



A Review Paper on the Impact of Industry 4.0 on the Future of Green Supply Chain

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ABSTRACT:

Industry 4.0 is revolutionizing the way companies manufacture, improve and distribute their products. Industry 4.0 is relatively novel to developing nations, especially in India and needs a clear definition for proper understanding and practice in business. Manufacturers are integrating new technologies, including Internet of Things (IoT), cloud computing and analytics, and AI and machine learning into their production facilities and throughout their operations. The supply chain function ensures integrated operations from customers to suppliers. Industry 4.0 creates a disruption and requires companies to rethink the way they design their supply chain.

Keywords: Industry 4.0, Green supply chain

I. Introduction

Industry 4.0 is revolutionizing the way companies manufacture, improve and distribute their products. Industry 4.0 is relatively novel to developing nations, especially in India and needs a clear definition for proper understanding and practice in business. Manufacturers are integrating new technologies, including Internet of Things (IoT), cloud computing and analytics, and AI and machine learning into their production facilities and throughout their operations. The supply chain function ensures integrated operations from customers to suppliers. Industry 4.0 creates a disruption and requires companies to rethink the way they design their supply chain.

II. Literature Review

(Muhammad Umar, 2021) in [1] examined that impact of Industry 4.0 in our economic and environmental performance by using the mediation of green supply chain management (GSCM), this is the power tool in emerging economy. In green supply chain management we also use Design/methodology/approach to testing of hypotheses, Smart-PLS in employment. According to them total 284 studies valid responses were analyzed. The findings showed that the Industry 4.0 will definitely useful for organizations in adopting eco-friendly practices by evaluating and monitoring GSCM practices and also understand their impact on environmental which also affecting the economic performance. They also give suggestion to the government they should also reform their policies, by the new policies it will enable manufacturers to think about green ideologies.

(Luthra, S, 2018) In [2] talked about the identification of problem for the Industry 4.0 initiatives and supply chain sustainability, total 18 challenges were identified. The challenges are empirically analyzed for the emerging economies in Indian context. The challenges occurs in the various dimension such as AHP ranks, Organizational challenges and many more, by this they are going give the direction for future research and Several obvious implications. They also discuss the effect and influence of green supply chain in whole business system via transforming the products are produced, designed delivered and discarded. This paper aims to recognize challenges to Industry 4.0 initiatives and identified key challenges to prioritize it for effective Industry 4.0 concepts. The Industry 4.0 initiatives can help industries to environmental protection and control initiatives and also the process safety measures in supply chains to s sustainable supply chains

(Ahmad H Sutawijaya, 2020) talked about consequences for increasing demands which shows transparency and high response from the company. The green chain management concept is to improve the performance of the organization's, costs efficiency, minimizes waste and integrates thinking into the supply chain. They use explanatory qualitative approach in various stages of collection of data by interviewing and observing the event. The study is conducted under two companies in Jakarta, namely Alphabet and New Diamond Putra. The result is based at the two event management companies, without significant impact on the 4.0 industrial revolution by implementation of green supply chains mainly in event organizers. This paper take out the finding that how they become the smart vendors/ suppliers. Smart management supported by smart operational indicators, smart data, smart warehouses, smart logistics and event decor. Therefore they have to make a rapid change in technology and knowledge in the form of the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, and Automation, Robots which directly affects operating procedures and logistics personnel industry, which later developed into green supply chain management.

(De Sousa Jabbour 2018) introduced two emerging topics which re-shaped manufacturing around the world: Environmentally-sustainable manufacturing and Industry 4.0. The integrating two industrial waves, present in current world promise to re-shape the patterns of production and consumption. In the paper they show that it's the one of the first works to point out it whether or not Industry 4.0 can synergistically boost environmentally-sustainable manufacturing with consideration of emphasis on the critical success factors that can pose opportunities and challenges to this process. They also propose an integrative framework containing twelve research propositions. He aims to shed light on the integration of two emerging topics that have re-shaped manufacturing around the world: Industry 4.0 and environmentally-sustainable manufacturing. We highlight that this work focuses on environmental sustainability rather than a 'triple bottom line' sustainability perspective. In the context of this scope limitation, we recommend bringing the social and economic dimensions of sustainability to this debate by A.B.L. de Sousa Jabbour et al. *Technological Forecasting & Social Change* 132 (2018) 18–25 23 developing the research agenda on Industry 4.0 and sustainability.

(Jr, Kenneth 2012) discussed a comprehensive GSCM practices model. While the entire individual hypothesis is not supported, the general model holds together logically well. The significance and strength of the positive links among the stage one and stage two GSCM practices suggest the importance of a staged execution of the practices. These results are uncomplicated leaving little doubt as to the recommended ordering. The impact of the stage two practices on environmental performance and economic performance is less clear cut. Specifically, the results associated with eco-design are difficult. It appears then that eco-design is not fully accomplishing the intended aim. Grote et al. (2007) argue that this may be because eco-plan methodologies require further development and improvement. A comprehensive GSCM practices presentation model is proposed and empirically assessed. The results of this examination support the proposition that GSCM practices are both environmentally necessary and good business. A structured two-wave approach to the execution of GSCM practices is recommended.

(Ritesh Kumar Hui 2021) he studied the process includes material sourcing, product design and selection, manufacturing process, delivery of the final product to the consumers, and end-of-life administration of the product after its useful life. The idea of GSCM is to abolish or reduce waste (energy, emissions, and chemical, solid wastes) alongside supply chain. As a systematic and included strategy GSCM has emerged as an important new innovation that helps organizations develop "win-win" strategy that achieve profit and market share objectives by lower their environmental risks and impacts, while raising their ecological efficiency. He also found that GSCM is mostly practiced in mechanized industries and few in the construction industries. GSCM has been experienced in some developing countries like Singapore, India, China, Hong Kong, Malaysia and South Africa. GSCM is a process of using environmentally friendly inputs and transform these inputs into outputs that can be reclaimed and re-used at the end of life cycle thus create a sustainable supply chain. As a well-known fact, materials are made from nature, thus needs to be 'environmentally friendly'. Hence, there is a need for movement awareness in the construction industry, which is a major issue the authors are address in their current research study.

(Carter, C. R 2011) talked about experiential validity is further enhanced by representative high levels of inter-coder reliability across family of codes; he uses a efficient literature review methodology. This methodology allows for the minimization of beneficiary bias and the maximization of reliability. They must declare that many of the trends that appear in the entity analyses of our data are probably signs of a broader trend toward performing more faithful research in the field of supply chain management as a whole. Still, we doubt that these individual analysis, and the trends which they reveal, help to auxiliary highlight the many exciting research opportunity in the area of SSCM. and replicability. The broad idea of sustainability and the key interface that sustainability has with supply chain organization, strongly suggests that sustainability is instead permit to do business in the twenty-first century. And supply chain management is an essential component of this license. It is also coupled with our own perspective and experiences will help to significantly guide future research in this strategic and essential area of supply chain management.

(Barbosa-Póvoa 2017) examined that a theoretical map, representing the main studied proportions of SSC (decision levels, sustainability pillars and OR methods), was proposed allow researchers and practitioners to imagine what has been done in the area. This, coupled with the deep examination performed, resulted in the definition of a future research outline structure composed by five main future research avenues: development of integrated decision models; sound treatment of the sustainability pillars; incorporation of uncertainty, risk and resilience management aspects into the OR models; explore a combination of OR methods so as to develop generic and solution efficient SSC models; study further reverse and closed-loop structures; expand the industrial application. This agenda opens several opportunities for research and partnership between academics and industries.

(Zhu, Qinghua 2013) observed that Green supply chain management (GSCM) has been a embryonic topic for at least a couple of decades Helping to make simpler and understand these complexity is necessary from both a realistic and research perspective. Given this situation and to further enhance thoughtful of the topic and even supply chain management in general, this paper develops and empirically tests a speculative model on the different types of institutional pressures fascinating manufacturing enterprises to pursue green supply chain management. Generally, structural relationships exist among GSCM adoption pressures, practices, and performance. The pragmatic results suggest that GSCM practice does not considerably affect economic performance, but improved environmental and operational performance upgrading can bring economic performance in the longer term. Thus, we recommend longitudinal studies to determine if the long-run economic performance is enhanced by some of these emerging GSCM practices. In particular, mimetic and normative forces are significant antecedents affecting the functioning of GSCM in manufacturing. It is useful that government and related bodies encourage GSCM by creating an awareness of the benefits and contribution successful experience. Such promotion can help to alleviate the doubts of the followers about adopting GSCM and reduce their risks organization with the environmental innovation adoption.

(Kusi-Sarpong 2013) they studied that they has introduces a sustainable advance criteria framework to deal with the sustainable advance issues within the Indian manufacturing sector. The Best–Worst Method (BWM) is useful to aid in ranking the sustainable innovation criteria. The results from this examining evaluation showed that the industrial managers viewed 'financial accessibility for innovation' as the most essential and critical sub-criteria to promote sustainable supply chain management and sustainable improvement followed by 'technical expertise availability and investment in R&D for green practices' and 'green industrialized and operational capabilities development'. It was also evident that 'Cultural, social values and norms' was the lowest ranked criterion. This study does have a number of assistance; there exist some boundaries and concerns. These boundaries do provide useful and additional opportunity for future and further studies into the subject. Given that only a few managers from the Indian manufacturing sector provide inputs,

generalisations cannot be made. The study is a snapshot in time, and much broader empirical and longitudinal exploration to determine if the sustainable innovation criteria significance may change over time is required. However, given the homogeneity of the respondent managers, we can be certain about particular routine and concerns in relation to sustainable innovation of Indian's manufacturing companies and its manufacturing sector

[Kusi-Sarpong 2019] talked about that the past supply chains were a non-competitive, unobserved element of strategy before the 1970s, today, they are a synergistic and dynamic part of corporate reasonable advantage. For passive Taiwanese firms, there are many challenges and unseen opportunities in recognizing and integrating SSCM. Suppliers are crucial to the competitive success of firms and the success of functioning projects. The fact that future supplier performance is expected to continuously get better and involve new attributes of sustainable Performance adds to the difficulty of the essential role of the supply chain management professionals. These decision-makers will need to recognize several foundational elements of SSCM. They also must have the skills to then operationalize these elements through reactive, cooperative and dynamic development of their organizations while working with their supply chain partners.

[Gunasekaran 2015] discusses the current trends and future study directions in green supply chain collaboration and incentives. The conversation begins with evolution of green supply chain collaborations and few contributions made so far. The editorial column piece introduces the special issue papers which address the green collaboration challenges and offers a general green collaboration research framework signifying pathways for future research. The article ends with the open research question in green supply chain collaborations and incentives. Collaboration is dependent on the provision of mutual benefit. Furthermore, it is not quite clear how upstream members are going to be benefited through green initiatives of focal companies. It is obvious that the focal companies are going to be benefited with the green initiatives. Hence the challenging questions for the focal company is how they should design incentive structures for green initiatives and interestingly how should they appropriately reward members across supply chain.

[Kushwaha 2016] talked about the focus on the facts and opportunities of green initiative for the success of the firm as well as sustainable growth. The paper is based on the investigative research, and broad literature survey has been done to bring the conclusion of the study. The automobile sector is rapidly growing its market share worldwide in recent years. It is because of various business strategy by automobile producer such as more focus on small cars and fuel-efficient cars having a low market price that are embattled to capture the maximum market. But due to increasing market share of the automobile sector there are several environmental issue are also arise such as carbon emission, global warming, etc. In such a situation, automobile manufacturers are facing dual pressure one, to save the environment and another is to maintain the performance of the firm in the long run. The performance of the firm can be judged on the basis of financial, functioning and marketing capability of the firm. This paper develops an approach towards the adoption of the green initiatives at the firm, and also tries to build a relationship between the performance of the firm and sustainable development through the adoption of green initiatives

III. CONCLUSION

This research paper underpins the link of Industry 4.0

- The study provides some managerial implications for production organizations and policymakers.
- The adoption of digital infrastructure could be more helpful for production organizations in getting positive results in operations and environmental management.
- The managers should focus on optimizing their logistics, procurement and production through adopting digital technologies as it will provide flexibility and reduce the cost through involving SC partners.
- The performance of the firm can be judged on the basis of financial, operational and marketing capability of the firm.

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