higher education institutions, 46 local governments, 48 Social Sector Organizations of the Economy, and other entities that play a role in promoting social decent work (Ministry of Economy, 2021).

The workplace and labor market have undergone significant changes due to demographic change, ICT innovation and diffusion, as well as the COVID-19 pandemic. One example of these changes is the gender disparity in labor participation, where globally men tend to participate more than women. This gap had been progressively closing in recent years but has unfortunately widened again during the COVID-19 pandemic, leading to a regression in terms of gender equality at work. The optimal integration of women into labor markets is crucial for sustainable economic growth at both national and global levels, as they represent significant human capital.

By effectively utilizing the skills and knowledge of women, poverty can be reduced, gender and income inequality can be addressed, and there will be an increase in economic growth, per capita income, better governance practices, business performance, innovation opportunities, and social welfare. This integration also contributes to the overall goal of achieving sustainable development (Bagaric & Franca, 2021). Mexico is promoting gender equality through various programs aimed at empowering women and girls. These initiatives involve the design, planning, and implementation of inclusive policies in both public and private sectors. Led by women in collaboration with local feminist organizations, these efforts prioritize the creation of inclusive spaces for women's advancement.

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However, these empowerment initiatives do not specifically focus on developing the skills necessary for success in Society 5.0. While the government's efforts are commendable as they aim to empower women within their immediate local and national contexts, there remains a need to address the integration of Mexican society into new work parameters associated with evolving technological advancements such as Society 5.0. In addition, considering that even before COVID-19 the world economy had already slowed down and the year 2020 was so disastrous for economic activities (United Nations, 2021), it is essential to reconsider and take advantage of any contribution that local and state governments can do so that citizens can access a job, in any industry and circumstance.

The need for isolation has also contributed to the transformation brought about by digitization in existing jobs. This transformation requires individuals to acquire new skills to adapt to and perform new tasks, which may lead to a reorientation or replacement of the current workforce. Digitization not only generates new job opportunities but also renders certain jobs obsolete. It brings about substantial changes in work conditions and sets new boundaries for production, distribution, and consumption (Bagaric & Franca, 2021).

In response to the demands of digitization, employment policies in Mexico must address the effects of digitization on unemployment, particularly for individuals with low levels of education. To address unemployment and minimize its effects, it is imperative to approach education from a comprehensive perspective. This entails establishing effective structures that facilitate the acquisition of essential skills and knowledge. Collaboration between governments, employers, and unions both at local and national levels is necessary to achieve this objective.

Mexican education considering Society 5.0

In the context of education, even before the occurrence of COVID-19, there were already concerns regarding global progress in meeting literacy and numeracy targets. In 2019, only 59% of third-grade students demonstrated proficiency in reading. Unfortunately, it is projected that because of the pandemic, an additional 101 million children (representing approximately 9% of those enrolled in primary and lower secondary school) will fall below the minimum threshold for reading proficiency. Consequently, this would bring the total number of students struggling with literacy skills to around 584 million by the year 2020. Given this situation, it raises questions about how Society 5.0 can successfully implement cyber-physical systems incorporating Artificial Intelligence if such a significant proportion lacks the basic reading abilities needed to improve their quality of life.

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To align with the demands of Society 5.0, Japan is considering making two changes in its educational system. Firstly, they are exploring the implementation of a more flexible grade progression model which includes support classes to ensure that students grasp and understand key concepts. This approach aims to prevent students from losing an entire academic year due to struggling with a single course. Instead, students would be able to advance to the next grade while still learning and addressing any gaps in knowledge from previous courses. Additionally, there is a push towards removing existing barriers between subjects and disciplines within the curriculum. For instance, mathematics, data science, and programming are being proposed as fundamental requirements alongside subjects like philosophy and languages (Secretary of Foreign Relations, 2019). In Mexico, the government does not currently address these changes.

The issue of poverty in Mexico directly impacts children's ability to learn. As a result, programs initiated by the Ministry of Public Education focus on ensuring that children and young people have access to education without experiencing hunger. To foster a symbiotic connection between education and employment, it is imperative to increase the engagement of individuals in ongoing educational opportunities and training. Continuous education and training play a critical role in enhancing livelihoods and cultivating a workforce that possesses resilience against economic disruptions while remaining adaptable amidst technological advancements. However, achieving gender parity in educational participation rates remains an unfulfilled goal for most UN countries.

Furthermore, it is essential to recognize the link between women's access to education and their participation in the labor market. In Mexico, initiatives are being implemented to promote gender equality and empower women in the digital transformation era. One such program is "Women in Digital Transformation", which offers a comprehensive 60-hour training program aimed at enhancing the participation of women in productive sectors through business development, as well as improving their digital and financial skills. This initiative places importance on economic empowerment while also addressing issues like self-confidence, gender equality, and empowerment. It seeks to bridge the gender gap by providing equal access to educational opportunities and enabling participation of women in the workforce.

With the shift to online education and remote work necessitated by the COVID-19 pandemic, proficiency in information and communication technologies has become increasingly crucial. However, recent data from 2017 to 2019 reveals that less than 40% of young people and adults reported using even basic ICT skills in the past three months, such as sending an email with an attachment (United Nations, 2021).

Globally, distance learning remains out of reach for at least 500 million students (United Nations, 2020). In Mexico, 30 million students suspended face-to-face classes (INEE,

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2021) and the challenge of providing the essential tools so that students and teachers get the most out of distance education. Therefore, digital skills are required along with constant training around educational platforms such as digital libraries or community chat rooms and the optimal preparation of classes with digital resources. Lastly, there are two main tasks identified as essential to ensure that the education system educates professionals in the fields where the demand will arise. The first task is to adapt the curriculum to incorporate emerging technologies and digital skills, especially, in IA to analyze Big Data (Deguchi & Karasawa, 2020). Secondly, information literacy, the capacity to interpret and use data and information (Deguchi & Karasawa, 2020) is a key skill to develop in Society 5.0 as the broader population most effectively utilize information.

Education institutions at all levels, including elementary schools and universities, along with companies and local communities, will have a crucial role in promoting information literacy among the public. But they should do so with the help of government and private industry organizations. As the public attains information literacy, the region has the potential to become a model for a data-driven society where data is utilized to enhance security and convenience in local communities. This is an important challenge for the Mexican education system because it requires a comprehensive and coordinated effort between multiple stakeholders and infrastructure to ensure that digital skills are effectively integrated into the curriculum and that students have access to the necessary tools and resources for learning.

Moving forward, it is imperative for the Mexican government to embark on a holistic reform agenda that addresses the root causes of educational disparities exacerbated by poverty. A strategic blend of targeted interventions, infrastructure development, and policy adjustments can pave the way for a more resilient and inclusive education system. Implementing a flexible learning environment that caters to diverse needs and breaking down subject barriers can enhance students' adaptability to the demands of Society 5.0. Additionally, fostering partnerships between the public and private sectors can bring forth innovative solutions and resources, ensuring that advancements in technology are accessible to students from all backgrounds. Moreover, the emphasis on continuous education must be bolstered, not just as a means of adapting to technological advancements, but as a catalyst for personal growth and societal progress. As Mexico charts its course in the era of Society 5.0, a collective commitment to transformative educational practices is paramount, setting the stage for a nation where every individual, regardless of socio-economic factors, can harness the full spectrum of opportunities offered by the digital age.

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Conclusion: Moving Towards a Technological Future

As technology continues to advance, we need to acknowledge both the advantages and drawbacks that come with it. Digital transformation has added a new level of complexity to our society, requiring us to address the challenges that arise from this technological shift. Considering the advancements in AI and Big Data, society is currently experiencing a profound transformation. To achieve an ideal society that can overcome obstacles to sustainability and ensure individuals lead fulfilling lives, it is essential to comprehend how to create an environment conducive to overall well-being. This requires building knowledge on fostering member welfare within societal structures. This task requires planners to engage in academic discourse regarding the direction of new urban environments, deliberate on how to plan and design societies, collaborate with scholars from various disciplines, and incorporate advanced technology and analytical methodologies that pertain to manufacturing and community development.

To achieve Society 5.0, it is vital to create an environment that promotes a higher quality of life and establish institutional foundations for constructing a sustainable society. These demands vary when considered within different cultural and socio-demographic contexts, such as those in Mexico which, as a country with a diverse population and unique social challenges, must carefully consider the implications of both Industry 4.0 and Society 5.0. The global landscape will persist with turbulence and uncertainty, prompting us to evaluate the adequacy of our academic and professional capabilities in fostering economic, social, and environmental sustainability. Mexico will need to adapt and integrate itself into the workflows of Industry 4.0, as well as the emerging concepts of Society 5.0, due to its position in global productivity chains. This transition must happen quickly for Mexico to keep pace with technological advancements and societal changes.

The reorganization of work and education is inevitable in our increasingly global society. The COVID-19 pandemic has served as a stark reminder of this reality, forcing us to adapt whether we were prepared for it or not. Future development is anticipated to be multifaceted, characterized by the emergence of start-ups and small businesses in addition to established ones. While adaptability is crucial, the impact on employment remains uncertain. Our responsibility as social actors and researchers is to diligently address the demands of this new era. Individuals must acquire the necessary skills for the future, enabling our society to embrace and navigate technologies that are conducive to social development in a Mexican context.

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