International Journal of Humanities Social Science and Management (IJHSSM)
Volume 4, Issue 2, Mar.-Apr., 2024, pp: 530-539 www.ijhssm.org

The Role of Technology in Optimizing Supply Chain Efficiency in the American Manufacturing Sector.

Omotolani Akinbolajo
Department of Industrial Management, Texas A&M University, Kingsville, Texas.

Date of Submission: 14-03-2024 Date of Acceptance: 28-03-2024

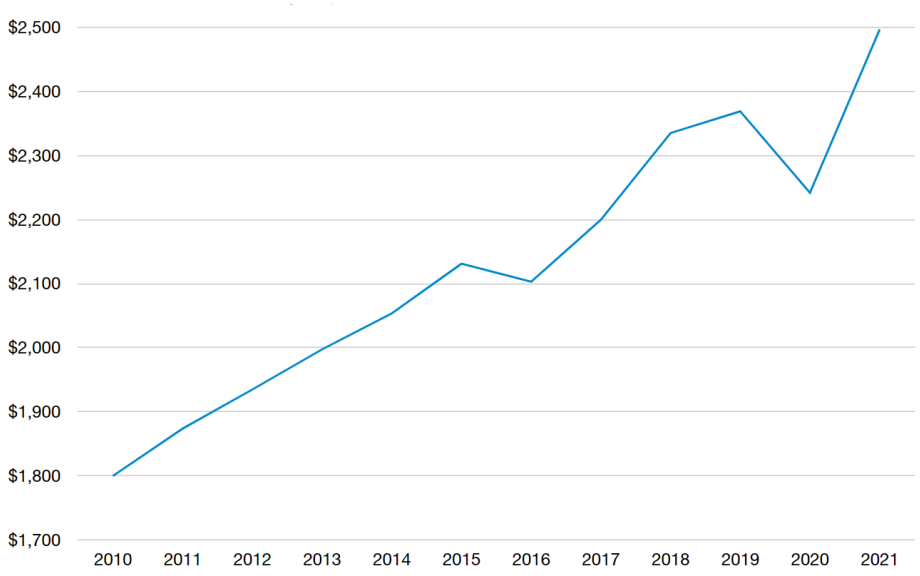
Abstract
The role of technology in optimizing supply chain efficiency in the American manufacturing sector has been investigated in this paper. Seemingly, the growth of the United States manufacturing sector over the years requires an efficient supply chain management for supply of raw materials to factories and finished goods to warehouses and retail outlets. Although, the use of modern technology in the US manufacturing sector is gaining ground gradually, the optimization of the supply chain process is capable of improving efficiency in the manufacturing sector. However, much as technological optimization of supply chain management is capable of improving manufacturing output in the US, it has some inherent challenges, which have been identified and discussed. The study observed that the solution to the challenges require multi-dimensional means, including, physical, legal, and operational resolutions. The study concludes that technological optimization of supply chain process will enhance the operational performance of the manufacturing sector in the United States. Therefore, multi-dimensional approach to the optimization of the US supply chain management with technology is recommended.

Keywords: Digital Technology, Supply Chain Management, Optimization, Manufacturing, Efficiency.

I. Introduction

The manufacturing sector is currently one of the economic boosters across the globe, and in particular, the United States. Whilst each nation strives for economic growth and seeks to maintain a stable prosperity level for its citizens, the manufacturing sector has seamlessly been instrumental in this this regard. In KPMG's (2023) report, the benefits of the manufacturing sector to an economy extend to important areas like employment generation and revenue drive for individuals and the state. This view is further corroborated by the National Association of Manufacturers (NAM, 2023), which asserts that 10.70 percent (about $2.5 trillion) of the total outputs in the United States was produced by the manufacturing sector in 2021. Additionally, about 8.41 percent of the United States workforce was employed by the manufacturing sector in the same year. The growth of the manufacturing sector in the US as shown in trend chart in Figure 1 shows an upward trend in the growth of the sector. A steady growth was maintained between 2010 and 2015, until a global economic crisis hit world in the mid-2015, and the sector bounced back in 2016, continued to maintain growth until the outbreak of the Covid 19.

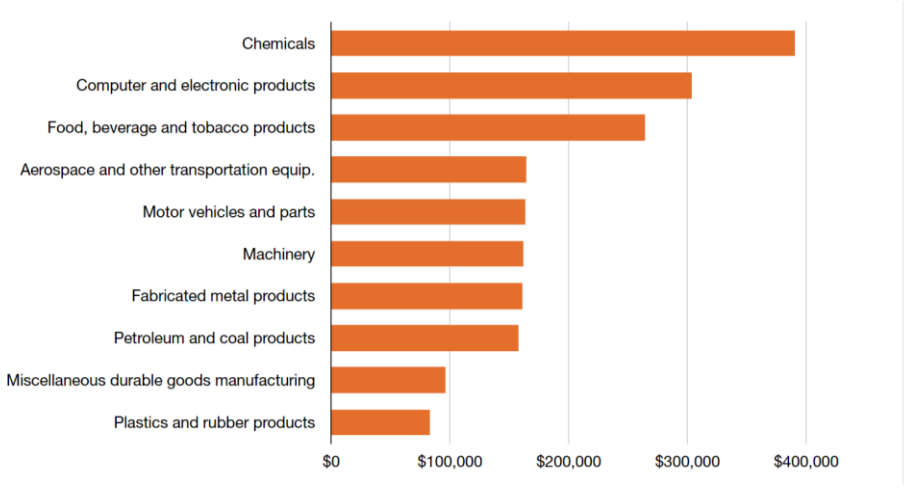
Figure 1: United States Manufacturing Output in Billion Dollars, 2010-2021



Source: National Association of Manufacturers, 2023

Since the advent of the covid-19 pandemic and its quick management through different emergency responses, the manufacturing sector in the United States has continued to expand both in leaps and bounds. The US manufacturing sector continues to grow with productions in different specialized areas such as: chemicals; computer and electronic products; food beverage and tobacco products; aerospace and other transportation equipment; motor vehicles and parts; and machinery, among others.

Figure 2: Top 10 United States Manufacturing Sectors, in Millions of Dollars, 2021



Source: National Association of Manufacturers, 2023

Manufacturing sector in the United States, over the years, has not only contributed immensely to economic growth, it has also continually adopted modern technology to optimize the manufacturing and supply chain processes. The emergence of digital technology such as the Blockchain, the

Internet of Things (IoT), Cloud Computing and Artificial Intelligence, has provided broader synchronization between manufacturing and supply chain management. Although, the direct adoption of modern technology is observed to be sluggish in the US manufacturing sector, the manufacturing-supply chain linkage is an identifiable panacea for technological innovation in the manufacturing sector. Unlike the manufacturing sector, the e-commerce, educational and health sectors embrace modern technologies, which according to Ning & Yao (2023) provided them an edge over other sectors during the Covid-19 pandemic. Ning et al (2023) observed that whilst the pandemic was ravaging the world, only education, remote workers, online shoppers, and telemedicine were able to take of advantage of digital technology. This raises a concern for the manufacturing sector, both in terms of disposition to technology and the adaptation of technology in manufacturing. Forbes (2023) asserted that the existence of a complicated relationship between manufacturing and technology was traced to industry's complex history. This calls for stakeholders' concern.

Supply chain management, though is not a direct process in manufacturing, remains an important midpoint between manufacturing sector and technology adoption. In a simple term, supply chain management is a systematic movement of products from the point of production to a point of storage and then to a point of use. From the point of production to the point of use, there exists a complex chain of people and processes, whose efficient management determines a firm's competitive edge. It is imperative, therefore, for manufacturers to rival one another not only on the basis of product differentiation but also in the adoption of technology in supply chain management. The advent of Big Data, 5G networks, cloud computing, Blockchain, and Internet of Things (IoT), among others have staged a new platform for both optimization of supply chain processes and competition for manufacturers. It is therefore imperative to investigate the role of technology in optimizing supply chain efficiency in the American manufacturing sector.

II. Literature Review

Supply chain management is critical to the operation and competitiveness of firms, Okoduwa et al (2023). The increasing relevance of supply chain management and its synchronization with current technological advancements are worth considering in relation to manufacturing sector performance in the United States. In view of this, this section of the paper focuses on the review of relevant literature on the subject of supply chain management optimization as enabled by modern day technological advancements.

2.1 Theoretical Review on Supply Chain Management

2.1.1 Resource-Based View (RBV)

The core of this theory is that firms compete on the basis of product supply rather than the logistics or means of products tracking and distribution. The theory asserts that a firm will operate better and distribute more efficiently if it has access to quality resources and technological capabilities. As such, a firm will be at a competitive advantage if it has access to better human, material and technical resources. Such firm is believed to produce optimally; hence, its supply chain management will be efficient. In the opinion of Barney (2001) a company's assets and capabilities are catalysts for superior performance and competitive advantage. This belief underlies the principle of resource heterogeneity and that a favorable access to and deployment of the firm's resources (tangible and intangible) will set it at a vantage position.

2.1.2 Stakeholder Theory (ST)

Stakeholder theory of supply chain management looks beyond the shareholders of a firm into a broader level of all contingent stakeholders. Stakeholder theory is adopted for many business decisions of firms such as outsourcing, supplier strategy, as well as make-or-buy decision (). In this theory, a firm's shareholders, employees, investors, customers, partners, environment of operation, regulatory agency, and competitors are all parts of the stakeholders to be considered in the design, management and delivery of supply chain management. Although, this theory is widely criticized for its idea of giving equal attention to all stakeholders, it remains one of the most-widely adopted theories in supply chain management.

2.1.3 Institutional Theory (INT)

The institutional theory focuses on how an organizational structure can be influenced by external pressure or institutional environment. According to Akhter et al (2018), institutional pressure and the quest for legitimacy may influence the operational structure of an organization in a competitive environment. The theory concerns the

impact of political and socioeconomic systems on the operation of a firm and how firm gains their legitimacy. According to Tate *et al* (2010), Institutional theory (INT) may be adopted in understanding how changes in legislations, technology advancement, and societal values influences a firm's decision in environmental sustainability practice. Delmas and Toffel (2004) investigated the relationship between organizational methods and the firm's adoption of environmental management methods using the institutional theory. This theory is relevant in supply chain management, especially where the role of technology and environmental concerns are of important consideration.

2.1.4 Transaction Cost Theory (TCT)

Transaction Cost Theory (TCT) is one of the prominent business theories with foundation in economics. Popularized by Williamson (1981) and traced to the works of Coase (1937), transaction cost theory is an indispensable business decision tool for a firm to adopt in taking decisions on a transaction cost related matter. The underlying principle of the theory is that all firms incur cost on transactions, the magnitude of the cost and the perception of whether high or low prompts the decision on either to internalize the cost or outsource it in the external market structure. In other words, a firm will take a decision that favors its cost reduction by either taking a cause of action internally or outsource it to be executed outside the organization. The theory is relevant as a fundamental background framework in supply chain management. The overall intent of the theory is to both minimize costs and maximize operation performance leading to efficiency in the management of organization's resources.

2.1.5 Resource Dependence Theory (RDT)

Resource Dependence Theory (TCT) is also one of the applicable theories adoptable in supply chain management. The theory rests on the fundamental basis that a firm is often found in a position, where interacting with other firms in its environment as a precaution against uncertainty becomes unavoidable. RDT sparks synergistic dependence between firms in a manner where one firm is reliant on the other for access to resources and enhanced managerial capabilities (Jajja *et al*, 2017). In the context of supply chain management, Akhter *et al* (2018) opined that the resource dependence theory posits the development of exchange relationship between two firms in order to gain complementary resources in a heterogeneous society. Ketchen et al (2007) identified the likelihood of imbalance in firms' interdependence, the concluded that such imbalance is "vital for reduction of environmental uncertainty."

Having considered different theories that are fundamental to supply chain management, one would easily conclude that there is no one-fits-all theory that fully captures the essence, concept, and working of supply chain management.

2.2 Trends of Technology Optimization in Supply Chain Management

The emergence of modern technology continues to make impact in supply chain management with extended impacts on the manufacturing sector. An efficient supply chain management system, among other things, can provide rapid and seamless distribution of manufactured products. Although, manufacturing has been observed to lag in in the adoption modern technology (Forbes, 2023), its connection to supply chain management serves as a channel of technological infusion into the fringe area of the manufacturing sector. The development of robotics, big data, artificial intelligence, blockchain and internet of things (IoT) has continued to push for better and more efficient supply chain management.

2.2.1 Artificial Intelligence and Automation in Supply Chain Management

The introduction of Artificial Intelligence (AI) in supply chain and logistics management has changed the operational dynamics in that business subsector. Since the introduction of AI and other advanced technologies, the supply chain landscape has taken a different turn with improved efficiency and reduced costs. Artificial intelligence has demonstrated high level of resourcefulness in supply chain management, especially in the area of optimization of supply chain. The process of optimization simplifies supply chain processes, thereby helping customers get what they want and when they need it. This involves improving supply chain and deploying AI to manage critical stages of the supply chain process. The adoption of AI in the optimization of supply chain management has typically yielded positive results in inventory management, demand forecasting, optimizing transportation, warehouse automation, and improved customer service.

Optimizing supply chain process with the infusion of AI technologies has proven to save time, increase distribution efficiency, and improve customer experience. However, the adoption of in the management of supply chain faces some drawbacks. As an instance, there could be a case of massive job loss in the society, while data security and privacy may equally be challenge to confront.

2.2.2 Blockchain Technology in Supply Chain Management

Blockchain (Distributed ledger technology) is a digital database that is often distributed in a chain-like connection of nodes of peer-to-peer business network. It could be defined as an information technology infrastructure in the financial space, which can synchronically connect business to business or product to product. (Lioa & Wang, 2018; Mohsen 2023). Since its introduction in 2011, Blockchain has demonstrated capacity to revolutionize supply chain management usually in the area of fostering transparency, cost-saving, traceability, and product tracking. As further identified by Mohsen (2023), Blockchain technology in supply chain management is capable of simplifying and improving regulatory compliance as well as improving monitoring process.

2.2.3 Cloud Computing in Supply Chain Management

Cloud technology's usefulness in supply chain management cannot be overstated. Cloud computing is a cutting-edge technology that allows organizations to plan, design and manage database at relatively cheaper and highly secured way. Supply chain management deals with clusters of people, data and processes that can be managed at high level of efficiency outside the office. Cloud offers a variety of choices for supply chain managers, which include: private clouds, public clouds, and hybrid clouds. It often comes in different packages for ease of adoption. For instance, cloud computing services may be offered in terms of Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud offers a range of opportunities in supply chain management, which include but are not limited to transparency, openness and accountability.

2.2.4 Internet of Things (IoT) in Supply Chain Management

Internet of Things (IoT) is a simplified description of the interconnection between technologies that processes and disseminates useful information via electronic devices, software, processor, sensors, etc. over the internet. The advent of IoT provides ease of developing software and programs that can aid automation, fast data processing, and dissemination of useful information in real-time. In supply chain management, Internet of Things provides smoothness in a systematic combination of digital and physical systems for inventory management, accurate forecasting of future trends, and product development. The roles of IoT in supply chain management are inexhaustible. As opined by Saberi et al (2019), Tziantopoulos (2019), Mohsen (2023), Internet of Things enables systems check of order and deliveries, real-time conduct of POS analysis, and quick inventory level control.

III. Supply Chain Optimization in the American Manufacturing Sector

Supply chain management can be regarded as the lifeblood of manufacturing. Its integration with the manufacturing sector provides room for flexibility, resilience and innovation (Siagian et al., 2021). The primary objective of production is to produce what is needed, at a time it is needed, and transported to the point of need. A corroborating production objective was by Daneshjo (2013), who described production objective as manufacturing of the right quantity and quality of goods and services at the right time and at a minimal cost. In a bid to achieve the objectives of production, the efficient management of the supply chain systems cannot be overemphasized. Importantly, optimization of the supply chain systems provides easy way for optimizing operational efficiency in the manufacturing sector (Duoming & Chin, 2022).

Optimization of supply chain management is the process of infusing modern technology in the SCM processes. Okoduwa et al (2024) opined that optimizing supply chain systems in the United States is capable of enhancing manufacturing performance and competitiveness of businesses. Vickery et al (2003) in agreement with Okoduwa et al (2024) asserted that improvement in customer service and financial performance in the United States are traceable to the improvement in supply chain management. Supply chain management systematically takes manufactured goods through the supply chain network to the users of the product at a minimal cost implication to all. Optimization of supply chain systems can be carried out in two ways. First, optimization of the supply chain

International Journal of Humanities Social Science and Management (IJHSSM)
Volume 4, Issue 2, Mar.-Apr., 2024, pp: 530-539 www.ijhssm.org

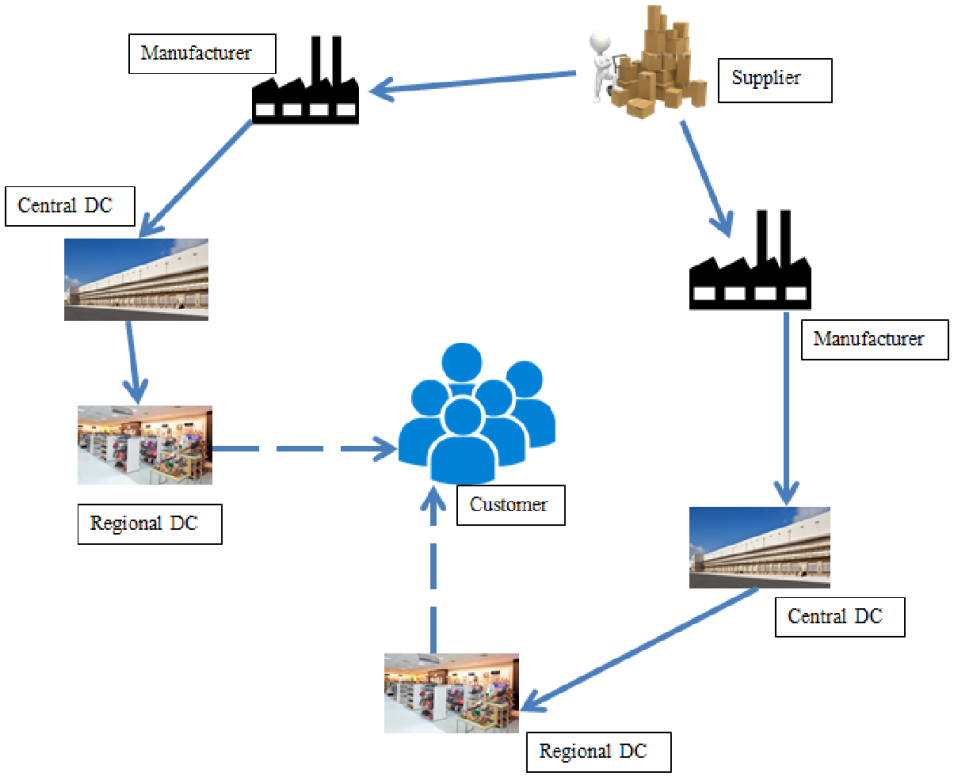
network; second, automation and IT infusion into the supply chain process.

3.1 Optimization of Supply Chain Network

Optimization of supply chain network entails a quantitative process of finding an optimal combination of production plants, warehouses and other distribution centers in the supply chain. It is the first step in supply chain management. Locating these core components, makes deployment of technology easier and more resourceful. As depicted by Figure 3, supply chain in relation to manufacturing and distribution of goods is not limited to finished products. Usually, the process of supply chain ensures continuous flow of raw materials to manufacturing plants from suppliers, while the finished products is distributed as a continuation of the supply chain management from producers to warehouses to retail outlets and then, the final consumers.

Central to supply chain network optimization are the people, the final consumers of the finished products. It is also a competitive position for businesses. Therefore, the process of supply chain network is often considered on multiple levels revolving around the provision of ease and value for money for the end-users of the product.

Figure 3: Multiple Channel of Distribution Supply Chain Network (MCDSCN)



Source: Yadav & Singh (2018).

3.2 Optimization of Supply Chain Management

Counterpart and continuation to the supply chain network optimization is the optimization of the supply chain management. The overall objective of optimizing this process is to make product tracking, distribution, and inventory management seamless and faster. This is the process of infusing modern technologies into the supply chain processes. Information and Computer Technology (ICT) is diverse in nature and their infusion into supply chain management is capable of changing the face of the US manufacturing sector. Optimization of supply chain management in connection with the manufacturing sector can make visible difference in the following ways.

3.2.1 Logistics and Transportation

Movement of raw materials, semi-finished goods and finished products is a critical component in supply chain management. The advancement of technology in the area of logistics is seamless. Distribution of items is now possible through the use of autonomous vehicles, such as drones and self-driving vehicles is possible. The process saves time, reduces human related errors, and improve efficiency. For instance, Volvo, TuSimple, Starsky Robotics, Uber Freight, and Embark Trucks, among others, are leading the frontiers in autonomous transport solution. The use of autonomous vehicles in supply chain management is a simple synchronization of hardware, software, internet access and cloud to provide enhanced efficiency in movement of goods and services.

3.2.2 Industrial Process

The use of robotics in industrial processes is gaining much ground by the day. Although, there is a high level of concern for loss of jobs and increase in unemployment, the considerable reduction in production cost is also worth considering. The onus is on stakeholders in manufacturing and supply chain management to find a Pareto efficiency, where the continuous deployment of robots in the manufacturing and SCM will increase efficiency in the sector without creating loss of jobs.

3.2.3 Inventory Management

Inventory management (IM) is a critical function in manufacturing and supply chain management (Munyaka & Yadavalli, 2022). It can be seen as a central coordination of procurement, storage, usage, and restocking of raw materials, work-in-progress, and finished goods. Computer and Information Technology deployment in inventory management is a game-changer in the management of inventory level. The process usually involves generation of barcode (such as GS1-128 barcode), which are scannable line-bar structure that provides necessary information about the product at real-time. Cross-border business relations have been made possible through the use of barcode, full or partial automation of supply chain systems, among others.

IV. Challenges of Technology Optimization in Supply Chain Management

Optimization of technology in supply chain management faces inherent challenges, which tend to undermine the it efficiency. In this paper, some of the recurring technology optimization in supply challenges management are examined thus:

4.1 Complexity in supply chain structure.

This is usually the foundational challenge of infotech optimization in supply chain management. In most common situations, it is rare to have one ownership structure of an entire supply chain. As observed by Burmester *et al* (2017), two agents are identified in the movement of goods along the supply chain, the person with ownership right of the goods and the person with logistics. In this instance, optimizing the supply chain process may be partial to the extent of each agent's innovation and availability of resources.

4.2 Cost of Installation and Maintenance.

Cost implication is one very important consideration in the technological optimization of supply chain systems. From the procurement of hardware, obtaining software licenses, installation, monitoring and maintenance of technological structure, it is apparent that optimizing supply chain process will depend of the size of the supply chain system and the financial strength of its active agents. This explains why full automation of supply chain process may be difficult.

4.3 Unequal Technological Advancement in the World.

Supply chain management is an important factor in cross-border trades. Adopting technological framework in supply chain may be hindered by unequal technological capacities of different countries. This may hinder bilateral trading agreements between nations and cross-border partnering companies. Developing countries may not easily catch up in terms of the optimization of the supply chain process as supply chain is not limited intra-country businesses. Therefore, sub-optimal use of technology in supply chain may hinder the efficiency and functionality of supply chain management and its contribution to the effective performance of manufacturing companies.

4.4 Regulatory Framework and Environmental Concerns

Much as organizations with financial and technical resources may be freely disposed to full adoption of robotics, artificial intelligence and automation of supply chain systems, the regulatory and environmental concerns may impose limitations. As an instance, government may legislate on limiting the extent of companies using

robotics and artificial intelligence in the manufacturing and supply chain management. Concerns for human safety, and preservation of humanity are of serious concerns to governments and policy makers around the world. Addressing this concern, Baranov *et al* (2020) emphasized the lack of preparation of parliaments and the limited capacity of the current legal design and framework in the context of robotics and artificial intelligence. Legal limitations are a serious concern the optimization of supply chain processes.

4.5 Data Privacy and Cybersecurity

Optimization of supply chain management requires a lot of data generation, sorting, analysis, and consumption, which makes information exchanges and decision-making easy for businesses. However, data privacy is a critical concern for businesses, agents, and all stakeholders engaged in SCM. How Individuals and companies lay emphasis on how their personal details are accessed and used in supply chain process. Accordingly, the optimization of the SCM process may not enjoy full participation of all required people. Furthermore, issues relating to cybersecurity in terms of providing foolproof assurance against hackings, online scams and malware are of equal concern as data privacy. The growing population of scammers and hackers is a threat to the adoption of IT, especially for a young organization.

4.6 Resistance to Change

Although, change is constant, adapting to new innovation may suffer setbacks due to over-reliance on historical process. Often times, a change to improve a system is carried out by individuals in line of duty. Optimizing a well-established supply chain system may encounter resistance in different areas of the process. Critical in the introduction of a technical innovation in supply chain process is to first educate the frontline workers and ensure their buy-in.

V. Future Trends in Supply Chain Optimization

Seemingly, the future has been brought forward by the advanced technologies currently making impacts in all spheres of humanity. Whether or not the world is read to accept the reality is a matter for further discussion. The future of supply chain optimization is beginning to unfold with the development of clouds, Big Data, Machine Learning and Artificial Intelligence, Robotics, Internet of Things (IoT) and Blockchain, among others. The right adoption of these technological innovations may reduce poverty, improve quality of life, create sustainable wealth and make supply chain process. The increasing use of Internet of Things (like Radio Frequency Identification, RFID), autonomous vehicles, robotics are expected to revolutionize supply chain management with much positive impacts on global manufacturing sector.

VI. Conclusion

Optimization is crucial to the further development of global standards in supply chain management. Movement of raw materials, semi-finished goods, and finished products between factory, warehouse, and retail outlets is a complex structure of human, equipment and modern technology. As found from the study, the optimization of supply chain process faces different challenges, which may undermine its efficacy in the process. The solution to the challenges has also been identified to require multi-dimensional means, including, physical, legal, and operational resolutions. Albeit, optimizing supply chain management remains a veritable tool in enhancing the effectiveness of the manufacturing sector in meeting different levels of societal needs. Therefore, the study concludes that optimization is necessary in supply chain management to enhance the productivity of the manufacturing sector, and ensure that the right product in its right quantity and quality is delivered to the right place at the right time.

REFERENCES

[1]. Akhter, B., Uddin, M. B., & Jahan, L. B. (2018). Theories of Supply Chain Management: A Critical Analysis. The Cost and Management ISSN 1817-5090, Volume-46, Number-01.

[2]. Ashish Kumar Gautam and Dr. Rajkiran Prabhakar (2019). Theories of Supply Chain Management: A Literature Review. International Journal of Innovative Social Science & Humanities Research. ISSN: 2349-1876 (Print) | ISSN : 2454-1826 (Online) https://www.csirs.org.in/uploads/paper_pdf/theories-of-supply-chain-management.pdf

[3]. Baranov, P. P., Mamychev, A. Yu., Plotnikov, A. A., Voronov, D. Yu., & Voronova, E. M. (2020). Problems of Legal Regulation of Robotics and Artificial Intelligence from the Psychological Perspective. Propósitos y Representaciones,

8(2), e511. doi: http://dx.doi.org/10.20511/pyr2020.v8n2.511

[4]. Barney, J. B. (2001). Is the resource-based " view" a useful perspective for strategic management research? Yes. Academy of management review, 26(1), 41-56.

[5]. Burmester, M., Munilla, J., Ortiz, A., Caballero-Gil, P. (2017). An RFID-Based Smart Structure for the Supply Chain: Resilient Scanning Proofs and Ownership Transfer with Positive Secrecy Capacity Channels. Sensors, 17, 1562; doi:10.3390/s17071562.

[6]. Delmas, M. and Toffel, M.W. (2004) Stakeholders and Environmental Management Practices: An Institutional Framework. Business Strategy and the Environment, 13, 209-222. https://doi.org/10.1002/bse.409

[7]. Duoming, H., & Chin, T. (2022). A systematic review for supply chain integration and risks. International Journal of Academic Research in Business and Social Sciences, 12(1). https://doi.org/10.6007/ijarbss/v12-i1/11856

[8]. Forbes (2023). Why is the Manufacturing Industry Hesitant to Adopt New Technology. https://www.forbes.com/sites/forbestechcouncil/2023/11/09/why-is-the-manufacturing-industry-hesitant-to-adopt-new-technology/?sh=24cccdcf702f

[9]. Hastig, Gabriella M. and Sodhi, ManMohan S., Blockchain for Supply Chain Traceability: Business Requirements and Critical Success Factors (November 25, 2019). Available at SSRN: https://ssrn.com/abstract=3493418 or http://dx.doi.org/10.2139/ssrn.3493418

[10]. Jajja, M.S.S., Kannan, V.R., Brah, S.A., Syed Zahoor Hassan, S.Z. (2017). Linkages between firm innovation strategy, suppliers, product innovation, and business performance: Insights from resource dependence theory. International Journal of Operations & Production Management, 37(8), 1054-1075.

[11]. KPMG (2023). Manufacturing for Prosperity. https://kpmg.com/ng/en/home/insights/2023/11/manufacturing-for-prosperity.html#:~:text=Importance%20of%20Manufacturing&text=The%20manufacturing%20sector%20is%20a,engineers%20in%20the%20manufacturing%20sector.

[12]. Liao, D.Y. and Wang, X. (2018). Applications of Blockchain technology to logistics management in integrated casinos and entertainment. In Informatics, 5; 4; 44.

[13]. Munyaka, J. B., & Yadavalli, V. S. S. (2022). Inventory Management Concepts and Implementations: A Systematic Review. South African Journal of Industrial Engineering. Vol 33(2), pp 15-36.

[14]. National Association of Manufacturers (2023). United States Manufacturing Facts. https://nam.org/state-manufacturing-data/2022-united-states-manufacturing-facts/#:~:text=Manufacturers%20in%20the%20United%20States,was%20%242.5%20trillion%20in%202021.

[15]. Ning, L., & Yao, D. (2023). The Impact of Digital Transformation on Supply Chain Capabilities and Supply Chain Competitive Performance. Sustainability 15, 10107. https://doi.org/10.3390/ su151310107

[16]. Okoduwa, I. O., Ashiwaju, B. I., Asuzu, O. F., Arowoogun, J. O., Awonuga, K. F., & Ndubuisi L. N. (2024). Supply Chain Integration in Manufacturing: A Comparative Review of USA and African Industries. International Journal of Management & Entrepreneurship Research, Volume 6, Issue 2.

[17]. Saberi, S., Kouhizadeh, M., Sarkis, J. and Shen, L., 2019. Blockchain technology and its relationships to sustainable supply chain management. International Journal of Production Research, 57(7), 2117-2135.

[18]. Shivakumar Keerthi (2023). 6 Types of Supply Chain Models to Know. https://www.upgrad.com/blog/6-types-of-supply-chain-models/

[19]. Siagian, H., Tarigan, Z., & Jie, F. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in covid-19 era. Sustainability, 13(9), 4669. https://doi.org/10.3390/su13094669

[20]. Tziantopoulos, K., Tsolakis, N., Vlachos, D. Tsironis, L. (2019). Supply chain reconfiguration opportunities arising from additive manufacturing technologies in the digital era. Production Planning & Control, 30; 7; 510-521.

[21]. Vickery, S., Jayaram, J., Dröge, C., & Calantone, R. (2003). The effects of an integrative supply chain strategy on

customer service and financial performance: an analysis of direct versus indirect relationships. Journal of Operations Management, 21(5), 523-539.
[22]. https://doi.org/10.1016/j.jom.2003.02.002
[23]. Yadav, V.S., Singh, A.R., & Jain, N.K. (2017). Optimization of Supply Chain Network Design for Multiple-Channel Distribution.