



# The role of Education 4.0 in Industry 4.0 to enhance Society 5.0

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## Abstract

Society 5.0 is an innovative governing strategy introduced by Japan. Society 5.0 is a new perspective which develops an economically advanced human-centered society by solving the social problems through the integration of cyberspace and physical space. Insurgence of industry 4.0 policy has great influence over Society 5.0. The implications of technologies developed by fourth industrial revolution, Industry 4.0, benefits the mankind as it is believed as the disruptive force that supports society 5.0. Experts believe that the employees of Industry 4.0 environment are expected to be sound in technical, methodological, social, and personal competencies. Education 4.0 is a learning approach which fits the bill of the fourth industrial revolution by transforming the future of education through advanced technology and automation. In this paper the role of Education 4.0, the required quality of education in shaping the society as defined by society 5.0 and the immediate need for educational paradigm shift to prepare the future Industry 4.0 workforce are dealt in detail.

## Keywords

Society 5.0; Industry 4.0; Education 4.0; quality of education

## 1. Introduction

In 2016, Japanese cabinet, during the 5<sup>th</sup> science and technology basic plan introduced the strategy called “Society 5.0”. Society 5.0 is a human centric society in which people will lead a quality life with solutions for all societal problems. The cyber space and physical space are interconnected for resolving the problems and thereby provides solutions for all the challenges. This frame of reference has common points with the objectives of Sustainable Development Goals proposed by the United Nations. Society 5.0 is a future vision model of a future society which is communicated to industry and the general public. It was a method of manoeuvring technology for social development and sophistication of human kind.

Industry 4.0, the fourth industrial revolution ameliorates the society by introducing philosophical transformation in education, economy and trade similar to the other previous industrial revolutions. It is geared towards increasingly individualized customer requirements [1]. This Industry 4.0 discovered new highly automated technologies in order to meet the present day dynamic market demands [2]. Few challenges and fundamental issues like predictability, flexibility, embedment, and robustness to unexpected conditions occur during the implementation of industry 4.0 in the industries. Professionally well trained Human resources are now in demand in order to overcome the challenges faced in Industry 4.0 work environment. Education 4.0 is a pedagogical technique that gets affiliated with the fourth industrial revolution [3].

Education 4.0 stimulates self-learning thereby embedding humanistic and constructivistic principles enfolded on the student for learning and teaching. It encourages the self-reflection, collaborative learning and metacognition of one's learning process. Education 4.0 also refers to the set of teaching techniques that promote learning among peers [4].

It is the role of the educators to create enablers for Education 4.0. Educators should ensure for the implementation of emerging technologies and different learning methods to improve the students learning processes and the training. This would create a healthy situation for students to meet out the future scenarios, thereby creating a human centric society 5.0.

This paper deals with the role of education and educators in bringing up a humane society. This paper is structured as follows: Section 2 presents the basic concepts of the society 5.0. Section 3 presents the concept of industry 4.0, benefits of Industry 4.0, challenges during the implementation of Industry 4.0. Section 4 provides the need for implementations of the education 4.0 concept in education and the need for the paradigm shift required for teachers to meet the zen type of students. Finally, Section 5 offers conclusions with few suggestions for future smarter generation.

## **2. Society 5.0**

Society 5.0 dwells in the following key words (concepts) namely “human-centered society”, “merging cyberspace with physical space” “knowledge intensive society” and a data driven society”. If these words /concepts are clearly understood by all sectors of people, a bridge between pillars of Germany described INDUSTRY 4.0 and what we expect in the reality as quoted by Japan to make a flourished society 5.0 could be easily developed in all countries irrespective of their diversity[5].

### **2.1 Basic Concepts of Society 5.0**

Problems are faced by the people in each and every moment of their life. Problems may be in their day to day activity faced by an individual, may be for the society or global problems, environmental issues etc. The role of a human is to find solution to lead a peaceful and happy, comfortable life. To resolve the issue and to find a permanent solution for any problem, the background has to be analyzed. The data has to be obtained. With the revolution of Industry 4.0, data could be easily collected from the existing real world. The nine pillars of Industry 4.0, helps in collecting, processing and analyzing the data of a problem in a micro level by using the computers. The result should be applied in the real world for the sophistication. The “data collection” and analyzation is called cyberspace. This involves a set of computer networks. Now the challenge is how this data collection in each and every step has been merged to find a solution. After finding the solution for various parts of physical world problems, all these systems should be interconnected through cyberspace. This gives the real world an automated sophisticated service. This would produce a very greater value in the society which ensures happiness and comfort. This comfortness would be extended to all aspects of life.

In the above paragraph, it has been mentioned that to solve a problem, data has to be collected. Data obtained from physical world is through cyberspace. Any phenomena from physical world could be obtained as numerical values, states etc and are known as data. The analysis of data gives information. Decision which is obtained through information is the knowledge.

This analyzation, gaining knowledge, derives solution. This improves society. Again these solutions, implemented in physical world give rise to a set of data which is again sent back for further analyzation. Thus, this would enable smooth data flow from “Physical space” to “cyberspace” and vice-versa. By sharing the experience/knowledge obtained from one situation, it could be extended for another.

To understand this concept of society 5.0 Deguchi et al [5] described with an example of air-conditioner which is very easy for understanding. Here another example is analyzed. For example in case of smart refrigerator, for its smart working, the data required are at first the type of items stored in it, a barcode (for Automatic detection of items for collecting the details such as expiry and usage), LCD display list, sensor for automatic opening/closing, program for smart working etc. These data collected using computers gives solution for each and every problems individually. This is actually known as cyberspace. The way of integrating all the above determined solution will give rise to sophisticated serve to the mankind thereby enhancing the comfortability of the human being.

In addition to this, the heat produced by the refrigerator mainly impacts the global warming. Mass consumption of these refrigerators, neglecting the ill effect of it will definitely harm the planet and inturn the human. Addressing this issue also and maintaining the balance is a very big task. The loop gets closed only if an ecofriendly solution has been arrived. Finding a solution for all these problems smartly and automatically with the help of technological revolution, without the involvement of manual work (each and every time) is said to be the smarter society as quoted by the Society 5.0.

The main purpose of Society 5.0 is to enhance people's quality of life with the use of potentialities acquired by Industry 4.0.

### 3. INDUSTRY 4.0

Advanced technologies from Industry 4.0 could contribute to the organization of a new society called society 5.0 [6,7]. Industrial revolution that happened in 21st century is Industry 4.0. As a part of high-tech strategy for 2020, the revolutionary word "Industrial 4.0" was first introduced in an article published by the German government in November 2011 [8]. Industry 4.0 encourages the companies for "smarter" products and services with low cost and high efficiency. This "smarter" product arises as a result of the system's automated procedures [9]. To produce these smarter products from smart factory few technical terms were introduced. These terms were generally referred as nine pillars of Industry 4.0 revolution which includes cyber-physical systems, Internet of Things, Big data, 3D printing, robotics, simulation, augmented reality, cloud computing and cyber security. The meanings for these nine pillars are detailed one by one. On a simple term Cyber-physical systems means linking typical equipment to a computer. The Internet of Things consists of physical devices that are embedded with electronic sensors, actuators, and digital devices with specific software enabling communications and the Internet. Big data is a field that analyze and systematically extract information from the data sets which are too complex to be dealt with traditional data- software. Cloud computing is the delivery of computing services which includes networking, software, storage, analytics, databases, and intelligence through the Internet Robots which could exist in various models such as vehicle-type rover, legged patrol robots plays an important role in Industry 4.0. 3D printing, an additive manufacturing process, enables construction of making three dimensional solid objects from a digital file.

Simulation is the combination of recreation and isolation. The steps include identification of variables in a situation, formation of hypothesis, repeated testing and prediction. Cyber Security is the intersections of intelligent systems to protect shared information from cyber-attacks. Augmented

reality is the enhanced version in which interactive experience of a real-world environment is obtained through computer-generated perceptual information. This Industry4.0 rely on these “nine pillars” of advanced technologies of manufacturing process environment. Along with these, in recent days, there is a demand for portable devices such as smart phones, laptops and other wearable electronic products and as a result change of software development for adapting to the relatively smaller screen size also has increased to a larger extent .

### 3.1 Advantages of Industry 4.0

Bi et al.[10] and Fleisch[11] has clearly explained that IoT reduces labor cost and also empowers the public to utilise the option of self-service. According to Fleisch (2010), data collection, its analysis and linking would enhance the relation between the organisation and client community due to effective communication. It provides additional service revenue opportunities. Big data and data analysis would be a boon for many business and service domains to improve efficiency, effectiveness and compliancy [12]. It emphasize that future production contains the products that control their own manufacturing with its efficient manufacturing systems. 3D printing helps the manufacturer to produce objects layer by layer [13]. Its benefits include the speed, reliability, quality improvement, safety and the cost reduction [14]. The inclusion of Robotics increases the efficiency in industry, reduces downtime to zero and less disruptions [15]. These pillars discussed so far would help to improve the overall performance and maintenance management of any industry. Industry 4.0 opens an opportunity to introduce smart manufacturing platform for all the industries.

### 3.2 Challenges of Industry 4.0

Digitalization, Miniaturization , networking, Self-organization, automation would be the key buzz words of Industry 4.0 which has brought the most profound changes in the world of Industry. These developments in the world of industry bring major challenges in the company, education and politics. As per the suggestions of industrial experts, researchersand educationalist that all workers has to expertise in different new skills. Manufacturers are in a position to prepare their entire working community to harness the power of technology. Frequent training, updated Learning, Development initiatives are very learning gaps of the existing workforce. It also means accelerated onboarding and skill upgrades are the very essentials for the new hires to make them multi-skilled.

Hence introduction of the information and communication technology in the field of education has now become inevitable. Now the conventional face-to-face education needs a shift. It has to be combined and rendered as blended learning with more open education. In this era knowing about the rate at which the changes are occurring is inevitable and applying the knowledge of technology has become indispensable [16]. Identifying the disciplines and training in the missing abilities of expectation of industry4.0 becomes inexorable now to reach society 5.0. The solution is nothing but

giving a quality education to the younger generation by introducing the policies of Education 4.0 in curricula of all countries [17].

#### 4. Education 4.0

Due to this shift to Industry 4.0, a gap exist between what is taught in school and what is required at work place. “soft skills” which is found at the junction between the professional and social skills are recognized as transversal competences,. Hard skills helps in succeeding the interview but soft skills are important for the sustainability of the job which in addition helps in the attainment of professional fulfilment. Soft skills become the part essential for teamwork on the shop floor level and communication in daily business. All these new technologies such as AI, data analytics, blockchain, and robotics obviously requires corresponding skills which include

1. Analytical thinking skill with innovation
2. Active learning and learning strategies
3. Complex problem-solving skill
4. Critical thinking skill
5. Creativity, originality, and initiative
6. Leadership quality and their social influence
7. designing and programming
8. Reasoning and problem-solving skill,
9. stress tolerance
10. Resilience

This generation has to be trained in all the above mentioned skills. The curricula should be in such a way that the students must be ready for any interdisciplinary work [18]. Education 4.0 is a new era of combining technology into almost every element of education.

All the education institutions play a major role in moulding the society and make it ready for industry 4.0 revolutions. Sackey and Bester examined the impact of industry 4.0 on the existing industrial engineering curriculum. Hands-on training models have to be given to the students in order to support their professional life. “Learning factories” or “mini-factory” which are trending in the universities helps the students in applying their theoretical knowledge in practice. In order to be a Smart Operators 4.0 in the smart factory, Education 4.0 should qualify the operators in such a way that he must perform the work with the support of machines, intellectually interact with robots and use advanced technologies including wearable devices and augmented and virtual reality[19]. Higher educational institutions should develop the curricula to meet the general competencies like transversal competency

(critical thinking, cooperation, collaboration, communication, creativity and innovation), Disciplinary Competencies (training in technical knowledge, capacity to do research, proposing technology based solution) that a student can apply them in their personal, professional and social lives.

Education 4.0 tends bring forth the most efficient, easily accessible, and more flexible educational programs. It introduces new teaching-learning methods emerge which involves use of various technologies, strategies, and pedagogical procedures in different modalities (Face-to-Face learning, Online distance learning, Hybrid learning) to redeem knowledge in younger generation. Hybrid learning allow the students to develop competencies to adapt for the changes and challenges thrown on them [20].

Teachers who are the king makers need to relearn and equip themselves with the digital tools to meet the learning preference of the Gen Z students [21]. Instructors have to update themselves in the nine fundamental trends of education 4.0 through the digital tools available online [22-25].

## 5. Conclusion

Society 5.0, coined and visioned by Japan, is the future digital society. Its completely humane centric society with precious customization. It also supports and aims for zero wastage. This could be achieved by the combination of Physical space and cyberspace. This amalgamation of Physical space with cyber space is possible with the support of the nine pillars of Industry 4.0 as the Digitization has become the part of today's industry. To work in such a smart industry, smart workforce is needed. This milestone would be reached by following the nine trends suggested by the Education 4.0. Educators and teachers should understand the importance of the trends specified in education 4.0 and design the curricula accordingly and should be ready to equip and update themselves in order to feed the zen generation. Its in the hands of students and teachers to understand the responsibility and make this society a sophisticated, value rich, smart, humane society.

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