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# Influence of Green Supply Chain Management Practices on Organization Performance: An Interpretive Structural Modeling Approach

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## Abstract

Supply chain management is crucial to enhancing and implementing a firm's competitive edge. The identification of environmental advantages and performance by businesses is crucial for spreading awareness of such activities among small-, medium-, and large-sized enterprises (SMEs). Digitalization and environmental sustainability have evolved into the hallmarks of social and economic progress. The study demonstrates the application of digital technology in the entire supply chain, eventually saving the energy, reducing emissions and protecting the environment. The digital technologies impacting the green supply chain performance are investigated in this study. The report also covers how these technologies can lower resource and energy input as well as pollutant emissions, enhancing the green supply chain's operational efficiency and bringing about positive effects on the economy, society, and the environment.

Digital technology was considered in five categories, namely Big Data, Cloud Computing, Blockchain, Internet of Things and Artificial Intelligence. The impact of these technologies on green supply chain is evaluated using the quantitative causal models.

The research examined the impact of various digital technologies used by the industries on the green supply chain initiative. Quantitative method to study the causal relationships through hypothesis testing was used, which provided the empirical results of impact of different constructs. Responses from different category of industries including automobiles, textiles, paper, chemical, steel, etc. were obtained and analyzed for the contribution of each digital technology on the green supply chain management in Industries.

## Introduction

The main sustainability threats are those related to global warming, climate change, resource depletion, rising numbers of human rights violations, food shortages, the production of hazardous waste, and chemical accumulation. The SDGs, which cover social, environmental, and economic sustainability, seek to change supply chain management methods to develop sustainable industries and ultimately

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lower global sustainability risks. Businesses have been encouraged to update their conventional supply chain management (SCM) framework to a green supply chain management as a result of the push for a global sustainable industrial transformation. Increasing customer pressure on businesses to implement environmental sustainability (green) practices that adhere to green and eco-friendly techniques and so lessen the unfavourable environmental impact of their goods and services is another factor contributing to the drive toward GSCM. Integrating of data is a part of GSCM. Data, which provide knowledge and important insight, are significant from a strategic standpoint. Digital Technology is a crucial instrument for predicting future business trends, providing insights that could improve companies' green businesses while continuously lowering environmental damage.

Digital Technology aids businesses in making wise decisions, spotting dangers, and perceive changes in the business environment, allowing the company to use its knowledge base. Digital Technology encourages data-driven decision making and produces creative approaches to task organization, routine learning, and idea generation. As a result, several company processes (such as eco-friendly practices, production efficiency, resource conservation, knowledge, and eco-friendly products) are managed better, which leads to better innovative performances.

Through inventions and green innovations in the production system, product development, and management practices to control hazardous waste and resource consumption, and provide a clean work environment, an organization can reduce the negative effects of their operations on various environmental aspects.

Businesses' new management-based green practices reorganize management processes and enhance product functionality to better cater to customer environmental consciousness. Benefits to the economy and environment result from these advances. Businesses that want to improve and go greener with their management practices must build their efforts around environmental frameworks like ISO 14001. It provides businesses the ability to maintain competitive advantages including client loyalty, reliability, and profitability.

Government support is essential to usage of digital technology, lessen environmental effect and promote socioeconomic sustainability because environmental deterioration is the primary concern of contemporary cultures. A firm should receive help in the form of technology, training, consultants, management, or money. The expansion of resource availability is necessary for the implementation of green innovation. Given the abundance of resources, businesses are encouraged to use digital technologies to comply with environmental management techniques. Environmentally conscious supply chain management incorporates this concept into the process. It covers product development,

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choosing raw materials, manufacturing procedures, and consumer product distribution, as well as product management following the useful life of the product or reverse logistics.

**Literature Review**

To date, research has covered the purchase of raw materials according to actual needs, saving procurement costs and avoiding resource waste. Shabanpour et al. (2012) and Akka and Gaur (2022) stated that using big data to push relevant raw material suppliers in line with procurement needs and help the final raw material suppliers' selection through comparison and analysis. Seele (2017) emphasized that in production practice, big data can accurately judge the quantity of demand. However, Singh and El-Kassar (2019) stated in research that, it is possible to understand consumer preferences to precisely estimate and analyze their preferences and provide them with more timely and personalized services. This is made possible by the click rate of the Internet, consumer consumption records, and other data. Singh et al. (2015) mentioned that in the production process, cloud manufacturing links production-related manufacturing resources to create a platform for resource sharing.

The use of artificial intelligence in manufacturing is widespread. For the simplest tasks, robots can take the place of people. Sharma et al. (2022) specified that a robot's ability to function is unaffected by interruptions in power supply. Robots utilize the most rigid working methods, whereas people are more flexible, which will unavoidably lead to production practice errors. Gawankar et al. (2020) mentioned that for their own personal gain, procurement staff members cover up for and work together to conceal various illegal circumstances that arise during the course of procurement activity. Chandra and Verma (2023) focussed that Green supply chain management is a management trend and cutting-edge tool. The majority of businesses use "green" as the development trend, invest in raw materials with high environmental performance, create finished goods that are low-carbon and recyclable, market the goods that consumers want, and share transportation services to ultimately achieve overall green development. Big data technology gathers a significant amount of data from the Internet, chooses the most useful information from this volume, Kamble and Gunasekaran (2020) mentioned that it uses a model to analyze the data, and discovers the basic operating principle of things. With the aid of such technologies, operators can obtain correlations between data to help them make decisions.

Agrawal and Pal (2019) and Singh et al. (2018) talked about a type of Internet-based computing is cloud computing. It uses the network's "cloud" to divide large amounts of data into a single data cluster, which is then processed and analyzed by a system made up of several computers. It

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incorporates the computation results at the end. Green products, processes, and administrative structures are just a few of the aspects and ideas that Singh et al. (2020) have studied and examined in relation to green innovation. Green technologies are used by businesses to improve their production systems and processes, which results in less resource consumption, a clean workplace, improved product functionality, and compliance with environmental standards. Green products and processes reflect these businesses. According to Kamble et al. (2018), one of the biggest benefits is the generation of new knowledge, establishment of new management rules, duties, and routines, as well as the restructuring of corporate structures and processes to accommodate eco-innovation strategies. Green innovation was quantified and analyzed in numerous aspects and concepts by Gupta and George (2016), including green processes, products, and organizational structures. Green technologies are used by businesses to improve their production systems and processes, which results in less resource consumption, a clean workplace, improved product functionality, and compliance with environmental standards. Green products and processes reflect these businesses. Anand et al. (2013) has shown that the company value added was greatly impacted by investments in information systems. Joshi and Sharma (2022) included financial crises and global health crises such as the COVID-19 Pandemic. According to Sharma et al. (2020), this has led to the development of new and ambitious environments as well as significant changes in the business environment. According to Sony (2019), this will aid businesses in achieving economic, social, and environmental sustainability as well as environmental responsibility, which has evolved into a strategic focus for multinational corporations looking to boost their reputation. Shou et al. (2018) research have concentrated on the favourable relationship between intellectual capital and supply chain performance, with the importance of intellectual capital as one of the antecedents for enhancing performance. Maheshwari et al., (2021) stated that Big Data analytics do, in fact, offer fresh perspectives on enhancing supply chain performance.

Tiwari et al (2018) stated that the supply chain is so dependent on information, big data analytics can specifically be used to enhance decision-making, address a variety of issues that may develop in supply chain channels, and enhance supply chain performance. According to Adhikari et al. (2018) green supply chain can add new value to the supply chain by increasing the use of environmentally friendly green systems and also integrating technology to mitigate the effects of harmful traditional systems on the environment. This will improve operational activities, reduce operational costs, and improve the reputation for businesses. Several measures have been proposed to gauge the success of the green supply chain, according to Mishra et al. (2017) Thirunavukkarasu and VenkatesaNarayanan (2021). Wang et al. (2016) have referred to the relationship between big data analytics and supply

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chain management as the concept of supply chain analytics, which focuses on using the organizational capabilities that firms possess to exploit big data and increase the effectiveness of activities. Dubey et al. (2020) indicated that there is still a dearth of empirical studies examining the beneficial connection between big data analytics and green supply chain management. Singh (2022) created construct items related to big data analytics capabilities, and construct performance metrics for green supply chains.

## Research Methodology

In order to evaluate a specific population or sample and research tools, this study use a quantitative approach. The respondents are SME firm owners and managers who are in charge of operating their companies and carrying out organizational policy. The analysis is processed through the use of quantitative and statistical methods. The statistical technique used in this study is partial least squares-structural equation modelling (PLS-SEM). The Likert scale is used to measure the questionnaires and analysed using Smart-PLS software to help descriptively test data. The indicators for each variable listed in the conceptual model were used to create the questionnaire.

## Conceptual Model and Hypotheses

The framework below describes the influence of application of digital technology in green supply chain management.

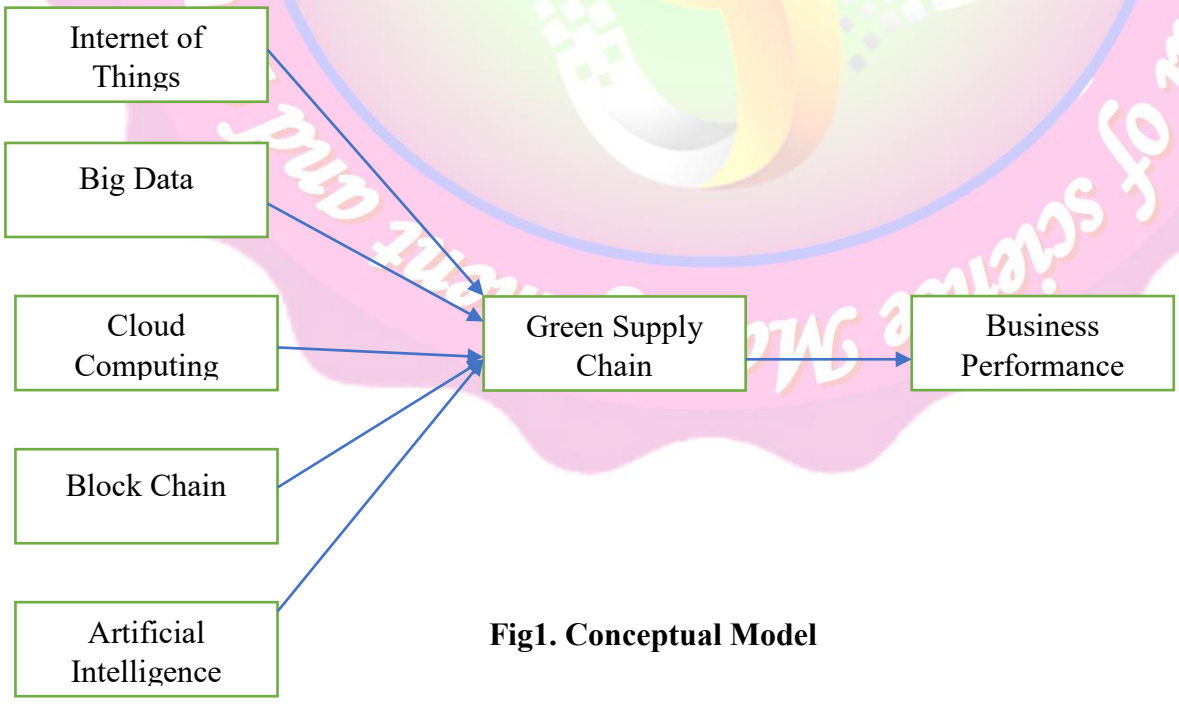


**Fig1. Conceptual Model**

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**Table 1. Constructs and Indicators of Application of Digital technology in Green Supply Chain and Business Performance**

| Digital Technology | Link to Green Supply Chain | Practices |
|---|---|---|
| **Internet of Things (IOT)** | • Green Procurement<br>• Green Production<br>• Green Consumption<br>• Green Logistics | • Selecting the best vendors.<br>• Calculating the quantity of demand and shortage (using radio frequency technology or another method) in order to purchase raw materials.<br>• Predicting with accuracy when raw supplies will arrive (using wireless location technology).<br>• Reducing manufacturing and procurement quantity errors.<br>• Decreases resource waste.<br>• A logistics information system facilitates effective stock and route planning.<br>• keeps track of real-time positioning when traveling. |
| **Big Data (BD)** | • Green Procurement<br>• Green Production<br>• Green Consumption | • Facilitates supplier selection for raw materials through comparison and analysis.<br>• Reduces acquisition costs by preventing resource waste.<br>• Aids in assessing energy-efficient industrial techniques.<br>• Analyze and accurately predict consumer preferences.<br>• Increasing the flexibility of the supply chain.<br>• By examining long-term consumption trends and modifying company models in accordance with projections, it improves consumer happiness.<br>• Preventing the buildup of surplus inventories to improve operations' environmental friendliness. |
| **Cloud Computing (CC)** | • Green Production<br>• Green Logistics | • By starting a common platform and integrated services, the fixed cost is decreased.<br>• Improving how much energy is used during production. |

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| | | |
|---|---|---|
| | | • Increasing production process automation.<br>• Reducing losses brought on by human mistake by creating green cloud services.<br>• Offers a standardized, shared platform for efficient transportation and logistics.<br>• Effectively combines all of the supply chain's resources. |
| **Block Chain (BC)** | Green Procurement<br>Green Production<br>Green Consumption | • Assists in developing long-lasting working partnerships by making data about raw materials, suppliers, and costs transparent when choosing the best sources.<br>• Why By creating a clear veil, procurement risks are decreased.<br>• Instantaneously reflects the level of satisfaction with consumption patterns on the site.<br>• Preserves the product's provenance and records the emissions of waste gases and harmful gases during manufacture.<br>• Encourages the growth of a sustainable green supply chain. |
| **Artificial Intelligence (AI)** | Green Production<br>Green Logistics | • Projects demand and upcoming logistics transportation.<br>• A rise in manufacturing efficiency<br>• A reduction in floor area due to robotic handling systems. |

**Measurement Model Validation**

By quantifying the impact of each statement on its latent variables, the model is used to assess the validity and reliability of the model. Three categories—convergent validity, discriminant validity, and reliability—are used to categorize the model test. The value of the outer loadings/loading factor, which seeks to gauge the link between the construct and its latent variables, is examined as part of the convergent validity test. In this study, the outer loadings/loading factor value must be >0.5 and the average variance extracts (AVE) must be >0.5 for the variable to be considered valid.

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According to Hair et al. (2017), Cronbach's alpha and composite reliability can be used to determine how reliable a variable is. It is deemed reliable if the Cronbach's alpha value is greater than 0.6. It is possible to declare all indicators to be valid and convergent for measuring the construct of research variables.

Additionally, the Fornell-Larcker value and cross-loading were examined to produce the findings of the discriminant validity test. The Fornell-Larcker value and the correlation between latent variables are compared for the discriminant validity test, and cross-loading is done by examining the strength of the correlation between each indicator and its associated latent variables.

**Table 2. Demographics**

| **Demographics** | **Frequency** |
|---|---|
| **Gender** | |
| Male | 58 |
| Female | 56 |
| **Age** | |
| 25-35 | 8 |
| 36-45 | 42 |
| >46 | 64 |
| **Experience in Business** | |
| 1-5 years | 36 |
| 6-10 years | 47 |
| >10 years | 31 |
| **Type of Industry** | |
| Steel | 6 |
| Food and Mineral | 32 |
| Electrical and Electronic | 21 |
| Construction and Habitat | 6 |
| Pharmaceutical and Health | 7 |
| Plastic | 16 |
| Wood and paper | 12 |

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| | |
|---|---|
| Energy and Environment | 4 |
| Others | 9 |
| **Position** | |
| Middle level Management | 62 |
| Upper-level Management | 52 |

**Structural model Evaluation**

**Table 3. Convergent Validity**

| Constructs | Items | Loadings | CA | CR | AVE |
|---|---|---|---|---|---|
| **IOT** | IOT1 | 0.72 | 0.89 | 0.92 | 0.76 |
| | IOT2 | 0.78 | | | |
| | IOT3 | 0.81 | | | |
| | IOT4 | 0.74 | | | |
| | IOT5 | 0.73 | | | |
| **Big Data** | BD1 | 0.88 | 0.86 | 0.94 | 0.61 |
| | BD2 | 0.82 | | | |
| | BD3 | 0.78 | | | |
| | BD4 | 0.83 | | | |
| | BD5 | 0.86 | | | |
| **CC** | CC1 | 0.91 | 0.82 | 0.89 | 0.71 |
| | CC2 | 0.86 | | | |
| | CC3 | 0.78 | | | |
| | CC4 | 0.76 | | | |
| | CC5 | 0.71 | | | |
| **Block chain** | BC1 | 0.82 | 0.74 | 0.87 | 0.57 |
| | BC2 | 0.79 | | | |
| | BC3 | 0.76 | | | |
| | BC4 | 0.74 | | | |
| **AI** | AI1 | 0.92 | 0.91 | 0.74 | 0.74 |
| | AI2 | 0.87 | | | |
| | AI3 | 0.81 | | | |

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| | | | | | |
|---|---|---|---|---|---|
| **GSCM** | GSM1 | 0.72 | 0.92 | 0.91 | 0.59 |
| | GSM2 | 0.79 | | | |
| | GSM3 | 0.85 | | | |
| **OP** | OP1 | 0.79 | 0.91 | 0.93 | 0.87 |
| | OP2 | 0.81 | | | |
| | OP3 | 0.82 | | | |
| | OP4 | 0.86 | | | |

Another test that verifies the suitability of the measurement tool is discriminant validity. Testing the Fornell and Larcker criterion is necessary. The bolded values on the diagonals in Table 4 were higher than those in their respective rows and columns, suggesting that the selection criteria were valid. Furthermore, the Heterotrait-Monotrait ratio is another technique to validate the discriminant validity is the (HTMT) ratio. The values shown in parenthesis in Table 4 are below 0.85, indicating ensure they meet the HTMT (0.85) requirement. Consequently, this study's discriminant validity is completed.

**Table 4. Fornell and Larcker criterion and HTMT Ratio**

| | **OP** | **GSCM** | **IOT** | **BD** | **CC** | **BC** | **AI** |
|---|---|---|---|---|---|---|---|
| **OP** | **0.74** | | | | | | |
| **GSCM** | 0.61 (0.74) | **0.78** | | | | | |
| **IOT** | 0.58 (0.72) | 0.54 (0.65) | **0.73** | | | | |
| **BD** | 0.52 (0.48) | 0.41 (0.52) | 0.68 (0.72) | **0.84** | | | |
| **CC** | 0.65 (0.72) | 0.61 (0.77) | 0.57 (0.62) | 0.52 (0.26) | **0.78** | | |
| **BC** | 0.48 (0.51) | 0.34 (0.42) | 0.49 (0.53) | 0.36 (0.41) | 0.72 (0.73) | **0.73** | |
| **AI** | 0.44 (0.52) | 0.52 (0.62) | 0.46 (0.53) | 0.52 (0.58) | 0.32 (0.39) | 0.46 (0.48) | **0.83** |

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**Table 5. Structural Model Results**

| Hypothesis | Description | Beta | T-Value | p-value | R2 | F2 | Decision |
|---|---|---|---|---|---|---|---|
| **H1** | Applications of digital technology-GSCM | 0.16 | 2.37 | 0.00 | 0.59 | 0.64 | Significant |
| **H2** | GSCM--OP | 0.49 | 9.77 | 0.00 | 0.46 | 0.08 | Significant |

The values of $R^2$ reveal that all dependent variables have reliability associations since a significant amount of variance is explained by the predictor factors of AI and GSCM for GSCM and OP, respectively. The significance value between constructs, t-statistics, and p-values all show how the variables are related and significant. The t-statistical analysis used in this work employs significance values > 1.96 and p-values 0.05. According to the study's findings, usage of digital technology has significant impact on green supply chain management which eventually enhances the performance of SMEs.

**Managerial Implications and Theoretical Contribution**

This study investigates how the use of digital tools affects organizational performance under the influence of green supply chain management. The results show a favourable correlation between the use of digital tools and GSCM. Organisations can begin implementing green supply chain management techniques with confidence that these practices will improve the company's operations and brand image, as well as the environmental and economic performance. Additionally, the requirement for strategic orientation as the business's strategic direction can help it adopt the right behaviour while implementing green supply chain management methods, enhancing both its ability to protect the environment and its ability to remain profitable. Therefore, to support the adoption digital technology for improving green supply chain management, it is vital to consistently enhance both the strategic orientation and the internal environment of the organization. Need to be highlighted that the primary obstacle for SMEs is the high cost of managing green supply chains using digital technology. The results of this study also suggest that small businesses often struggle to influence their supply chain networks to support green efforts through digital technology tools. Digital technology aid businesses in generating insightful information, facilitate decision-making based on green problem-solving, and provide eco-friendly business practices. Consequently, usage of digital tools significantly aids in tracking, anticipating and reacting to market demands, customer wants, and rivals' responses. It is one

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of the strategic sources that helps businesses to look for and gather information to address the changes in the corporate environment. Businesses are urged to seek for and gather pertinent information to resolve environmental concerns impacts brought on by excessive resource consumption and unfavourable business practices. As a result, information creation, storage, and utilization must give priority to environmental issues.

Consequently, green processes are improved through digitalization, staff green awareness is raised, CO2 emissions are decreased, and hence improving businesses' perceptions of their sustainability green expansion. Developing digital technologies, and training staff increase businesses green reputations as well. Making green technology investments enables a firm to foster the long-term image of its brand, leading to greater commercial growth. The adoption of green supply chain management, a desired environmental practice, was not seen by SMEs as providing a competitive advantage. Additionally, adoption of digital tools for employing green supply chain management strategies may increase costs for businesses. Additionally, research has indicated that the high expense of managing SMEs is their top challenge.

The study's findings that the green supply chain was positively impacted by each technique of digitalization, accelerates the supply chain's sustainability level. The industries should improve the technological capacities that contribute investing in infrastructure, metadata, and training to implement Big data analytics, AI, IOT, Cloud computing and Block chain.

**Practical Implications**

The results of this investigation provide three useful conclusions. The findings provide managers with a logical integration of resource-based qualities that they may utilize to adopt effective GSM in their businesses. Greening the SCM procedure through adoption of digital technology will advance businesses. These initiatives will ultimately calm environmental authorities and lessen supplier pressure and customers to encourage managers to implement and use sustainable business practices, more powerful GSCM, additionally, will enhance company performance. Having high-quality data analytics tools also permits organizations to create a green image is especially helpful for increasing operational legitimacy in international markets.

**Conclusion**

The study looks into the variables influencing business performance in small and medium-sized enterprises in Indian Northern region. This study yields results that are pertinent to the relationship

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between digital technology tools and greening of supply chain management in relation to business performance. The results show that SMEs are benefitted with the application of digital technology on green supply chain management. The majority of small and medium-sized businesses lack the necessary money, human resources, and infrastructure to implement GSCM principles. To explore more complex linkages between GSCM practices and organizational performance in the SME sector, future research may expand on this study's methodology to include other performance variables, such as operational and financial performances. The environmental performance of SMEs would also be impacted by green supply chain management.

It would be preferable and more advantageous to conduct a study using a longitudinal method to address the development of green innovations, and company performance.

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