Chapter 82
Education in the Era of Industry 4.0: Qualifications, Challenges, and Opportunities

Dharmendra Trikamlal Patel
https://orcid.org/0000-0002-4769-1289
Charotar University of Science and Technology, India

ABSTRACT

Industry 4.0 has changed the thinking of industry owners in terms of technological usage. With the help of modern digital technology, industry can fulfill the requirements of customers easily and compete strongly against their competitors. In order to achieve good quality of products at an affordable price, industry needs skilled people who are aware of autonomous and intelligent components. To prepare skilled people compatible with Industry 4.0, education plays a very important role. The chapter starts with which kind of qualifications are needed to fit in the smart factory era. In next section, the chapter deals with challenges that emerge in education in order to implement skills suitable for Industry 4.0. Lastly, the chapter describes opportunities for the education sector as far as the smart factory is concerned.

THE WAY OF SMART FACTORY: AN EDUCATIONAL PERSPECTIVE

In 1780, the first revolution of industrial manufacturing (Nic Von,1996) had started. No technology was used in that era and manufacturer heavily depended on laborers for any kind of productions. Laborers had to do the mechanical kind of work so not a specific kind of qualifications were expected from them.

The second industrial revolution (Joel Mokyr,1998) had started in 1870 which is considered as the technical revolution as the manufacturer had started using numerous technologies. This revolution comprised of heavy usage of manufacturing machineries, communication via telegraph, electrification, use of petroleum and transportation by means of railroads. This revolution had changed the thinking

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of the education sector and they started more emphasizing on atomization, telecommunications and electrification concepts.

The era of 1970's is considered as the third revolution of industry (Xiaowen, 2016). The ways of communication in the form of Internet and mobile devices have changed the entire thought process of industry personnel. Artificial Intelligence has replaced laborers with automatic entities like robots. The use of 3D printing is unbelievable. The industry has started by using renewable energy in their production. Agriculture sector became dominant as genetically modified crops, farming started. Due to nanotechnology, new materials became lighter and more durable. The third revolution is the most rapid revolution due to information and electronics technologies. The education sector has boosted up the speed of the third revolution by producing right level of skills in diversifying areas like information technology, electronics technology, nanotechnology and synthetic biology. The third revolution has changed choices of Indian students and educational institutions and universities as well.

Cyber-physical systems (Antsaklis, 2014, Shi J, et al., 2011) and interoperability among machines have given the birth of the next revolution, i.e. Industry 4.0(Aehnelt et al., 2014, Bauernhansl et al.,2014, Brettel, et.al,2014, Kolberg et al.,2015, Weyer et al.,2015) or Smart Factory(Aehnelt et al.,2014). Smart factory revolution facilitates any organization to digitally manage the entire life cycle of the project starting from planning to the testing phase. Smart Factory(Groover,2007, Kane et al.,2015) emphasizes on two things: **(a) Information Technology** that is responsible for business process automation and **(b) Operational Technology** that is responsible for industrial process and factory automation. The Machine to Machine communications and Human Machines Interface permits machines with intelligent sensors to converse as human language to ERP system(Lazovic et al.,2014, Scheifele et al.,2014). Internet of Things (IoTs) based technology (Kovatsch et al., 2012) plays a crucial role in the integration of IT and OT. The main challenge for educational institutions is to produce skills that fulfill demand of IT and OT. The People having fusion knowledge of the domain and Information technology will survive in today's era. The knowledge in the field of cyber-physical systems, hand held robotics, RFID (Priego et al.2014), NFC, Intelligent networking, etc. is expected from people to survive in this highly digital era.

The following **Figure 1** describes educational evolution in terms of the industrial revolution. From the figure it is determined that Industry 3.0 and 4.0 has completely changed the scenario of educational systems. A person having only domain knowledge will not survive in a smart factory era due to extensive use of digitization.

The Cyber-Physical system has changed the direction of an educational organization. Educational Cyber Physical System is the need of the modern education. Educational Cyber Physical System needs many components to work it efficiently.

1. **Collaborative Learning Tools**: It provides the communication and interaction between teacher and learner.
2. **Learning Management Tools**: Administrative functionalities to manage learning processes and data.
3. **Assessment Tools:** It is needed to assess the learning progress of the students.
4. **Educational Guidelines:** It takes care of the student development from different angles.
5. **Intelligence Tools:** Covers some intelligent aspects for better teaching-learning.
6. **Engagement Tools:** It provides high level participation experience to the students.
7. **Integration Tools**: It provides integration of sound, video,3D animations, text to the system for better experience of teaching-learning.