

# **Supply Chain 4.0: A Shift in Paradigm**

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## **Abstract**

The vision of Industry 4.0 accentuates the global networks of machines in a smart factory setting capable of autonomously exchanging information and controlling each other. This cyber physical system allows the smart factory to operate autonomously. Fourth industrial revolution or better known as Industry 4.0 (I4.0) is changing the manufacturing industry. However, the change is not limited to manufacturing sector, but also to the field that are linked with it. One of the field that is changing with I4.0 is supply chain. Therefore, it is important to know about the current trends, opportunities, and challenges associated with the advent of this pioneer revolution. This paper explores the supply chain in context of I4.0. Current state of the art of this field, and the future prospects have been investigated in this work.

## **Keywords**

Industry 4.0, Supply Chain, Cyber-physical system, and Internet of Things (IoT).

## **1. Introduction**

The evolution of Industry 4.0 (I4.0) has proven being fruitful in providing several business benefits including operational optimization and value chain optimization (Strange & Zucchella, 2017). I4.0 is an amalgamation of digital technology with the manufacturing, which transmutes the industrial production to next level. With the arrival of cyber physical systems (CPS) into the manufacturing domain, the concept of I4.0 evolves. Basically, it was originated and nurtured by the German manufacturing sectors. However, at present every nation is investing in this pioneer technology and all the big firms are adopting it (Bag et al., 2018). The fundamental platform for the success of this technology is the revolution in technologies that consists of Internet of Things (IoT), Big Data analytics and Cloud Computing in the CPS side, and advanced materials, additive manufacturing, and smart robotics in the manufacturing side. I4.0 will change the complete production, operations and maintenance of products, and services through connected components, machines, and humans. With the effect of I4.0, the industrial production systems are anticipated to perform 30% faster than before and 25% more efficient (Gerbert et al., 2015). The first industrial revolution was driven through steam power that transformed lives of people. The second industrial revolution was driven through electricity and communication, production line, enabling just in-time operations and production lines

by the mid-1800s. The twentieth century observed the third industrial revolution through the introduction of Information Technology. However, the fourth industrial revolution is much more advanced which involves CPS and can process data at ultra-fast speed at a fraction of cost compared to previous applications. The fourth revolution has gifted superior speed, increased visibility and cost economics beyond our imagination (Bag et al., 2018). Figure 1 below shows the various stages of industrial revolution.

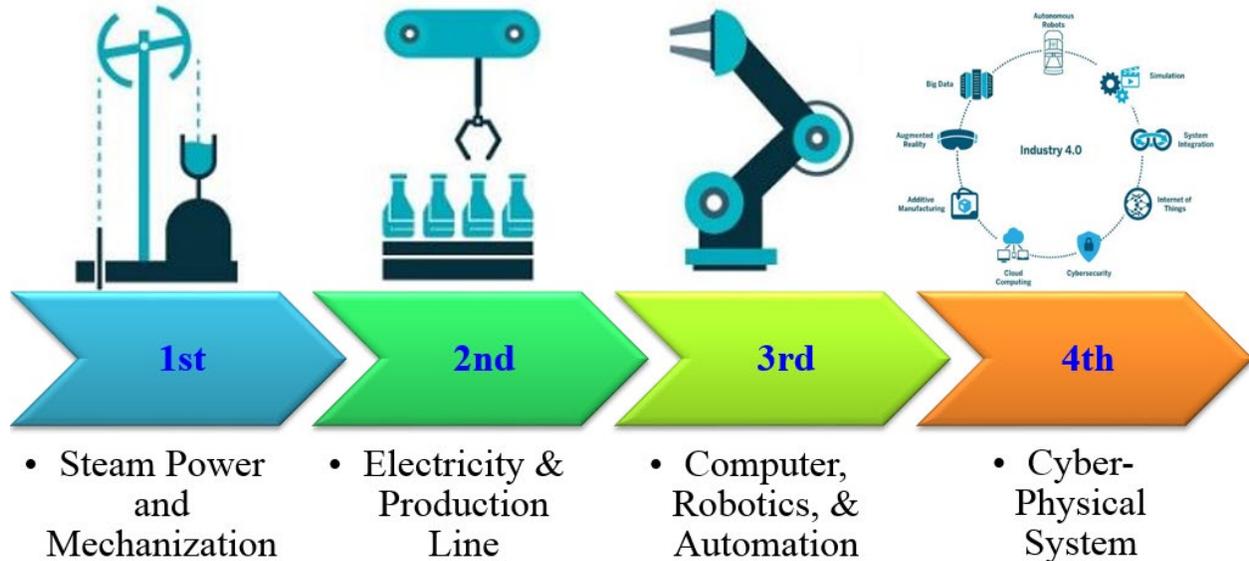


Figure 1. Various Industrial Revolutions

## 2. Supply Chain in the Era of I4.0

I4.0 is not only revolutionizing the manufacturing sector, but also the associated fields, and one of them is supply chain. The supply chain management should be progressed with the same pace so that the organizations can fulfill the demands of the customers efficiently. CPS technologies, sensors, smart systems etc. have lot of application in supply chain. Conventionally linear, supply chains nowadays are truly being renovated into highly interconnected, persistently changing systems that integrate information impeccably to advance production and distribution. At present, this is all about linking the physical to the digital world (Datex, 2018). 80% of the respondents to the 2017 annual MHI survey on next generation supply chains recognized that they are certain that the digital supply chain or Supply Chain 4.0 will be “the preponderate model within the next five years”. In order to bring the vision of the I4.0 supply chain to life, traditional supply chains must advance toward a “smart”, connected resourceful supply chain structure (Datex, 2018). Supply Chain 4.0 is also known as digital supply chain. As the supply chain moves towards digitalization, the “loose ends” will wear off. Improved visibility will deliver limpidity into the necessities and challenges of supply chain network partners. Schrauf et al. (2017), suggested five steps to transform towards digital supply chain, as shown in figure 2.

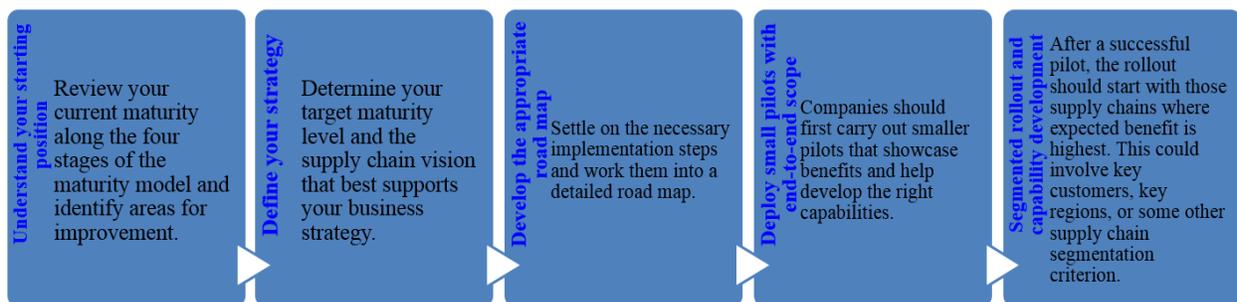


Figure 2: Steps towards Digital Supply Chain

## 2.1 Challenges in Supply Chain 4.0

I4.0 creates a disruption and requires corporations to reconsider the way they design their supply chain. Numerous technologies have emerged that are modifying conventional ways of working (Bienhaus & Haddud, 2018). However, the red-hot issue in front of industries is the lack of coherent tactic for managing total supply chain all delivered through automation and enabled workflows. Poor management lowers efficiency, thereby leading to direct and indirect financial losses. Enhancing skills, changing the traditional organization structure and change management are critical levers under the Industry 4.0 digitalization. Therefore, social, environmental and economic impacts have certain crucial implications for the firm and need to be taken care through proper technological selection and management. Nowadays, due to dynamic and changing supply chain environment, organization faces many challenges in manufacturing space such as global competitiveness, lack of adaptability, go to market time (Arif-Uz-Zaman & Nazmul Ahsan, 2014).

Recently, globalization policy eradicates the restriction of market boundaries. The small and medium scale manufacturers are finding it hard to compete with the global large manufacturers, as they are incapable to acclimatize with the newer technologies to process difficult materials, optimize space utilization, and consume less energy (Thomas & Trentesaux, 2014). Another problem is introducing a new product and make it available to consumers at the right time. The common issue faced by manufacturers is to predict the right demand versus supply and to decrease the manufacturing lead-time. Consequently, it becomes inevitable for them to equip with right resources and processes along with technology to bring up revolutionary products and world-class services (Manavalan & Jayakrishna, 2019). Figure 3 shows these challenges.



Figure 3. Key challenges for supply chain organizations (adapted from (Arif-Uz-Zaman & Nazmul Ahsan, 2014))

Factors that effects uncertainty in supply chain management are global competition, lack of adaptability, delayed entry into market. The technology IoT provide solutions for these issues, which considerably transmutes the supply chain industry. For instance, this technology can be utilized to track the consignment location and speed of the vehicle and so that the users are notified by late or early deliveries. IoT technology can be used for monitoring the condition of an equipment from a remote location (Qiu et al., 2015). Temperature sensitive products can be observed with sensors and the data can be communicated through internet. For example, perishable products are wasted during transit. The confluence of internet, wireless, predictive analytics and cloud technologies can revolutionize the whole supply chain operations and bring more value out of it (Yang et al., 2013).

Therefore, there is a need for supply chain to adapt with the help of these new technologies. Besides the need to adapt, supply chains also have the prospect to reach the next level of operational success, to leverage evolving digital business models, and to transform the company into a digital supply chain.

## 2.2 Supply Chain 4.0 Influencing Factors

For better comprehension of supply chain and its tasks, it is inescapable to identify the impacting factors which affect supply chain. Generally, the factors that affect the performance of supply chain are shown in figure 4 (Manavalan & Jayakrishna, 2019).



Figure 4: Factors influencing the Supply Chain 4.0

## 2.3 Supply Chain 4.0 Enablers

A number of technologies are driving the digital trends such as sensors, cloud services, nanotechnology, big data, etc. Supply chain 4.0 requires several of these technologies to move towards digitalization. Rutkowsky et al. (2015), defined some of these enablers that are digitalizing supply chain process and are shown in figure 5.

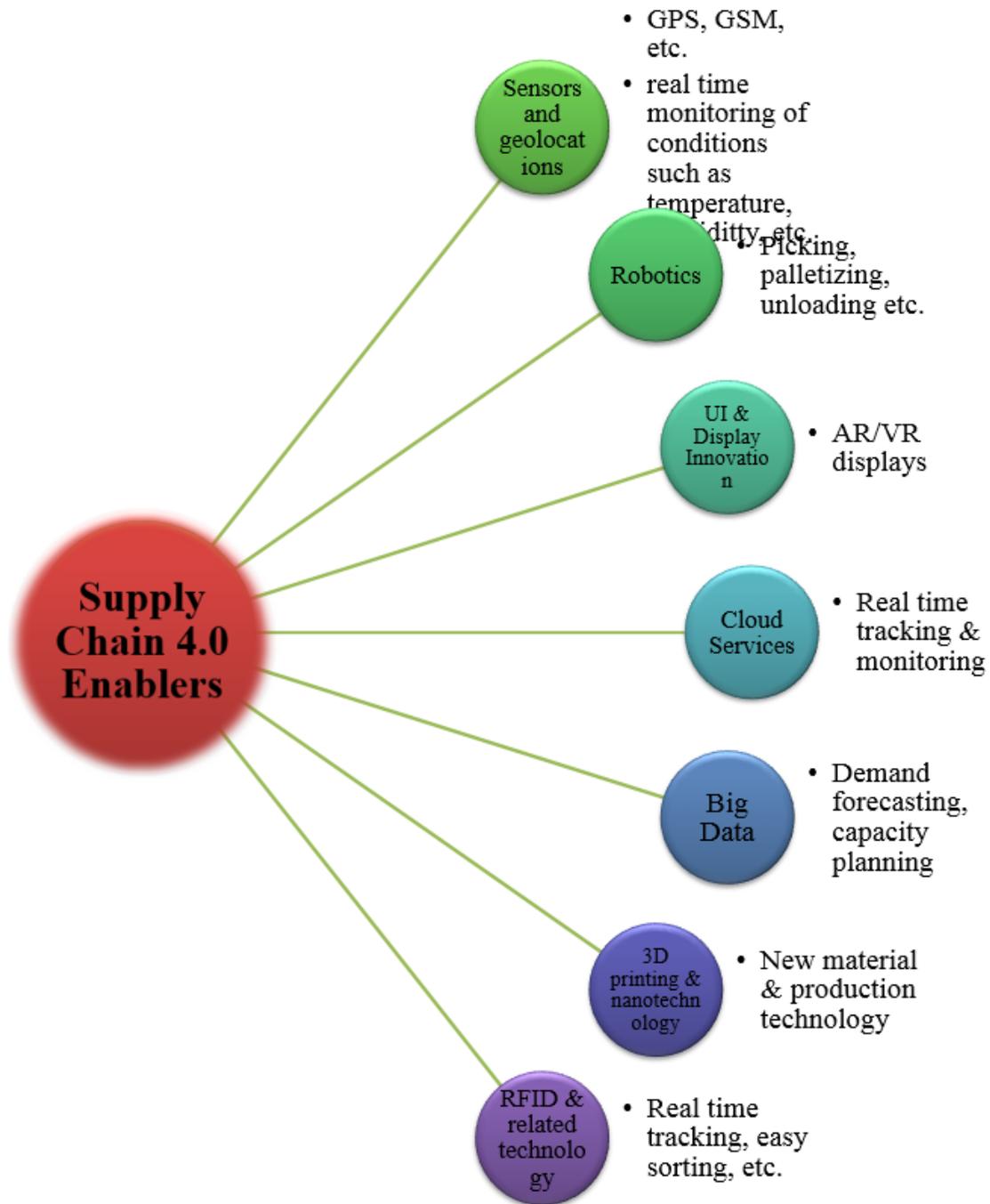


Figure 5: Enablers of Supply Chain 4.0

Rutkowsky et al. (2015), also presented a framework for supply chain 4.0. It includes connected products, embedded services, shared products, and omni-channel distribution. Figure 6 shows the framework for supply chain 4.0.

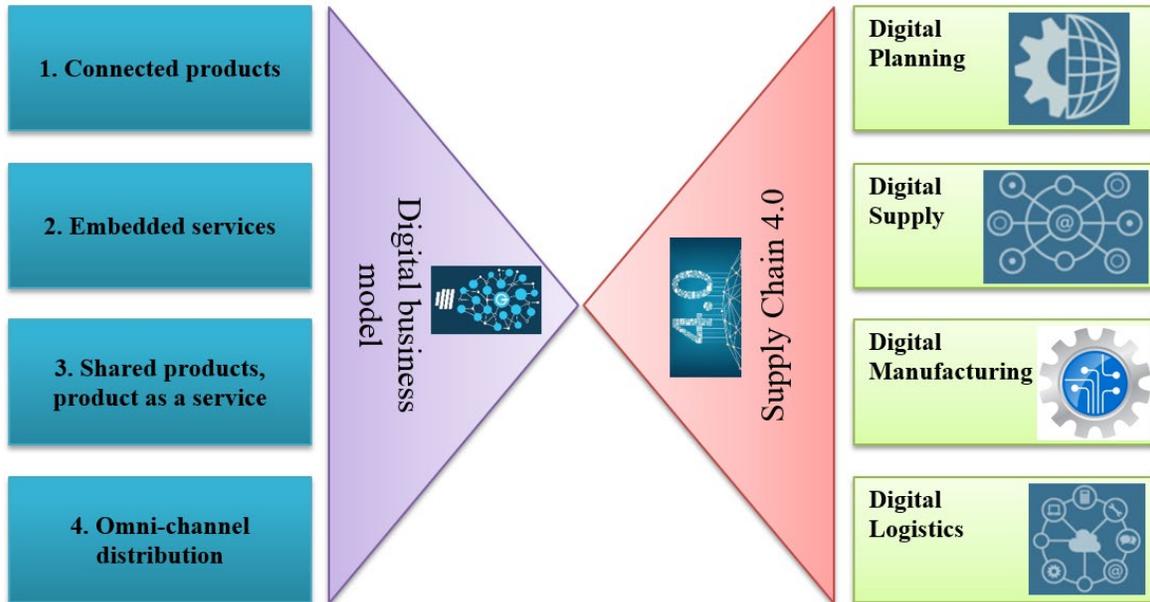


Figure 6: Framework for Supply Chain 4.0

### 3. Discussion, Conclusions and Recommendations

The digitization of the supply chain empowers organizations to address the new requirements of the customers, the challenges on the supply side as well as the remaining expectations in efficiency improvement. Digitization brings about a Supply Chain 4.0, which will be faster, more flexible, more granular, more accurate, and more efficient. The potential impact of Supply Chain 4.0 in the next two to three years is huge - up to 30 percent lower operational costs and a reduction of 75 percent in lost sales while decreasing inventories by up to 75 percent are expected, at the same time increasing the agility of the supply chains significantly. The characteristics of the supply chain 4.0 are shown in figure 7.

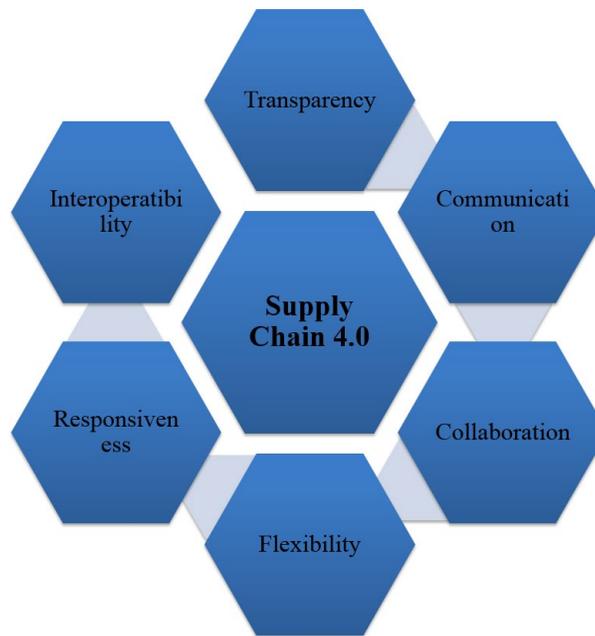


Figure 7: Supply Chain 4.0 characteristics

*Transparency* – Complete view and monitoring of supply chain

*Communication* – Information is available to all members of supply chain simultaneously

*Collaboration* – Natural development of collaboration with customers as well as suppliers

*Flexibility* – End customer demand changes can be rapidly assessed

*Responsiveness* – Real time response on planning and execution level (across all levels to demand changes)

*Interoperability* – Works with various platforms, and technology type

Supply chain 4.0 is the future, and one should invest wisely in this domain. The delivery will be made through drones and autonomous vehicles; orders will be placed online, and customers will have full flexibility in terms of material and product specifications. Changes in the order will be made by the customers can be dealt in the more efficient way if all the machines and human involved in the supply chain are connected and real time monitoring and tracking is enabled. Therefore, to deal with the future demand and supply, it is important to digitize the various levels of supply chain.

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