Industry 4.0 as a Skill in Emerging Technologies

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Abstract: It has been observed that the emerging technologies have enormous potential to transform technologies in new business opportunities. In this perspective Industry 4.0 is a real revolution in the field of engineering that brings the development of several intelligent systems to solve real-time issue in the field of engineering, technology and science as well. One of the dramatic change that has I.R 4.0 is driven that is interconnection of various systems and devices together to merge at cloud and make the data more intelligent by using artificial intelligence like human. For this reason, in this paper, various dimensions are discussed for I.R 4.0 that offers the solution by solemnizing the smart system knowledge in an interoperable way. Furthermore, the paper review techniques to separate the status quo for Industry 4.0 and the various industries by utilizing Information and Communication Technologies (ICT)—Industry 4.0 together that offers a significant positive impact on the growth of the different industries that will offers the practitioners and researchers in the ICT industry to enhance the automation of work processes and managerial activities in the engineering and technology.

Keywords: Emerging Technologies, Information and Communication Technologies, Industry Revolution 4.0.

1. Introduction

Industry 4.0 is termed due to latest advancement in technologies in the industry [1]. The impact of Industry 4.0 is not limited to manufacturing but it is extended to construction, education, automation, telecommunication and etc. means it has almost revolutionize all the corners of society [2-3]. Nowadays, Industry 4.0 is transforming in skill not as a technology. Industry 4.0 was begin from Smart Manufacturing Leadership Coalition1 in the US and Industry 4.0 in Germany to enhance the efficiency, performance, and productivity. The history of Industry 4.0 is depicted in Fig.1.
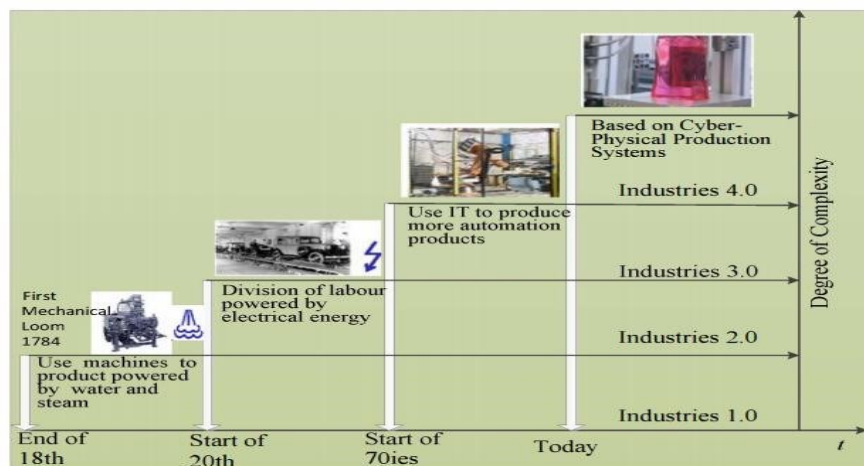

Fig.1 Historic perspective of Industry 4.0 [4]

It illustrates that from 18th century the machines are transformed into autonomous system via cyber physical system [5]. It later provide the connection of objects by virtual mean and offer the customization of product, service and management efficiently. The main goal at that time was everything should be interlinked with cyberspace. Starting from material to production. This introduce the concept of wired and wireless communication based on 5G, IoT and etc [6]. The technologies offers the autonomously connection between devices that optimized the production. The main focus of Industry 4.0 was over manufacturing to increase the revenue [7].

2. Emerging Technologies

The concept of Industry 4.0 is also well known by the term smart factory to change the concept of manufacturing industry. This include various aspects including automation, communication technologies and manufacturing technologies [8-9]. Along with that concept of cloud, enterprise, IoT, and many more is induced in Industry 4.0. Currently, the focus in Industry 4.0 is shifted towards use of smart technologies including smart sensors, robots, data analytics, Artificial intelligence, and many more. All these emerging technologies are used to accomplish the multidisciplinary characteristics application and related tasks [10]. However, all these concepts are based cyber physical structure. In Industry 4.0 connects the equipment's from production that realizes to form the exchange of data to attain the combination of virtual and real-time world. The Industry 4.0 improves the utilization of resources to mitigate the need of unused resources [11] as shown in Fig. 2.
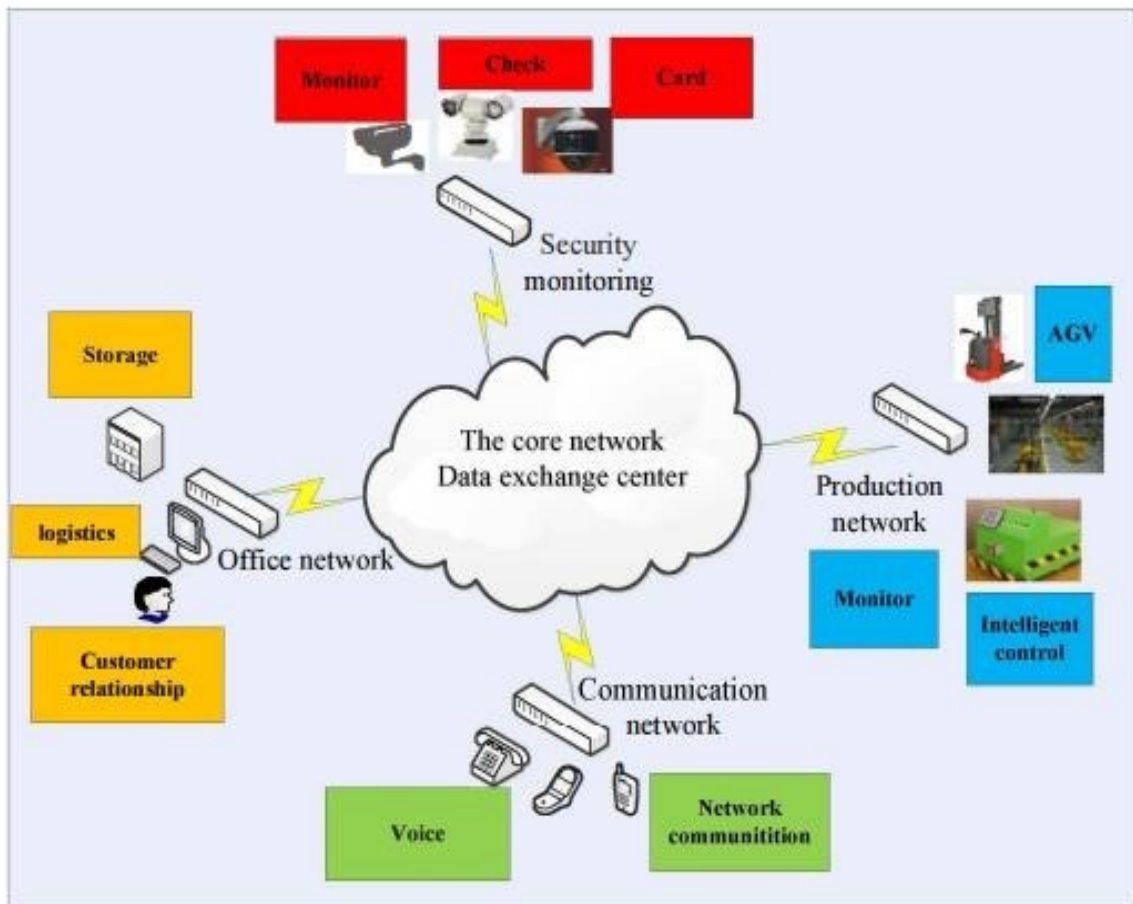

Fig. 2 Wireless Interconnection for Industry 4.0 [4]

One important aspect is Industry 4.0 doesn't mean that the all factories will be unmanned, instead concept of interlinking production system with people via internet and other connecting protocols. Because it is the human that will decide, modified and optimized the system according to the need of industry [12] The importance of embedded system in Industry 4.0 is worth to understand as all the system that are embedded in chip are link via IoT and cloud. IoT is interconnection of sensors and devices via wireless communication. This in Industry 4.0 offers direction to convert information to decision. In comparison to traditional embedded system and IoT, the embedded system are more simple and doesn't have any complexity of data processing [13].

It is also defined that a traditional industry is composed of different level including system level that included devices and systems, and the interconnection level such as PLC and DCS systems and then manufacturing system to control the process [14-16]. Even at some places the concept of resources management is also induced in Industry 4.0 that will help in operation of industry to manage the cost, inventory, supply chain and production [17]. The Industry

4.0 is based on wireless network that offers the interconnection of devices along with business expansion at global level. The business expansion is linked with different divisions [18].

Industry 4.0 requires the fast and safe and excellent quality of interconnection of devices and production system as the system become very complex and need to be more secure in terms of connection [19]. Furthermore, the interconnection should be uninterrupted for that various sources are used including device to device communication, Terminal to Terminal communication network. All these networks are requested due to offer the globalization of information. Fig.2 defines the interconnection of wireless devices for Industry 4.0. It illustrates that for Industry 4.0 the wireless network is essential to connect part of industry to attain the task for production [6].

In Industry 4.0, the focus is shifted from centralization to decentralization by keeping the intact with physical cyber link for automation. This is achieved due to interlink of different module of industry [9]. The main of these technologies is to enhance the productivity and revenue of industry by increasing speed, reliability, flexibility and competitiveness. Industry 4.0 via these emerging technologies offers he mass custom for fast and better quality. The unmanned vehicles are also one of the important aspect of Industry 4.0 as it is beneficial for human in terms of reducing efforts and paly vital role in revolutionizing the industry [11]. These unmanned vehicles in industry are used for loading and unloading of stuff, carrying heavy objects, spying and many other functions [18].

In results, it reduce labor cost and also offers the great handling of products when the dealing with the hazardous material [21]. These unmanned vehicles are developed using sensors, robots and ICT devices including cameras, networking devices. These vehicles are used based on demand of products from customers for small orders the human efforts are taken. In the studies, it has been observed that supply chains management is heavily using these vehicles. Not only this but in some application it can be used for predictive maintenance as well [22]. Another aspect of Industry 4.0 is combining all these devices and system and how they can perform efficiently together for industry as social manufacturing.

As Industry 4.0 is composed of various system including sensors, networks, wireless connection a must needed platform of information management is required for data, equipment's, tasks, safety via different ICT technologies. The main driven force of Industry 4.0 is enormous growth in digitization of economy and society in various sectors including agriculture, factories, production, services, tourism, and etc. All these sectors are connected by different ICT emerging technologies such as; cloud management, intelligent systems, Internet of Robotics Things (IoRT), Virtual Realty (VR) and many more. Despite of that enormous growth in technology, industry 4.0 is facing various challenges to cope with human and machine interfacing, data analysis and management in the context of cyberphysical [23].

In particular, the challenges can be solve to share the knowledge and skill management as distributed partners of the I4.0 technology [24s].

The skill management in Industry 4.0 will develop a domain knowledge that enable machines to reason for solving real-time issues [25]. In this paper, engineering skills are reviewed for Industry 4.0 that are essential for accreditation bodies for various HEIs. The paper narrates that there some specific skills are required for fulfil this gap of sets of skills that includes innovation, active and advanced learning strategies. The outcome of this research work will be help for providing the need of current skills so that engineering graduates will have no problem in getting a job in the future in any domain [26].

3. Industry 4.0 And Disruptive Technologies

The disruptive technologies are transforming Technology to business. This computing of large data and its connectivity via analytics and intelligence and digital physical transformation. The main technologies that will become future of Industry 4.0 are IoT, AI, Robotics, wearables and 3D printing. Among them, Robotics and 3D printing have proven themselves in all sectors and reduces the amount of workforce. In a research it was narrated that if robotics start to dislocate the human, jobs related to human action that includes creativity, innovation, learning and emotional intelligence may become several [26].

4. Skill Management Concept In Industry 4.0

Industry 4.0 is growing very fast in the field of automation that is influenced by the quick expansion of technology [26]. This has generates need of introducing several skills and demand of jobs in all area of work as current and past practices are not so much useful to fulfil the demand of market [26]. This also has negative impact of reducing jobs that are no longer having feature of Industry 4.0. These new technologies are replacing old machinery, people and skills frequently that 66.6% of job vulnerable to be made terminated in this developing world due to technology disruption [26] as shown in Fig. 3.
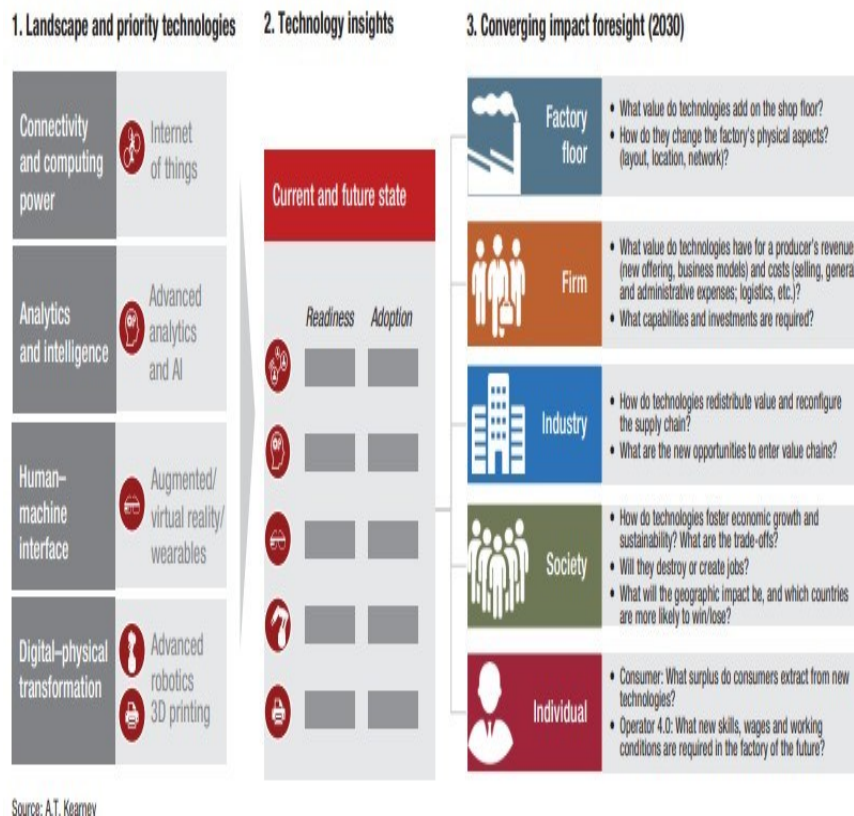
Fig. 3 Steps approach to developing insights [28]

It was discussed in the past that many old disruptive technologies immediately creates the abolishment in jobs and skills but at the same it also opens the new doors for creating new jobs and use new kills to enhance the productivity, economy, and revenue for countries. For examples advancements in Technology such as 5G, IoT, Big Data, Data Sciences, and etc. have created a lot of opportunity for new skills and jobs. In Fig.3, it is discussed that technological impact over global databases on production and labour [27]. This defines how quantitative input is converging technologies is developing values in chains along with how technologies would change that by 2030 in incremental and disruptive scenarios [28].

As all the engineering programs are monitored and accredited by Pakistan Engineering Council (PEC) and all these engineering skills are set by engineering accreditation bodies as per Washington Accord followed by Government of Pakistan.

PEC has already determined the engineering attributes of engineering students so that they can accomplish their duties professionally. These including problem solving skills, ethical measures, leadership skills, working with team members, communication skills, management attributes, lifelong learning and many more. It is discussed in the past studies that these attributes are categorized differently for every country need. Among these communication skill is used by many countries along with teamwork and lifelong learning skills [26].

Apart of that are mainly ten skills that are required as an engineering graduate Communication skill, Teamwork, Lifelong learning, professionalism, Management, Technology skill, Decision making, Thinking skill, Entrepreneurship and leadership [26].

However, these skills are not sufficient and no extensive suitability in fulfilling the requirements of industry. Furthermore, a great enhancements is required in handling the challenges of Industry 4.0.

5. Industry 4.0 Skills

Industry 4.0 skills requires the updation and targeting new skills that should be incorporated by all stakeholder including Higher Education Institutes, Vocational training Institutes and Industries as well [26].

The skill management will be key factor in enhancing the performance of Industry 4.0 skills. However, it is not as much as easy to include these skills due to the prompt expansion in various advanced qqtechnologies. Industry 4.0 skills that are required for 2020 are shown in Table 1.

Table 1. Skill Management for industry 4.0

Sr. No.	Industry 4.0 Skills for 2020
1	Complex Problem Solving
2	Innovation
3	Critical Thinking
4	Creativity
5	People Management
6	Coordinating with Others
7	Emotional Intelligence
8	Judgement and Decision Making
9	Conflict Management
10	Active Learning

The difference between past skills and currents skills is that currently industry 4.0 require Innovation, artificial intelligence, and active learning. In this, the graduates should be given an early exposure to the need for mastering the new skills that require Innovation, artificial

intelligence, and active learning. With these skills the same should be incorporated in HEIs and employees on mastering these new skills to handle the challenges of Industry 4.0. In this regard, the Pakistani graduates should be given intensive focus on skills in understanding and requirements of skills needed for graduates that can help them to work in Industry 4.0 [26].

6. Assessment of Existing Skills And IR 4.0 Skills

Industry 4.0 need to train the graduates and employee in the domain of Innovation, artificial intelligence, and active learning. This should be main concern for the various stakeholders that include governments, semi-government, businesses man, autonomous institutes and individuals [29-30]. It was narrated in the past that graduate attributes required for the both organization and all its stakeholder should adopt the skills such as; software, non-technical, transferable or professional skills in order to meet the industry and job requirement. All these skills are deponent of certain job type and current trends [31-32].

In the past, engineering skills are only focused on communication, problem solving, decision making, teamwork, lifelong learning. When the graduates are reaching in the market [33-35]. The requirement from the industry is different because of rapid growth in technology i.e. Industry 4.0. All of sudden graduates regret themselves to have focus on all the skills that were taught to them in their engineering graduate time that were not suitable to the requirements of Industry.

In comparison, exiting engineering graduate skills and new industry 4.0 skills have a significant gap. These gap is due to innovation, active learning, creativity, intelligence. All the Industry 4.0 skills are not explored so far in terms of definitions and attributes in engineering field to meet the requirements of industry and society ideation.

7. CONCLUSION

In conclusion, it is observed that skills management and its development are very much important to make assurance for graduate's skills that are suitable and required for industry job market. This will help them in competitively selecting their career and make them to deliver them for industry based on latest technological developments in terms of Industry 4.0. This paper, first describes the background of Industry 4.0. After that emerging technologies were discussed that are currently and in the past were used in for Industry 4.0. This discusses many issues starting from sensor, devices, PLC, DSC, IoT, Wireless communication, 5G, Big data and many more. After that interconnection of devices were discussed based on wireless technologies. Industry 4.0 from centralization to decentralization was discussed along with physical cyber link for automation.

The concept of unmanned vehicles were introduced in the aspect of Industry 4.0 as it is beneficial for human in terms of reducing efforts and paly vital role in revolutionizing the industry. Furthermore, the discussion were carried towards knowledge management. In the second part, skill management in Industry 4.0 was discussed and its importance for disruptive technologies was also demonstrated. After that existing skills used in Pakistan Engineering Council were discussed in light of Washington Accord.

Finally, the Industry 4.0 skills were discussed that are suitable for meeting the requirement of industry and after that comparison against existing and industry 4.0 skills were illustrated. The industry 4.0 skills are important for everyone who is graduating in engineering an ICT related fields, furthermore HEIs should encourage their faculties to enhance their industry 4.0 skills. The paper offers the furthermore direction for various bodies to develop similar skills framework with clear attributes for each skill and there implication in HEIs. The proposed model will help as guidance for institutes and the industry for giving assurance to graduates that are competitive and have no problem in getting a job in the future for working on future technologies.

Acknowledgement

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