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The role of digitalization in adopting green supply chain management practices: A critical review of literature

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ABSTRACT

Increased digitalization in modern society along with environmental concerns have prompted suppliers to adopt strategies to follow Green Supply Chain Management (GSCM) practices. As awareness is increasing, developed nations have started incorporating these practices and methods in their manufacturing processes in various sectors, with developing nations following steadily. India is one of the countries which has seen growing acceptance of GSCM processes. A few hurdles persist which makes it difficult to implement the GSCM practices. Along with this, there are certain factors which directly or indirectly affect the efficient implementation of GSCM. Studying these variables and their relationships with one another can help us understand the positives and negatives of implementing GSCM in various industries and make useful predictions for implementation of the same in potential manufacturing industries. In this paper we aim to analyse the literature for some of the factors which influence GSCM in the manufacturing sectors, identify the effects of these factors on GSCM and the interactions amongst them. We also aim to study how digitalization will help in developing strategies to implement GSCM practices. This paper is a part of the literature review which is carried out as a preliminary phase, which aims to bring out the various variables and their role in establishing a relationship between digitalisation and adoption of GSCM practices.

Key words : *Green supply chain management, Digitalization, Strategies*

Introduction

The current state and trend of environmental degradation (from regulatory, consumer, and moral standpoints) indicate a need for a change in manufacturing and supply chain philosophy. That is, there must be a fundamental shift in the way production systems operate. There must be a move towards sustainability, achieved through vast reductions in resource use and waste generation, and a move away from one-time use and product disposal. The first step in such a move is to extend the structure of the current one-way supply chain to a closed loop, including supply chain operations designed for end-of-life product and packaging recovery, collection, and reuse in the forms of recycling and/or remanufacturing (Beamon, 1999).

In this globalized era, most industries will not be able to survive by simply optimizing internal structures and infrastructures based upon business strategy. The most successful manufacturers seem to be those that have carefully linked their internal processes to external suppliers and customers in unique supply chains (Zailani and Rajagopal, 2005).

Over the next five to 10 years, supply chains will change dramatically. Today's supply chains are a

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series of discrete, siloed steps involving marketing, product development, manufacturing, distribution, and eventually customers. This change will be brought by digitisation; by bringing down walls and creating an integrated ecosystem that is completely transparent to every player involved. This ecosystem will depend on several key digital technologies- including logistics platforms, analytics, robots, and even 3D printing. Those who move quickly to digitize their supply chain will gain efficiencies, develop new business models and revenue streams, and create competitive advantage ("Digitizing the Supply Chain", 2018)

Supply Chain Management

The concept of supply chain management has been extensively elaborated in the state of the art review article by Mentzer *et al.* (2001). They noticed that it was Forrester (in 1958) who first used the term supply chain management (Salo, 2006). The Global Supply Chain Forum's definition of supply chain management is the following: "Supply chain management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and stakeholders" (Lambert *et al.*, 1998).

Green Supply Chain Management

The concept of environmental quality was almost non-existent even in developed countries like the United States (Beamon, 1999). Then, the concept came to mean cleaner air and cleaner water. Now, environmental quality has come to mean "... safe drinking water, healthy ecosystems, safe food, toxic-free communities, safe waste management, and the restoration of contaminated sites'' (Council on Environmental Quality, 1996). Increasing environmental concerns have caused suppliers to adopt a "greener" approach to functionalise their supply chain. Srivastava (2007) defines Green Supply Chain Management as integrating environmental thinking into supply chain management including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life.

Digitalization

Digitalization is one of the most significant on-going transformations of contemporary society and encompasses many elements of business and everyday life (Hagberg *et al.,* 2016). In this paper, digitalization refers both to a transformation from 'analogue' to 'digital' (e.g., a shift from material lists to electronic databases) and to the facilitation of new forms of value creation (e.g., accessibility, availability, and transparency) (Amit and Zott, 2001).

Effects of Digitalisation on strategies of various Business areas

Technologies are resources that firms must use effectively by creating value and competitive advantage. The emergence of new technologies influenced businesses. The structure and operations for most of the sectors have been drastically changed due to advent of new technologies. The Financial services, Marketing, Human Resources and Operations sectors have been largely affected by the digital age. The constantly evolving technologies had a huge impact on all these sectors, hence creating new challenges and bringing out new opportunities. Digitalization of these industries mean that enterprises can move fast, innovate and create new and exciting features.

Finance

Internet Banking is the delivery of banking services through the open-access computer network (the Internet) directly to customers' home or private address (Lau, 1997). This offers a wider range of potential benefits to financial institutions (Howcroft and Durkin, 2000; KPMG, 1998) due to more accessible and user-friendly use of the technology, as the internet does not restrict banks to physical locations or historical geographical areas. Internet Banking offers an excellent opportunity for cross-selling banking services and products and thus, enhances the banks competitive position; meets consumer demands better; creates new distribution channels; improves the business image, and reduces costs (Lam and Burton, 2005). The relative advantage associated with the convenience of being able to conduct one's banking outside of branch opening hours has been found to be important in both the case of the adoption of ATMs and telephone based direct banking services. By contrast, the attributes of flexibility and convenience were found to be of limited value as a source of relative advantage in a study of electronic cash. Many studies demonstrated significant cost savings, owing to electronic business, in product origination processes and operational ac-

tivities, such as billing and document processing, for a variety of sectors ranging from brokerage, mortgage, and insurance to credit cards. Two information technologies effectively used in inter-firm relationships, in the early days of inter-organizational information systems (IOS), were electronic data interchange (EDI) and electronic funds transfer (EFT) system which was used between financial institutions and large companies (Blanning and Bui, 2000).

Human Resources

Owing to the advancements in information technology, researchers have developed decision support systems and expert systems to improve the outcomes of human resource management. Data mining refers to the extraction of useful patterns or rules from a large database through an automatic or semi-automatic exploration and analysis of data (Chen, 2015). With the help of data mining techniques, computers are no longer limited to passively storing or collecting data. They can also help the users to actively excerpt the key points from huge amounts of data, and make use of analysis or prediction. Researchers reviewed the personnel selection studies and found that the important issues including change in organizations, change in work, change in personnel, change in the society, change of laws, and change in marketing have influenced personnel selection and recruiting. Improvements in information technology are greatly affecting personal selection and human resource management. In few studies, decision support system to predict the length of service, sales premiums, and persistence indices of insurance agents.

Marketing

According to Brady *et al.,* (2008), technology has encouraged the development of relationship marketing, which improves the relationship between the consumer and company compared to the traditional transactional marketing mix entailing the 4P's. According to El-Ansary (2006), marketing strategy is the taxonomy of marketing strategy formulation and implementation processes. It is defined as the "integration of segmentation, targeting, differentiation, and positioning strategies designed to create, communicate, and deliver an offer to a target market". The involvement of technology in marketing strategy leads to improved communication, better product content, and connection in a market between consumers, company, and competitors. Marketing strategy also involves the processes of creating value (price/product), communicating the value (promotion), and delivery of the value (channels). The technologies collect data on visitors to the company's websites, purchases, inquiries, and competitors. The technologies synchronize data from various sources to determine the changes in market and consumer demands from inquiries, comments on blogs, and online comments on social media sites. Data collection techniques using technologies like mobile and internet-based technology have the advantage of lower costs, high response levels, faster turnarounds, broader stimuli potential from inclusion of colour, lower respondent error, flexibility from adaptive questioning, sounds and graphics, and greater enjoyment to the consumer or respondent (McDonald and Adam,2003).

Operations

Coordination, collaboration, and cooperation are often used more or less interchangeably for describing integrative efforts among partners to improve the overall efficiency of the supply chain (Holweg *et al*., 2005), such as collaborative planning, forecasting and replenishment, CPFR (Danese, 2006). Information integration implies the sharing of essential information along the supply chain network in a manner that is enabled by information technology (IT). IT facilitates the alignment of forecasting and scheduling of operations between firms and suppliers, allowing better inter-firm coordination, allows firms to increase the volume and complexity of information which needs to be communicated with their trading partners, provides real-time supply chain information, including inventory level, delivery status, and production planning and scheduling which enables firms to manage and control its supply chain activities. Information technology in various forms and combinations ranging from the Internet, WWW, HTML and XML to different applications and systems including enterprise resource planning (ERP, ERP2), customer relationships management (CRM) supply chain management (SCM), and enterprise application integration (EAI), are enabling and facilitating business processes and creating new business contexts for companies to operate (Mukhopadhyay, 1998). Lee *et al.* (2000) show that information sharing can lead to lower cost through reductions in inventories and shortages. However, to realize this value, changes in the logistics system

are required, such as Vendor-Managed Inventory (VMI) programs, lead time reductions, order quantity reductions, and more frequent deliveries (Selldin and Olhager, 2007).

Green Supply Chain Management

Companies today increasingly recognize that improved management of supply chains can be a source of competitive advantage. As a result, many have reorganized purchasing and logistics functions into supply-chain management (SCM) organizations. They have invested heavily in software to manage the information flows in the supply chain. From 1999 to 2002, vendors sold more than $15 billion in SCM software licenses which does not include the cost of installation and maintenance contracts (Kanakamedala *et al.*, 2003).

Present Scenario

"The supply chain is a set of firms that pass materials forward" (La Londe and Masters, 1994). Sustainability and environmental issues are among the most pressing concerns for modern humanity, governments and environmentally conscious business organizations to promote organizational sustainability, specifically for the emerging economies (Hsu *et al.*, 2013; Fabbe Costes *et al.*, 2014; Tseng *et al.*, 2015). In the recent time, Dubey *et al.* (2015) and Zhu *et al.* (2012) suggest that the regulatory bodies have forced the industries to improve adoption of Green Supply Chain Management (GSCM) practices. The organizations of 21st century are operating under the strict evaluation of the government and non-government stake holders or their accountability towards both environmental and social concerns. For example, the leading organizations that failed to meet such standards include Sony (unsafe levels of Cadmium in Playstation consoles), Home Depot (sourced logs form protected forests) and Mattel (Lead detected in toys) (Parmigiani *et al.*, 2011; Lee, 2008). Kirchoff *et al.* (2016) highlight that managers are motivated by the potential benefits associated with GSCM, including enhanced reputation, increased efficiency, effectiveness, differentiation, and revenue growth but the potential for economic benefits is key for managerial adoption of green practices and the appropriate allocation of resources. The various operational and organizational challenges involved in the adoption of GSCM make it a promising area within academia and industry both (Zhu *et al.*, 2013).

Indian organizations have reported cost reduction, increase in profitability and productivity through enhanced supply chain management (Seuring and Muller, 2008). Indian organizations have reoriented their business practices by focusing on how to control their supplier's process, technology and capability to improve their competitive advantage (Srivastava, 2007). The process of SCM involves extraction and exploitation of the natural resources; the waste and pollutants emitted by the supply chain have been detrimental and responsible for global warming and acid rain causing serious environmental hazard (Seuring and Muller, 2008). Green supply chain policies are thus desirable for reducing these environmental hazards and making businesses sustainable by greening their supply chain (Jayaram and Avittathur 2015; Mitra and Datta, 2014). Although the legal framework to support environmental protection in India is at par with any other country in the world, the degree of enforcement is very low, resulting in very low priority being given to the environment by the industries. Despite having regulatory framework for ensuring the protection of the environment, India is lagging far behind the satisfactory standards, mainly owing to lack of implementation, ease of manipulation, corruption, lack of adoptability and short-term measures. This justifies the urgent need of GSCM adoption in Indian organizations. The various factors that apply GSCM are: Technology & Innovation, Economics, Markets and Competition, Policy and Regulation, Procurement & Sourcing, and Supply chain strategies & Re-engineering (MacCarthy *et al.*, 2016).

Advantages of implementing GSCM

Companies that adopt a pro-environment policy will see numerous positive results, both tangible and intangible. Early adoption of environmental strategies and green supply chain initiatives will mitigate business risks, by differentiating themselves from competitors, transforming their companies into industry leaders, building credibility with stakeholders and attracting investors. It will motivate better performing suppliers to become preferred vendors in green supply chain and attract consumers in the rapidly-growing green marketplace. It will help in preserving business continuity, by attracting top job candidates, enhancing employee satisfaction and enhancing market access and degrees of business strategy freedom. It creates

significant competitive advantage by creating brand distinction and recognition. On the other hand, it is helpful for the society and the general people and becoming better stewards of the planet's natural resources. Over 75% of a company's carbon footprint is related to transportation and logistics activities. Organizations are producing products which are technologically advanced and environment friendly (Bhattacharjee, 2015).

Results indicate that Chinese Small and Medium-sized Logistics Service Providers (SMLSPs) are attracted by Cloud Computing to reduce cost in a short term and to gain sustainability through green benefits in a long term (Subramanian, *et al.*, 2014). The integration of CC not only allows transportation and logistics services to be more efficient through optimal utilization, reduced empty mileage, improved throughputs and reduced overheads but also provides logistics service providers with other significant benefits such as integrated promotion and customer relationship management, and consolidated bidding across different channels (Yang *et al.*, 2013; Oliveira, 2013).CC also enables the consolidation of transportation and logistics services, thereby reducing freight-related negative externalities such as environmental pollution (Barnatt, 2010; Oliveira, 2013)

Hurdles in Implementing Digital GSCM

Resistance to Technological Advancement

As this demands more potential from the employees, they show resistance to change in technological advancement.

Lack of Knowledge and Expertise

Most of the organizations do not have the expertise, and inadequate knowledge of GSCM benefits is also a major obstacle in implementing GSCM.

Poor Quality of Human Resources

Quality brings cost to the organisation with which the top management concentrates on decrease of cost rather than preparing mentally towards implementation of green concept with quality people.

Market Competition and Uncertainty

Making the companies to deter from implementing GSCM concepts as market competition influences the innovative capability as well as intention to adopt innovations.

Lack of Government Support

The Automobile industry is expecting more subsidies and tax exemptions to implement GSCM. But they are lacking this support from the Government.

Lack of Implementing Green Practices

The management is showing resistance to implement green practices due to increased market competition, cost and time bound targets.

Lack of Top Management Commitment

Top management is not able to initiate and implement the green concepts as it increases the financial burden wherein the assessment of ROI and distribution of costs cannot be done perfectly so this has become a big obstacle to top management to initiate green SCM across the organisation.

Cost Implications

The initial investment requirement by green methodologies, such as green design, green manufacturing, green labelling, green packing etc., is too high. Therefore, high cost has become a focal point in implementing GSCM as compared to conventional SCM.

Supplier Reluctance to Change Towards GSCM

Suppliers in the GSCM need to understand the social and environmental impact of the product he supplies to the manufacturer. Supplier and manufacturer relationships are considered most important for developing competitive advantage for the manufacturer. The manufacturers cannot produce green products unless the supplier supply eco-friendly raw material to meet the GSCM requirements of the manufacturer.

Unawareness of Customers

A major barrier of GSCM seen in Indian automobile industry is lack of awareness of customers about the benefits of green products. Customers' awareness means increased demand for eco-friendly products; To meet the customer requirements the company has to incorporate new technology for innovative green products. Green Supply Chain initiatives are rapidly becoming high priorities for the society these days, as it reduces carbon footprint.

Lack of Systematic Economic Recycling

The timing of collection of the product at the end-of-

life for proper disposal may lead to certain serious environmental issues and concerns for the government agencies and common man.

Lack of Coordination

Members of the Green Supply Chain should work as integrated systems rather than working individually to improve the overall performance of the GSCM. Most of the firms' SCM are affected by lack of coordination and whose consequences are like inaccuracy in forecasting, excessive inventory, inadequate customer service, inventory costs, time concerns, poor quality, poor customer focus and poor customer satisfaction.

GSCM practice implementation, especially on external relationships such as green purchasing and customer cooperation focusing on environmental concerns, is lagging. In most cases these enterprises have only planned to consider or, at most, considering corporate environmental management and GSCM implementation. Therefore, GSCM implementation has only slightly improved environmental and operational performance, and has not resulted in significant economic performance.

Future Prospects

Though becoming an increasingly necessary strategic initiative, Big Data and Predictive Analysis is still not fully leveraged in those firms using its tools and methodologies daily (Hazen *et al.,* 2016). Enterprises which will do best are those that will best leverage Big Data. More things will get integrated, and the future looks very much like a framework which is able to store, process, visualize, and support for intelligent, advanced and timely decision-making (Koetsier, 2014). The increasing volume of data from service and manufacturing supply chain management (SM-SCM) is a challenge which requires tools to make full use of the data (Huang *et al.,* 2015).

The digitalization of after-sales, particularly spare parts sales, isboth a strategic opportunityand a threat for many original equipment manufacturers, as the focus of the competition increasingly shifts away from the price and quality of the offerings toward the delivery of value to customers. 3D Printing or Additive Manufacturing aims to achieve this as technology improves, enhancing current technology parameters. Additive Manufacturing could eventually lead to complete elimination of transportation within the supply chain as designs could be shared and printed in the printing setup. The following potential advantages of using AM machines for the distributed production of spare parts can be summarized as follows: lower overall operation costs, lower down time, higher potential for customer satisfaction, lower capacity utilization, higher flexibility, higher robustness to supply chain disruptions, reduced need for inventory management and logistics information systems, and potential for sustainability improvements as AM machines become smaller and more energy efficient (Khajavi *et al.,* 2014).

From green supply chain perspective of the internet of things, actualization of the IoT into the complexsystem for green inventory management will link the real world with the digital world seamlessly. Modellingthe complex systems in green supply chain can be difficult if a computational utilization and inventory managementof relationships exists (Chen, 2015).

Potential supply chain management enhancements prevail in integration, green collaboration and sustainability by adoption of digitalization (Subramanian *et al.,* 2014).

Conclusion

The need to react to market changes and the critical role of the supply chain in meeting this need, and the potential benefits of integrating the supply chain, can no longer be ignored. This potential, however, will be realized only if the interrelationships among different parts of the supplychain are recognized, and proper alignment is ensured between the design and execution of the company's competitive strategy (Zailani and Rajagopal, 2005). As technology evolves, it allows for more and better uses of its applications. The movement towards open standards has provided efficiency and flexibility gains to organizations involved and employing those suggested open standards (Salo, 2006). Analysing all these various factors and studying their interactions with one another will lead to better understanding of the implementation of GSCM in manufacturing setups. With the aid of greener and digitalized supply chains, the principles of supply chain management strategies will be enhanced allowing for more efficient and effective strategy making and implementation.

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