

Impact of Industry 4.0 on Supply Chain

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Abstract

Every time, Technological disruptions change the business models and create new avenues for doing business. "Industry 4.0" is the upcoming wave of disruption capable of permanently changing how the Goods are produced. Without fail, Technological interruptions change the plans of action and make new roads for working together. "Industry 4.0" is the impending rush of interruption that can forever change how the goods are created. Industry 4.0 is the structure of cutting-edge innovations (Autonomous robots, big information examination, Augmented Reality, Additive assembling, Cloud, Cybersecurity, Industrial Internet of things, Horizontal and Vertical joining, Simulation) that will make an interconnected assembling framework that will convey, break down and utilize the data to settle on wise choices. Indian Industries has a tremendous advantage from industry 4.0 since the public authority arrangements (Digital India) are adjusting to the economy's digitalization. This paper clarifies the effect of these advancements in key execution measurements of the drivers of production networks (Inventory, Transportation, Facilities, Information, Sourcing and evaluating).

Keywords: *Industry 4.0, Digital India, Cyber Security, Augmented Reality, Artificial Intelligence*

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I. INTRODUCTION

The term Industry 4.0 was coined in Germany as an impact of change brought by digitalization and web in the assembling businesses, which altered the interaction between the item's plan and assembling measure and the tasks of assembling associations. The expected innovations that will shape industry 4.0 are Autonomous robots, IIoT, Augmented reality, Artificial Intelligence, Bigdata Analytics, Systems Integration, Simulation, Cloud, added substance production [BCG]. Because of industry 4.0, the associations are reexamining and overhauling their stockpile chains to adjust to the progressions and difficulties that the innovations of industry 4.0 will bring. The key exhibition measurements that will gauge the productivity and responsiveness of store networks (Logistics, Inventory, Facilities, Information, Sourcing, and valuing) will be significantly influenced by advances of Bigdata Analytics, Autonomous Robots, and IIoT.

1.1. Literature review

Abdeen et al. (2018) Facilities Management (FM) is a powerful calling, which supports center business works by establishing a successful and productive assembled climate for customers, inhabitants, and guests while keeping up with communications with gatherings like FM specialists, in-house FM groups, workers for hire, providers, and specialist co-ops. The different idea of FM capacities requires viable stock chains. Consequently, this paper intends to examine the concept of an FM inventory network alongside upstream and downstream capacities, different streams, and various gatherings engaged with FM supply chains. Sandanayake et.al., (2020) The examination researched the idea of FM store network with its exercises, streams, and gatherings engaged with significant FM capacities like support, fix and repair, energy, and water the executives, building administrations and tasks, wellbeing security and cleanliness, and housekeeping. Information assortment was restricted to the clothing area. The exploration discoveries can be utilized as an aide by customers and FM groups for upgrading the exhibition of the FM store network.

Deepesh Singh et al. (2018) The purpose of this paper is to outline the Inventory of the board in-store network and their present Inventory related issue in a current-day business and present an applied approach for a related issue. The procedure depends on the stock, contributions for the technique, and the advantages, which are the system's yield. Ajay Verma (2018) A writing audit is directed at the administration or control of stock. Furthermore, it gives identification with stock in the industry and its different boundaries. A calculated procedure for stock issues in the present business.

Ernst Pessl et.al., (2017) expressed that the industry 4.0 difficulties the different divisions like buy, coordination's, creation, deals and human asset of the assembling organizations. The creator examined the procedural model empowering the organizations to break down their individual development level in

distinguishing the objectives and foster an activity plan in executing them. Ability development model aides in assessing the current circumstance of the organizations regarding an analyzed activity field. Then again, method model aides in executing of the substantial undertakings of the organizations by characterizing the means to accomplish their objectives. Sebastián, González-Gaya (2020), The creator additionally expressed that the organizations have recently begun to manage Industry 4.0 as it was impractical to characterize the objective level. Consequently, the guide Industry 4.0 is a precise apparatus for further developing the individual multi-disciplinary I4.0 procedure to expand the I4.0 development.

Foerstl et al. (2021) Embracing to revoke past reevaluating choices is turning into a boundless practice among firms. While the basic exhibition drivers for firms (e.g., lead times, responsiveness, or security of supply) are surely known, the social viewpoints hidden administrative dynamic cycles regarding embracing stay disregarded in experimental exploration. Cataldo (2021), We study the impacts of supervisors' mentalities toward adopting, their apparent conduct control (PBC) over the embracing choice, and the impact of mimetic tension on embracing choice expectations and conduct while establishing our model in the Theory of Planned Behaviour (TPB). We test speculations with information accumulated in a vignette-based investigation among 145 supervisors and apply stepwise relapse examination to discover support for the beneficial outcomes of disposition and mimetic tension on goals to adopt.

Hashmi U (2017) The activity of transportation in inventory network the board decides the proficiency of moving items. The advancement in strategies and the board standards works on the moving burden, conveyance speed, administration quality, activity costs, the utilization of offices, and energy saving. Auditing the current condition, a solid framework needs a reasonable edge of coordination, and an appropriate vehicle executes and strategies to interface the creating techniques. The paper's target is to characterize the job of transportation in coordination for the reference of additional improvement. The examination was embraced to characterize and understand the fundamental perspectives on coordination and its different applications and the connections among coordination and transportation.

Jenny Bäckstrand et al. (2019) Most researchers of buying and supply the board (PSM) know about some type of a buying cycle model (PPM). A PPM is the visual portrayal of the arrangement of exercises that establish buying and supply the executives. A particularly visual portrayal can be an apparatus in showing PSM since it gives understudies an outline of a generally elusive interaction. In addition, a PPM can likewise be seen as a portrayal of the character of PSM, giving a pattern of what is PSM (and what it is not). In this notes and discussions article, a precise outline of various sorts of PPMs, and their advancement, is introduced, in view of a writing audit and an overview, with the models being delegated strategic/functional, vital, repeating, or dynamic cycles. Suurmond,(2019), Our first point is to motivate PSM researchers and instructors when they are thinking about different PPMs to be utilized in their educating of PSM. Our subsequent point is to discuss the inquiry where the development of PPMs is going and investigate whether a solitary all-encompassing model can give an exact and agent system to structure buying exercises both today and later.

Kumar and O. Shoghli (2018) in his investigation, examined the effect of IoT in giving constant update on conveyance and information for dealing with materials in inventory network the executives and furthermore the job of IoT in esteem expansion works that could acquire the type of materials the board and correspondence in an undertaking. This investigation centers around the employments of IoT in reconciliation of organizations and furthermore gadgets with shrewd sensors could help in materials following and correspondence which is of high exact and clamor free. Nizamis (2020), In development, SCM is a vital errand to be done in taking care of the development materials, since materials cost hold a significant segment in the development. Without legitimate SCM, deficiency of development materials or early and unreasonable section of materials may happen which again prompts expansion of different immediate and circuitous expenses. So, by the utilization of IoT in SCM, the expense can be limited and furthermore working fair and square of correspondence and materials taking care of our improved. Additionally, Cloud registering, and large information assists with breaking down and store the crude and handled data from sensors.

Matthew A. Waller (2013) expressed that there are more freedoms for research where the SCM meets with information science, prescient examination and huge information, which is altogether alluded as DPB. The uniqueness of big information lies the volume, assortment and speed of information which is economical and is broadly accessible to store and access the information. The justification more volume of information is that more subtleties of information are caught. Stanley (2013) reasoned that we have recently started to investigate the potential outcomes of big information in Supply chain the executives and more inventive educated choices are to be approached to further develop production network plan, relationship advancement, further developing client care activities. Likewise, it is more difficult to see the immediate association between enormous information and inventory network the board.

Parkhi et al. (2015) Store network management philosophy of further developing the business measures, making them stronger, spryer, and thus, more serious. The primary capacity of SCM is to work on the item or administration seriousness Based on a methodical writing survey, we have endeavored to investigate the

fate of Supply Chain. We have caught different meanings of SCM given by specialists from the underlying to ongoing period alongside significant old-style definitions. Different elements of Supply chain are an essential piece of this investigation. The paper talks about SCM and its measurements; and attempts to depict SCM from related regions additionally explains different speculations of SCM. On consummation of intensive writing audit, the paper closes with an end and future extent of work.

Tjahjono, Esplugues et. al., (2017) featured that industry 4.0 accentuates in the worldwide organization of machines in a savvy processing plant which helps in return and control the data self-sufficiently through IoT. This makes the keen manufacturing plant to work self-governing. Later, Industry 4.0 structures an association among machines and individuals in digital actual frameworks. The creator means to fill holes in the innovation execution in Industry 4.0 principally in distribution center, coordination's, acquirement, and satisfaction capacities. Inventory network switches like move to sell, to purchase, to store are interconnected and each switch addresses a space of production network the executives and furthermore KPIs are characterized for each switch for acquiring quantifiable measures. Gayialis (2020), The creator expressed in the end that execution of innovations, for example, 3D printing, computer generated reality, expanded reality and reenactment results to different sorts of chances for an association. Then again, advancements like large information, cloud, network safety, IoT, mechanical technology, nanotechnology may prompt freedoms or dangers for an association. This is on the grounds that, as every one of the spaces are interconnected with no unmistakable limits between them, it might prompt positive or unfortunate underlying meaning relying upon the spot of investigation.

II. DRIVERS OF SUPPLY CHAIN

The drivers are classified into two main types that influence the performance of the supplychain such as,

Logistics drivers – facility, inventory, logistics

Cross-functional drivers – information, sourcing, pricing.

Facility:

Offices are the real actual areas where the materials are being put away, gathered, and afterward manufactured. Offices can be of two sorts to be specific creation area (plants) and capacity area (stockrooms). The store network execution increments because of better administration of the area, limit, and adaptability of these offices, Abdeen (2018).

Inventory:

Inventory includes the raw materials, work in progress and finished goods of a company. The supply chain efficiency and responsiveness are affected due to the changes in the inventory policy. Cycle inventory, safety inventory and seasonal inventory are the 3 basic decisions for creating and holding the inventory, Singh (2018).

Transportation:

Transportation refers to moving the inventory from one place to another in the supply chain. Depending upon the performance characteristics, it takes any combination of the routes and modes. The modes of transportation can be of six types such as ships, railways, trucks, airplanes, pipelines, and electronic transport, Hashmi (2017).

Information:

Information provides the connection between different stages of the supply chain by providing coordination and to maximize the profitability. Usually, information can be used for forecasting and planning for future demands, coordinating the daily activities related to supply chain driver functions, and to analyze the information's in the supply chain through the emerging technologies, Parkhi (2015).

Sourcing:

Sourcing refers to the purchasing of goods and services in a business activity. Managers should take decisions relating to outsourcing of the service, and the services that can be performed within the organization itself. In house or outsource decisions are to be taken to perform the task inside the firm or to outsource. And the number of supplier selection for a particular activity, Bäckstrand (2019).

Pricing:

Pricing refers to how much the firm charges for a particular goods or services. Pricing strategy affects the behavior of the buyer which eventually affects the supply chain performance. Pricing can also be considered as a lever to the supply and demand analysis, Foerstl (2021).

2.2 Analysis

Industry 4.0 uses heavy automation and leverages exchange of information through the industrial internet of things. In the smart factory era Autonomous mobile robots will take care of inhouse logistics. Automatic guided vehicles and rail guided robots will take care of managing the warehouse thus eliminating human intervention for identifying, pickup and delivery of various goods in inventory for supply. Supply Chain Operations Reference model (SCOR) evaluates performance, and it identifies areas for improvement in

organizational supply chain. It is based on 5 processes plan, make, source, return, delivery. SCOR model has high credibility, universal scorecards, and standardized metrics.

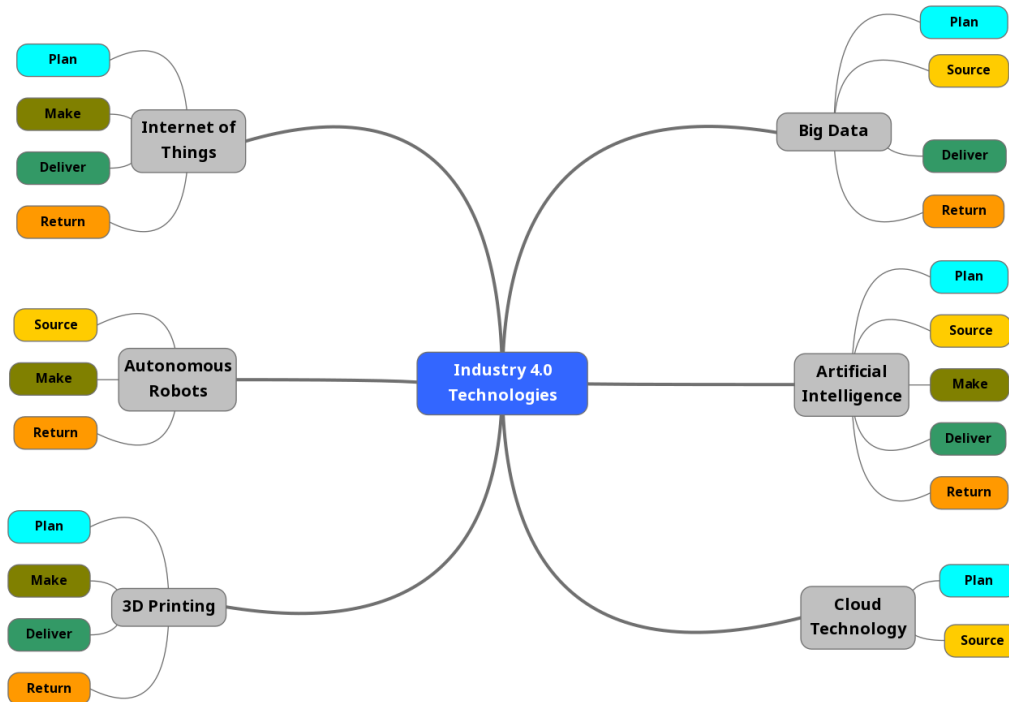


Fig: 1 Industry 4.0 Technologies SCOR Model
Source: Author's own source

Big data Analytics

The buzz word of the century "data" carries a huge potential in changing the business models. The advent of big data and analytics brings opportunities for better performance of supply chains. The data collected from the IIOT, and modes can be used in optimization of supply chain with help of big data analytics. Bigdata analytics uses both qualitative and quantitative analytics techniques in estimating flow and storage of inventory [big data]. These analyticstechniques can be applied to optimize the routes and helps to find the shortest distance between the source and destination. In Industry 4.0, the sensor data of production machinery uses big data analytics to analyze and predict when the repair operations are needed. Big data helps the companies to improve in operations by improving warehouse processes, eliminating bottlenecks, predictive maintenance.

Autonomous Robots

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Artificial Intelligence (AI)

Man-made intelligence the "thinking machines" are equipped for imitating, learning, and replacing the exercises that are customarily done by people. The artificial neural networks are equipped for accommodating in course streamlining, overseeing stock successfully from the information storehouse accessible with association and help in expanding the precision of demand planning. Consequently, managing stock adequately and moving products in savvy course. AI in industry 4.0 is mainly applied in OEE optimization, quality 4.0 operational excellence. AI techniques gave rise to product optimization, supply chain integration and better product development.

Internet of Things (IoT)

Internet of things is brilliant detecting gadgets which are interconnected to connect the correspondence and innovative gap between the main partners of the task i.e., provider and client. IoT helps in expanding the supply chain perceivability to settle on better educated choices and exercise better authority over the inventory network. The materials are better followed on development and gives sufficient measure of information to make

data driven decisions. IoT in industry 4.0 enables the enterprise to meet the growing demand, boost efficiency and to give better customer experience.

Augmented Reality (AR)

The target of increased the truth is to expand this present reality with the virtual data giving continuous setting to virtual climate components. An up-front console will help the experts read the rundown, furnish with ongoing data to ship products and tell the effective way through the distribution center to get the merchandise. AR assumes a significant part in offices arranging as it assists with picturing the full-scale perspective on the following office. With the goal that the chiefs can display their office considering the future necessities and requests of the business. AR in industry 4.0 provides transformation and consistency. AR is also used in smart construction, process design process, engineering training, it helps people to look at the things in a different way.

3D printing

3D printing otherwise called additive manufacturing that enables clients to make a 3d object from a PC model. 3d Printing Technology permits clients to construct complex items from a wide assortment crude material running plastic, metal, fired, sap, biomaterials, food materials and so forth at the point when carried out it will significantly affect the store network as numerous organizations will in general rethink fabricating in this way decreasing stock. It will significantly affect cost since set up costs, stock expenses can be diminished. 3D printing in industry 4.0 benefits in quality prototypes, cost and pricing, printing speed, printing material and technological advancements.

Cloud Technology

Cloud Technology includes conveying administrations over the web. Capacities and assets of the distributed computing innovation empowers clients to utilize cloud for programming as an assistance, Platform as a help and Infrastructure as an assistance which lessens the expense of possession. With the information produced from IoT organizations can utilize distributed storage administrations to store and recover the information and can utilize this information in doing investigation. Since the speed with which the information is created cannot be put away in an actual stockpiling it is better for the organizations to utilize distributed storage innovations. By utilizing this the data driver of inventory network will be affected more. Cloud computing in industry 4.0 is essential as, it is flexible and safe, it is agile and adaptable to business needs, enables effective supply chain and provide maintenance.

Drivers	Facilities	Information	Inventory	Pricing	Sourcing	Transportation
Additive Manufacturing 3D Printing	Yellow		Blue	Blue	Blue	Yellow
Artificial Intelligence		Orange	Orange	Orange	Yellow	
Autonomous Robots	Orange					Orange
Big data analytics		Blue		Orange	Yellow	Orange
Cloud technology		Blue			Orange	
Internet of Things	Orange	Blue	Orange			Yellow

III. CONCLUSION

Thus, the proposed idea assesses the impact of the key technologies that forms the part of the future industries (Industrial Automation IoT 4.0) these drivers of SCM to keep supply more responsive orefficient. The impact of these technologies on each driver of the supply chain are detailed in this paper and it is found that the technologies Autonomous robots, Bigdata Analytics and IoTwill have major impacts on the drivers of the supply chain. Hence, a complete industry 4.0 integration with SCM drivers. In this technique SCM drivers plays a vital role which is a connectivity from industry 4.0 technologies to drivers such as facilities, information, inventory, pricing, sourcing, and transportation. Hence, by implementing these technologies modernization to industry 4.0 can be achieved.

REFERENCES

- [1]. Abdeen, F. N., & Sandanayake, Y. G. (2018). Facilities Management Supply Chain: Functions, Flows, and Relationships. *Procedia Manufacturing*, 17, 1104-1111.
- [2]. Abdeen, F. N., & Sandanayake, Y. G. (2020). Facilities management supply chain: collaboration of FM functions, flows, and parties in the apparel sector. *International Journal of Logistics Research and Applications*, 1-20.
- [3]. Bäckstrand, J., Suurmond, R., van Raaij, E., & Chen, C. (2019). Purchasing process models: Inspiration for teaching purchasing and supply management. *Journal of Purchasing and Supply Management*, 25(5), 100577.
- [4]. Cotrino, A., Sebastián, M. A., & González-Gaya, C. (2020). Industry 4.0 Roadmap: Implementation for small and medium-sized enterprises. *Applied Sciences*, 10(23), 8566.
- [5]. Chen, H., Chiang, R., and Storey, (2012), "Business Intelligence and Analytics: From Big Data to Big Impact", *MIS Quarterly*, 36(4), pp 1165–88.
- [6]. Cheng, H. Tieng, H. C. Yang, M. H. Hung, Y. C. Lin, C. F. Wei, and Z. Y. Shieh (2016), "Industry 4.1 for wheel machining automation," *IEEE Robotics and Automation Letters*, vol. 1, pp. 332–339.
- [7]. Ernst Pessl, Sabrina Romina Sorko, Barbara Mayer (2017), "Roadmap Industry 4.0 – Implementation Guideline for Enterprises", *International Journal of Science, Technology and Society*, 5(6), pp 193-202.
- [8]. Foerstl, K., Franke, H., & Cataldo, Z. (2021). What drives managers to insource production? Evidence from a behavioural experiment. *Journal of Purchasing and Supply Management*, 100715.
- [9]. Gayialis, S. P., Konstantakopoulos, G. D., & Papadopoulos, E. P. K. G. A9 (2020) An Advanced Transportation System Based on Internet of Things.
- [10]. Hashmi, U. (2017). The Impact of Transportation in Supply Chain Management: Evidence from Private Sector of Pakistan. Available at SSRN 3022644.
- [11]. Helen Rogers, Norbert Baricz, Kulwant S Pawar (2016), "3D printing services: classification, supply chain implications and research agenda", *International Journal of Physical Distribution & Logistics Management*, 46(10), pp 1-22
- [12]. Hokey Min (2010), "Artificial intelligence in supply chain management: theory and applications", *International Journal of Logistics Research and Applications*, 13:1, 13- 39, DOI: 10.1080/13675560902736537.
- [13]. Kumar and O. Shoghli (2018), "A review of IoT applications in Supply Chain Optimization of Construction Materials", *International Symposium on Automation and Robotics in Construction*.
- [14]. Mastos, T. D., Nizamis, A., Vafeiadis, T., Alexopoulos, N., Ntinis, C., Gkortzis, D., ... & Tzovaras, D. (2020). Industry 4.0 sustainable supply chains: An application of an IoT enabled scrap metal management solution. *Journal of cleaner production*, 269, 122377.
- [15]. Matthew A. Waller and Stanley E. Fawcett (2013), "Data Science, Predictive Analytics, and Big Data: A Revolution That Will Transform Supply Chain Design and Management", *Journal of Business Logistics*, 34(2), pp 77–84.
- [16]. Maqbool Khan, Xiaotong Wu, Xiaolong Xu, Wanchun Dou (2017), "Big Data Challenges and Opportunities in the Hype of Industry 4.0", *IEEE ICC SAC Symposium Big Data Networking Track*.
- [17]. Parkhi, S., Joshi, S., Gupta, S., & Sharma, M. (2015). A study of evolution and future of supply chain management. *Supply Chain Management*, 9(2), 95-106.
- [18]. Singh, D., & Verma, A. (2018). Inventory management in the supply chain. *Materials Today: Proceedings*, 5(2), 3867-3872.
- [19]. Stentoft, J., Mikkelsen, O. S., & Johnsen, T. E. (2015, January). Going local: a trend towards insourcing of production?. In *Supply Chain Forum: an international journal* (Vol. 16, No. 1, pp. 2-13). Taylor & Francis.
- [20]. Tjahjono, C. Esplugues, E. Ares, G. Pelaez (2017), "What does Industry 4.0 mean to Supply Chain?", *Manufacturing Engineering society International Conference*, Vol 13, pp 1175-1182.
- [21]. Wilson, M. C. (2007). The impact of transportation disruptions on supply chain performance. *Transportation Research Part E: Logistics and Transportation Review*, 43(4), 295-320.
- [22]. Zhou, T. Liu, and L. Zhou (2015), "Industry 4.0: Towards future industrial opportunities and challenges", *International Conference in Fuzzy Systems and Knowledge Discovery (FSKD)*, pp 2147–2152.
- [23]. <https://www.simul8.com/manufacturing/implementing-industry-4-0-with-simulation>