



A Desk Study on the Impact of Industry 4.0 on the Supply Chain in India

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ABSTRACT

Industry 4.0 can be simply defined as industrial work with fully automated concepts. It has established a major impact on the supply chain in India. It has not only automated the production sectors but has also upgraded the typical supply chain into a digital one. The digital supply chain enables a population to gain appropriate products with satisfaction. India is introducing itself as a developing country for the last few years. The major importance of industry 4.0 on the supply chain can be easily seen in India. India is the second-highest populated country in the world, so the digital supply chain is acting as a boon for the country, some valuable projects like Digitalization and Make-in-India have reduced the old policies in the manual supply chain system. This paper presents a desk study on how industry 4.0 has enhanced the digital supply chain in India and helping a large population to get rid of the old school supply chain facility. At the end of this discussion, it can be concluded that industry 4.0 or I4 or smart factory plays an important role in key factors that are responsible for the development stage in India.

Key words: Digital India, Industry 4.0, Make in India, Smart Supply Chain

1. INTRODUCTION

India is a developing nation for the last few years. According to a study of bbc.co.uk, India is proving itself an emerging and developing country (EDC) that is experiencing rapid economic development [2]. Since the country is facing drastic changes in development, it is also facing a change in old and outdated industrial works which directly or indirectly affects the population. The industrialization has always been a topic of discussion in India. Until the year 1991, India was a conservative market where there was a "License Raj" in which industries were given a quota for production outputs [11]. Due to this conservative type of market, the supply chain was very dull and inferior but time has changed today. With the help of many campaigns started by the Indian government like Make in India and digitalization, India is experiencing modern world industries that are fully automated.

Industry 4.0 which is also known as a smart factory has many front-line technologies like smart manufacturing, smart supply chain, etc. A smart supply chain or digital supply chain is the major front-end technology of industry 4.0 [8]. Various technical concepts like Industrial 4.0 internet of things (IoTs), cloud service, big data, and analytics, are very responsible for industry 4.0. Outside the industry or factory, a digital or smart supply chain includes technologies to support the horizontal integration of the factory with suppliers for the delivery of the product. This affects the operational costs and delivery time [8]. In India, the digital supply chain has established its roots in the last few years. Despite having a very large population, India has very well adopted the digital supply chain. Although with so much of the population, this was a big challenge. It is crucial to increase the transparency of all the steps from when the order is dispatched until the end of the life cycle of the product. Therefore, it is important to analyze the impact of I4.0 on the supply chain between suppliers, manufacturers, and a large number of consumers [15] And since consumers in India are large in number so, the digital supply chain is playing a major role in India. Also, the Industrial Internet of things made it possible for the automated and digital supply chain.

2. LITERATURE REVIEW

This section of the paper presents a review of most appurtenant works regarding Industry 4.0 and the supply chain. The shared information provides some basic and significant systematic data which helped in studying the field.

2.1 Background

Many informative works have been done in the related field. Reference [11] presents the study on how India is upgrading to Industry 4.0 from Industry 2.0. Digital networking platforms have also been focussed. Some government campaigns like Make in India and digitalization also helped a lot in raising the level of smart manufacturing as well as the smart supply chain. Some studies result in Industry 4.0 solutions for Reverse supply chain management with the help of the Internet of things. Some supply chain management or SCM 4.0 also involved the coordination of materials, information, and financial flow in a systematic

and automated manner. An informative study has been done on new stages of some major components of SCM 4.0 which are mentioned above[10] There are several challenges in the adoption of Industry 4.0 and the smart supply chain. Reference[19] presented a study to explore the major challenges in Smart Supply chain management (SSM) and Industry 4.0. This study also suggests methods to improve SSM adoption. Reference [17] shows the analysis of the supply chain in terms of order fulfillment and transport logistics implementing technologies involved in Industry 4.0. Industry 4.0 mainly involves smart manufacturing and smart supply chain. Reference [15] aims to evaluate the current adoption of Industry 4.0 which enables technologies in the manufacturing and supply chain management factors. Implementation of Industry 4.0 plays a vital role in smart manufacturing and smart supply chain. Reference [8] presents factories that own an advanced level of implementation of Industry 4.0 tend to adopt most of the front-end technologies. Digital transformation of the industry sector, as well as supply chain, have a vast future which is studied in depth [9]. Industry 4.0 is becoming increasingly tropical. Reference [4] presents a study on the scope and definitional components of the phenomenon regarding Industry 4.0.

With all tremendous informative research projects, we have studied some basic impacts of Industry 4.0 on the supply chain in India.

3. EVOLUTION OF INDUSTRY

In India for centuries goods like clothes, food, houses, weapons, decorative stuff, etc, were manufactured by hand or with the help of work animals. A drastic change comes into Existence by the beginning of the 19th century in Industry. This development in Industry results in more accurate products with technologies involved in manufacturing the products.

3.1 Industry 1.0

The First Industrial revolution takes place in 1760 and lasts around 1840. This stage of development includes water steam-powered machines [3]. Steam power was already known but the use of this power was not known before, first industrial revolution introduces the methods to use steam power as a mechanized version to increase human productivity. The first revolution from hand production methods to machines, Steam power, and water power is a vital role in the industrial revolution growth. Under Industry 1.0, many industrial sectors like Textile manufacture, Iron industry, steam power, machine tools, chemicals, cement, gaslighting, glassmaking, agriculture, paper machine, transportation, mining, etc come into existence [18].

3.2 Industry 2.0

By the beginning of the 20th century, electricity-driven machines were introduced. These machines were easier to use than water and steam-driven machines. The introduction

of Industry 2.0 has made manufacturing facilities more efficient and effective [3].

3.3 Industry 3.0

In the last 20th century, electronic devices like a transistor, integrated circuit chips were invented and added to industrial works. Many software systems were introduced to control and maintain the hardware components. Much logistic planning such as material requirement planning, supply chain management came into existence. These all facilities made this stage of development of industry more effective and accurate [3].

3.4 Industry 4.0

In the 21st century, the latest and most advanced stage of the development of industry came into existence. Industry 4.0 links the Internet of things with manufacturing techniques. This made things easier to share information, analyze the system, and use intelligent actions [3].

The development of new technology that includes additive manufacturing robotics, artificial intelligence, and many more has made industrial work easier and more effective.

The evolution of Industry has made many drastic changes and provides us more ease to connect to an Industrial system. As Industry 4.0 is highly automated, it gave birth to the digital supply chain. Figure 1 shows the drastic evolution of the industry.

The introduction of the Internet of things (IoTs) has made things easier to gather or convey information inside or outside the industry. IoT which works inside the industry sometimes called the Industry Internet of things (IIoTs).

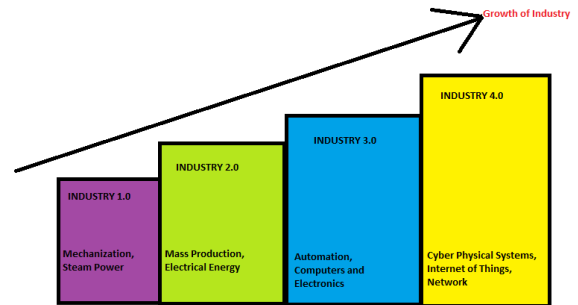


Figure 1: Evolution of Industry (Durand, 2018)

4. INDUSTRY 4.0: BASIC CONCEPT

Industry 4.0 was introduced by a German initiative of the federal government with some private companies and universities. It was a program equipped with strategies and logistics. Its initial aim was to increase the productivity and efficiency of the national industry. It also focuses on smart manufacturing techniques in adding value to the whole product life cycle. It also considers the flow of information and the blending of the supply chain (digital supply chain) which synchronizes production with suppliers to minimize delivery time and information disturbance.

5. IOTS AND SUPPLY CHAIN: DIGITAL SUPPLY CHAIN

Today in India, the old and outdated paperwork is losing the grip. The country is changing its way of sharing information. The IoT is a new model that is increasing its area in modern wireless telecommunication ground. The IoT provides a platform for the supply chain by enabling the flow of information [15]. IoT also provides man-to-machine or machine-to-machine interactions which facilitate the supply chain to collect or gather information. The use of the internet makes the supply chain 'digital'. A network of physical things that are digitally connected to monitor intersect within a factory or between the factories and the supply chain. The digital connection enables the facility of time planning, control, and coordination of the supply chain processes [15].

Although India has a large population, the use of digital or smart supply chains is very well adopted by the country. In the current scenario where the whole world is in a pandemic situation suffering globally with Covid19, the digital supply chain has played a vital role for the suppliers as well as consumers. Industry 4.0 and supply chain are interrelated as supply with digital frames which is one of many applications of Industry 4.0 [4].

6. POPULATION IN INDIA AND SUPPLY CHAIN

The major challenge in India for the smart supply chain is its increasing population. India was under old industry policies for many years. Change in technology in Industry and its components was not easy to be adopted by India.

Figure 2 represents the growth of the population in India [6].

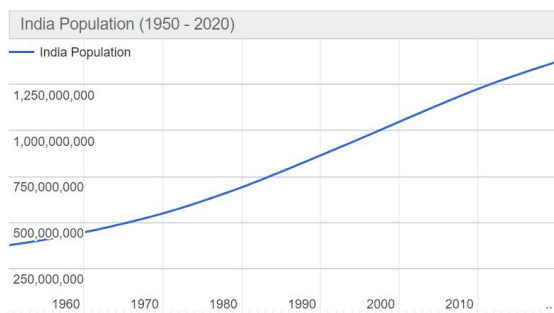


Figure 2. Growth of population in India

The population of India represents 17.99 percent of the world's total population which means that in every 6 people one person is a resident of India [1]. With so much population, it was very difficult for executing the digital supply chain in India. Industry 4.0 and the digital supply chain both are associated with the Internet of things (IoTs), which was also a big challenge for India to include areas with Internet and systems. But with help of a government campaign i.e., Digitalization and Make in India [11], India has adopted new technologies that helped to initialize the digital supply chain.

7. INDIAN GOVERNMENT CAMPAIGNS

The government of India has introduced some projects like Make in India, Digital India which enhances the industrial sector in India as well as the modern digital supply chain. Both the projects have upgraded the level of manufacturing technologies and smart supply chain. With a large population both the projects have helped India to boost its manufacturing demand and supply chain.

7.1 Digital India

Digital India is one of the dream projects of the Indian government. It was introduced to remodel India into a digitally empowered society [16]. This made digital resources and technologies available for the citizen of India. It helped in an establishment of a digital platform for smart and digital supplies. It vanishes the majority of old paper works which was a hard task to maintain. This project has provided a helping hand to the industries to maintain manufacturing and supplying techniques digitally. It also provides a big opportunity to use the latest technology to redefine Indian paradigms of Industrial service.

There are nine pillars of Digital India which facilitate the development of Industry technology and digital supply chain [16].

- ☑ Broadband Highways
- ☑ Universal Access to Phones
- ☑ Public Internet Access Programme
- ☑ E-Governance
- ☑ Electronic delivery of services
- ☑ Information for all
- ☑ Electronic manufacturing
- ☑ IT for jobs
- ☑ Early harvest programs

7.2 Make in India

The government of India has launched the Make in India project with the primary aim of making India a worldwide manufacturing hub with upgraded technology of Industry 4.0 [13]. This means that all the industrial works whether domestic or public can be under one boundary roof. This gave India's Industrial supply chain a boost and an encouragement to advancement. With all the technologies equipped India's industry stage gets upgraded and hence the supply chain becomes more digital and easier.

8. INDUSTRY 4.0 TECHNOLOGY RELEVANT TO SUPPLY CHAIN

There are many Industry 4.0 technologies which directly or indirectly connected to the supply chain. These technologies are mostly responsible to convert the supply chain to a digital and smart supply chain. These technologies are mainly Radio frequency identification (RFID), Internet of Things (IoTs), Cloud Computing (CC), Big Data Analytics (BDA), and Blockchain technology [15].

8.1 Radio frequency identification (RFID)

RFID is simply a wireless product tracking system. It uses radio waves for tracking and tracing products. The main component of RFID includes the tag, the reader, and the middleware system [15]. The reader covers the product information stored in the tags, and the middleware acts as a data processing unit that creates a link between RFID hardware and industry application [15].

RFID technology plays a vital role in automating the process of data gathering of products at different stages, which improves the tracking and tracing of products throughout the supply chain.

8.2 Internet of Things (IoTs)

IoTs uses sensors and actuators on the products which remotely track and interact with each other over the internet. It supports two types of interactions,

- ☒ Man to Machine
- ☒ Machine to Machine

When IoTs are introduced in the industry sector, a new term comes into existence 'Industrial sector'. IoTs convert conventional products into smart products. IoT helps to sense, monitor, and interact within an industry and its supply chain which enables tracking and information sharing. This results in timely planning, control, and coordination of the supply chain processes.

8.3 Cloud Computing (CC)

Cloud Computing is an essential industry technology. Cloud Computing technology offers computational and storage facilities by sharing IT infrastructures such as hardware, software, and services over the internet, which can be changed as per the dynamic requirement [15]. This results in a meeting of fluctuating demand of the market.

8.4 Big Data Analytics (BDA)

In the last some decades the amount of data generated has been increased due to advancements in technological fields. Industries are facing challenges to get business benefits out of these data, due to its high volume, variety, and complexity [15].

BDA involves different analytical techniques that have a high computing facility to analyze such raw, unorganized data. It also helps in decision-making on a real-time platform.

8.5 Blockchain

In Today's world where the industry is becoming more automated, and information sharing has been made so easy, there are chances of cyber-attacks. These attacks can tamper with the information and data that has been shared. To reduce these types of attacks, technology is there which is called Blockchain.

Blockchain is a distributed ledger technology in which data is managed in a decentralized way so that the tampering of data can be reduced. In the supply chains, blockchain technology is very beneficial. It can be used for improved product tracing and to maintain transparency for

building a better and trusted relationship with different consumers.

9. INDUSTRY 4.0 IN INDIA: CURRENT SCENARIO

According to a survey conducted by PwC and Market Search (India) Private Limited, which covers high officials from Indian manufacturing companies, tried to get the level of adoption of industry 4.0 by Indian manufacturing sectors. This survey concluded that 86 percent of the respondents have interested in investing in Industry 4.0. Many of the respondents expected that the establishment of industry 4.0 would help in reducing product cost and increase efficiency [5].

As per the survey, it can be observed that India is moving in the path of adoption of all the technologies involved in industry 4.0. The digital supply chain is one of the technologies under industry 4.0 that is very well adopted by India, thus reducing the paperwork procedures [8]. Some factors that should be considered for a better digital supply chain are as follows:

- ☒ Digital platforms with suppliers
- ☒ Digital platform with customers
- ☒ Digital platform with other company units

10. LIMITATIONS

Though India is moving very positively in technical fields in the industrial sectors, some factors are acting as a barricade. Some of the factors in India have been discussed as limitations in this section.

The main factors that this section focuses on are India's Literacy rate and India's internet user percentage. These two factors decide the success of industry 4.0 and its impact on the supply chain.

10.1 India's Literacy rate

The literacy rate plays a vital role in the development of any country in any sector. With a large population, India struggles for a good literacy rate. The rural areas of India lack many literacy issues. India's literacy rate is 77.77% [14], although this percentage is good the remaining percentage left has issues in literacy. The literacy rate directly affects the knowledge of technologies, their components, and their applications. So, this factor somehow limits the exposure of the introduction of technologies throughout the population.

10.2 Internet usage in India

Another factor that limits the topic is the use of the internet. The rural regions of India lack internet connection of India, which results in slow progress in technical fields. Some urban areas also lack a slow internet connection. The region with the highest internet rate in India is Delhi NCT. Although the rate of internet usage has been increased from the last 5 years, 50% of the population still lacks internet access [12].

Figure 3 shows the rate of Internet usage in India. According to the current scenario, internet connectivity should be more accessible to the population of India.

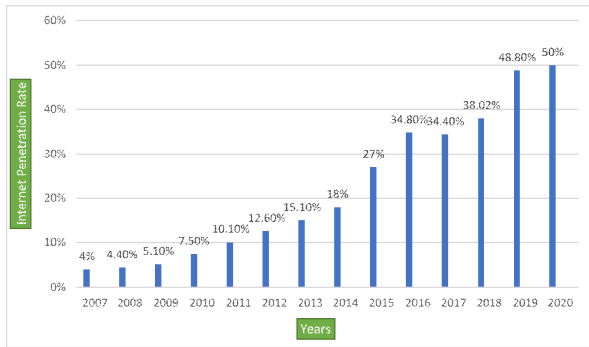


Figure 3. Internet usage rate in India

11. DISCUSSION

The positive impact of technologies that are linked with industry 4.0 on the supply chain in India is the topic discussed in this paper. As there have been many technologies developed in the industrial sector, it also influences the outside industrial work to be full of automation. This results in a smart or digital supply chain. With so much technology, the supply chain is getting easier and easier to handle in India. Some limitations are also been discussed. Apart from these limitations, India is improving and adopting technologies in industry 4.0.

12. CONCLUSION

This work presents a study on the impact of industry 4.0 on the supply chain in India. After studying the current condition of India in industrial sectors, this paper concludes that India is moving on a fruitful path in the field of industry 4.0 and its applications. Government projects like Digitalisation and Make in India have supported industrial sectors and their technologies inside and outside the industry. The decisions for replacing paperwork with smart and digital technologies are very significant in sharing and cycling of information throughout the process of the supply chain. This makes the supply chain in India smart and digital. With the help of the Digitalisation platform which is already introduced in India, it will create a base for the future advancement in industries with industry 5.0 and many more.

REFERENCES

1. Ministry of statistic and programme, **trading economics**, Retrieved from www.tradingeconomics.com: <https://tradingeconomics.com/india/population>, 2020
2. BBC, **Bitesize**, Retrieved from www.bbc.co.uk, 2020
3. Crandall, R. E., **Association for Supply Chain Management**, Retrieved from ascm.org, 2017

4. Culot, G., Nassimbeni, G., Orzes, G., & Sartor, M., **Behind the definition of Industry 4.0: Analysis and open questions**, *Internal Journal of Production Economics*, 1-14. DOI: 10.1016/j.ijpe.2020.107617, 2020.
5. Das, G., **Business Today**, Retrieved from www.businesstoday.in, 2017.
6. Department of Economics and Social Affairs, United Nations., **Worldometer**, Retrieved from Worldometers.info: <https://www.worldometers.info/world-population/india-population/>, 2020.
7. Durand, P., **Automation World**, Retrieved from AutomationWorld.com, 2020.
8. Frank, A. G., Dalenogare, L. S., and Ayala, N. F., **Industry 4.0 technologies: Implementation patterns in manufacturing**, *International Journal of Production Economics*, pp.15-26. DOI: 10.1016/j.ijpe.2019.01.004. 2019.
9. Hahn, G. J., **Industry 4.0: a supply chain innovation perspective**, *International Journal of Production Research*, doi:10.1080/00207543.2019.1641642, 2019.
10. Hofmann, E., Sternberg, H., Chen, H., Pflaum, A., & Prockl, G., **Supply chain management and Industry 4.0: conducting research in the digital age**, *International Journal of Physical Distribution & Logistics*, 945-954. doi:10.1108/IJPDLM-11-2019-399, 2019
11. Iyer, A., **Moving from Industry 2.0 to Industry 4.0: A case study from India on leapfrogging in smart manufacturing**, *15th Global Conference on Sustainable Manufacturing*, pp. 663-670, Elsevier. DOI: 10.1016/j.promfg.2018.02.169, 2018.
12. Keelery, S., **Statista**, Retrieved from www.statista.com: <https://www.statista.com/topics/2157/internet-usage-in-india/>, 2020.
13. Make in India. (n.d.), **Make in India**, Retrieved from www.makeinindia.com.
14. Nandini., **Hindustan Times**, Retrieved from www.hindustantimes.com, 2020.
15. Raut, R. D., Gotmare, A., Narkhede, B. E., Govindarajan, U. H., & Bokade, S. U., **Enabling technologies for Industry 4.0 manufacturing and supply chain**, *IEEE transactions on engineering management (EMR)*, 1-22. doi:10.1109/EMR.2020.2987884, 2020.
16. Roy, D., **opIndia**, Retrieved from www.opIndia.com, 2019.
17. Tjahjono, B., Esplugues, C., Ares, E., & Pelaez, G., **What does Industry 4.0 mean to Supply Chain?** *Manufacturing Engineering Society International Conference*, pp. 1175-1182, Vigo (Pontevedra), Spain: Elsevier. doi: 10.1016/j.promfg.2017.09.191, 2017.
18. Vinitha, K., Prabhu, R. A., Bhaskar, R., & Hariharan, R., **Review on industrial mathematics and materials at Industry 1.0**, *Materials Today: Proceedings*, pp.1-5, 2020.

19. Yadav, G., Luthra, S., Jakhar, S. K., Mangla, S. K., & Rai, D. P., **A framework to overcome sustainable supply chain challenges through solution measures of industry 4.0 and circular economy: An automotive case**, *Journal of Cleaner Production*, pp.1-15. doi: 10.1016/j.jclepro.2020.120112, 2020.