

The Implications of the Industry 4.0 Concept: A Review of the Fourth Industrial Revolution

Samsudeen Sabraz Nawaz¹ and Hussaien Abdul Saththar²

¹Department of MIT

²Office of the Registrar

South Eastern University of Sri Lanka (SEUSL)

Oluvil, Sri Lanka

sabraz@seu.ac.lk, saththar1963@gmail.com

Abstract. The modification of the production process and technological development have evolved deeply global industrial landscape innovation in the modern world. The research literature concentrated on clarification, importance and implication of technological system in the Industry 4.0 concept. The present literature represents of lack of operating skill efforts to systematically in the new fourth revolution. The intention of literature to contribute to the industry 4.0 concept, value and indication of the technological system in Industry 4.0. The improving production processes and increasing productivity and economy affecting the product life cycle impact on creating a new business model in the new industrial paradigm. The companies adopt the "industry 4.0" framework furthermore, many companies are not responsive about the challenges in the framework of concept. The research focus to contribute to the industry 4.0 concept, importance and implication of technological system.

Keywords: Fourth Industrial Revolution, Industry 4.0, Industrial paradigm, Technological development

1 Introduction

The term of "Industry 4.0" concept becomes increasingly significant topic in the new industrial world. The mastery of production and high technologies have amplified within three revolutions represent and distinguished for mass productive system assemble lines using electric, fourth industrial revolution and adoption of computers with the smart autonomous system through information and machine learning in this modern technical world.

The first revolution contrivance steam engine in England, in the 18th century. The second Industrial revolution invention mechanical manufacturing facilities and mass production and replacement of steam in electrical energy emerged and enlightening of the industry in the 19th century. The industry and mechanization amplified with automatic operations and enhancing productivity through the second revolution. The third industrial revolution mounted technological advancement and achieve automation in production in 20 the century [4]. The impact on industrial processes countenancing productivity through disruptive technology. Furthermore, the productivity system urbanised in every industrial revolution.

The fourth industrial revolution is discussing and researching widely in the new technological system through academic and companies. The umbrella term of new industrial paradigm efforts on the Cloud Manufacturing, Cyber-Physical Systems (CPS), Internet of Things (IoT), Robotics, Big Data and Internet of Services (IoS) in the industry [4]. The machines, production modules independently able to exchange data, products, and prompt

actions and control each other, enabling an intelligent manufacturing environment through the adoption of advanced technologies.

The academic research focused on new manufacturing paradigm adopt with the new strategy, industrial development and CPS technology among the companies in the digital and physical world. This production technology of organization and business model approaches afford to social development and economic development and implement opportunities. This review is structured "Industry 4.0" phenomenon, illuminates of concept presumed the visions and models. The Industry technology consequences on the new industrial paradigm, findings the "Industry 4.0" concept and implications.

2 Industry 4.0 Concept

The fourth industrial revolution is concentrated and combined with competitiveness, production processes, data management, and association with customers. The set of technological advances high impact in the current industrial landscape. The background of Industry 4.0 phenomenon is evaluated and abetted for the future manufacturing vision through a new manufacturing paradigm.

2.1 Background of Industry 4.0

Industry 4.0 is a concept that materialised due to technological headways and disruptive gains in the global industrial sector in the last years. Firstly, the concept article published by the German government in November 2011 and followed by resourcefulness concerning the high-tech strategy [1]. The idea enticements on earlier and perspectives that advanced over the years [8], [9].

2.2 Future Manufacturing Vision

The Industry 4.0 notion is a deeply new approach in the digital and physical worlds. Researchers and companies hold main aspects that address the future manufacturing vision: Smart Factory, Smart Products, Business Models and Customers [11]. The future of production as projected consists of manufacturing elements autonomously exchange information, trigger actions and control themselves independently by Industry 4.0 [6]. The digitalized production networks that act without human involvement and autonomously control their operations depending on their environment changes and requirements in the manufacturing approach [10].

The term "smart" is flattering central in the Industry 4.0 framework. The concept definition is not east to find out accurately and explained by several authors associated with independent and autonomous devices. Furthermore, able to converse in real-time and collaborate in a smart environment with smart devices, making decisions and performing actions [12]. The Industry 4.0 manufacturing new paradigm deeply focused on the creation of smart products and smart machines, the transformation of manufacturing systems into smart companies. The combination, digitization and the use of flexible structures and smart solutions consisted of whole value chain adopts with monitoring production stages, data storage, resources, activities and conducts in the capability of the companies [7].

Smart products able to described as CPS capability supporting the connection between physical and virtual worlds [14]. The smart products characterized such as computation, data

storage, communication and interaction with the environment and identify themselves. Furthermore, smart products have an extraordinary degree of autonomy, being able to relate independently with their physical environment over their lifecycle [2]. The business models are being highly influenced by Industry 4.0 for new manufacturing paradigm to an introduced new way of communication along supply chains. The new industrial and market requirements and new business models are developing, allowing the creation of collaborative environments through the changes of business modelling [15]. The key factor of the business model and Industry 4.0 is customers. These advantages bring a set of advantages for them, improving communication along the value chain and enhancing the customer's experience [11]. Briefly, smart factories, smart materials and smart products are tracked along their whole lifecycle time, allowing a high degree of customization [10].

2.3 Key Technologies Enablers for Industry 4.0

This Industry 4.0 concept is complex such as digital manufacturing technology, network communication, computer and automation in technology system [1]. Technology development boundaries are in Industry 4.0 between the digital and physical world, integrating human and machine agents, materials, products, production systems and processes [10]. Consequently, this review provides a brief description of CPS, IoT and IoS technology of Industry 4.0.

2.4 Cyber-Physical Systems

Cyber-Physical Systems (CPS) used to define Industry 4.0, significant advances regarding computer science and information technologies development. The interaction intense on the physical and the virtual environment, integrating, controlling and coordinating processes and operations and using data accessing and processing in the technological system [24]. Mostly, CPS able to defined as innovative technologies for the management of interconnected systems through the integration of physical and computational environments [25].

The manufacturing environments entail further development and industrial implementation of CPS. The integration systems with production, logistics and services an industrial transformation and CPS, which are specifically Cyber-Physical Production Systems (CPPS) when applied to production, an important role will play, consist all levels of production connection between autonomous and cooperative elements [26]. The CPS is connected with internet things [14]. The manufacturing environment allows the vertical and horizontal integration of IT systems and the interconnection between the potentially transforming and whole supply chain of today's factories into Industry 4.0 factories [25].

2.5 Internet of Things and Services

The Internet of Things (IoT) increased in new research, which is based on the connection between physical things and the Internet [14]. The new paradigm consists in endowing everyday objects with intelligence, permitting them not only to collect information and interact with their environment but also to be interconnected with objects, exchanging data and actions through the Internet [28]. The upward interest regarding habitually pointed out as one of the main drivers of Industry 4.0 in the emergence of visions differently and definitions as a result. Generally, IoT defined everyday physical objects on the shop floor, people, IT systems, creating a smart manufacturing environment in a smart factory [29].

According to Haller [30] has defined the physical objects are seamlessly integrated into the information network, and become active participants in business processes in the world.

The Internet of Services (IoS) concept developed and will carry new opportunities to the service industry. The advantages are provided business and technic for business networks created through the service providers and customers. This approach is similar to IoT and connection with the organization, customers, intermediaries, aggregators and suppliers [2], [31]. The IoT is opening within three main pillars: process, resource and creation of autonomous systems [35]. The IoT techniques will provide to become smarter, autonomous and more reliable assisting the products added - value and services [36].

2.6 Impacts of Industry 4.0

The company's impact on internal business areas and unmanned factories promoted to occurred supply chains and sensor networks in the fourth industrial revolution. The capitalist conditions driving efforts to minimize the essential risks in the external environment through the structure of global value-added networks [31]. The groups of companies correlate with consumers, sellers, and dealers and provide opportunities for learning and benchmarking and create transparency of the central organization in the Industry 4.0 [32]. There no merging into a single digital network follows in future, that relations with suppliers and customers will be changing in the near future.

The Industry 4.0 concept main idea reflects on studies and encouraged the scientist to talk regarding digitalization, intelligent and fully autonomy factories. The term Industry 4.0 introduced in 2011 [17]. Industry 4.0 leads to potential deep changes and impacts categorized into six main areas: industry, products and services, business models and market, economy, work environment and skills development. Impacts of Industry categorized into six main areas; they are briefed in Table 1

Table 1. Impacts of Industry 4.0

Impacts of Industry 4.0	Statement
Industry	<ul style="list-style-type: none"> ▪ The production elements can autonomously control themselves, trigger actions and respond to changes in their environment [10]. ▪ The emerging paradigm proposes to integrate products and processes, shifting the product vision from mass production to mass customization in the higher level of complexity [37]. ▪ This new paradigm is changing the current industrial landscape through three parts: digitization of production, automation and linking the manufacturing in a comprehensive supply chain. ▪ Industry 4.0 contains full network integration and real-time information exchange [19]
Products and services	<ul style="list-style-type: none"> ▪ This is highly influenced by this new industrial paradigm. ▪ The economic landscape vastly changed and dynamic market requirements have resulted in an increased demand for the development of complex and smarter products [38]. ▪ The products will become more modular, promoting mass customization and configurable to meet specific customer requirements [14].

Business models and market	<ul style="list-style-type: none"> ▪ The new innovative business models will arise. ▪ The new disruptive technologies in the Industry 4.0 context have changed the way products and services are sold and provided. ▪ The traditional businesses affecting and bringing new business opportunities and models [15]. ▪ The digitization of technical result swelling and will lead to the totality of complex and digital market models [40].
Economy	<ul style="list-style-type: none"> ▪ The technological paradigm develops and conventional emerged in technology. ▪ The digitization holds in consolidating between physical and virtual worlds and influence in each economic sector [9]. ▪ The significant driver for productivity and competitiveness modernisation n the society.
Work environment	<ul style="list-style-type: none"> ▪ The work environment is vastly changing due to the advancements of technology and Industry 4.0 is transforming jobs and required skills. ▪ Industry 4.0 and future systems should have a concentration on workers and their importance [37], [41] ▪ The new technologies will have an impact on job profiles, work management, organization and planning on production systems and the increasing implementation of industry technology innovation. ▪ The main challenge is to avoid technological unemployment, current jobs and taking measures to adapt to the workforce for the new jobs [19].
Skills development	<ul style="list-style-type: none"> ▪ Skills development high= influential factors on the industrial revolution and demographic and social changes in the internal and external impacts on industry revolution. ▪ The future work vision will demand new competencies and create opportunities through high-quality training and facilities [10]. ▪ Industry 4.0 will lead to increased automation of tasks [10]. ▪ The qualified staff required in technological fields to report industry.

The positive and negative feedback received from customers, dealers, investors and suppliers and connectivity is important for the implementation of industry. The telecommunication network is using for the prevention dissatisfaction of dealers or customers. The ERP system characterised and help to implementations, benefits, analysed the current situations for implementation in the future.

- The products sales and purchasing through online or new innovation of technology without dealers and distributors.
- The production framework modified and used a new design with customers' knowledge.
- Smart mobile applications used App, Web, data, messages and manufacturing operations.
- Job offer easy to identify and flexible to work online without dissatisfaction.

- The on-line business received items and track lines information necessary without delay.

5 Conclusion

The new industrial paradigm increased attention commonly known as Industry 4.0 has elevated many questions and technological developments and impacts related to the effective adoption of innovations in the industry. Industry 4.0 is being principally moulded two main drivers: Cyber-Physical Systems and the Internet of Things and Services. This paper concentration on Industry 4.0 contribution and characterized by connectivity and production digitization. The transformation is characterized through the technological advancements that are eliminating the boundaries, integrating workers, production systems, machines, smart products and processes in the digital world.

Fundamentally, to succeed better process efficiency and competitiveness, companies moving towards Industry 4.0. The enormous potential for organizations and, industry transformation will have an impact in many other fields such as work environment, products, new enterprise models, austerity, services and skills expansion in new paradigm Industry 4.0.

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