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Moderating Influence of Information Technology Analytics in Big Data and Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia

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Abstract. The ongoing data processing employs a parallel and distributed approach, with each dataset undergoing access, maintenance, and storage in a database system. This framework operates in the realm of big data (BDA), investigating its functioning, challenges, applications, and potential for bolstering analytics in information technology. Supply chain management (SCM), has gained relevance, as seen in numerous publications contributing to its discourse. Additionally, Information Technology (IT) is increasingly recognized as a key facilitator for enhancing efficiency in supply chains. While prior research has explored the intersection of IT and (SCM), this paper pioneers the consolidation of current knowledge on the Moderating Effect of IT on the Relationship between Big Data Analysis and Green Supply Chain Management (GSCM).

The study focused on a population of (360) in top management and mid-level roles employed across (11) factories operated by the National Industry Company in the Kingdom of Saudi Arabia, spanning various industrial sectors. To achieve the study objectives, a researcher-developed questionnaire was used to collect primary data from the sample individuals. The method of path analysis (PLS) was employed to test the study hypotheses. The results demonstrated that Information Technology significantly moderated the relationship between Big Data Analysis and Green Supply Chain Management. These findings underscore a robust association between Big Data Analysis and Green Supply Chain Management in firms within the National Industry Company in the Kingdom of Saudi Arabia.

Keywords: Information Technology, Big Data Analysis, Green Supply Chain Management.

1. Introduction

The business landscape is undergoing a profound transformation due to Information Technology, particularly in the realm of Supply Chain Management. Success in this domain hinges on the ability to make decisions based on information and data. The extensive volume of big data has revolutionized the decision-making process, presenting challenges for conventional database management systems in handling such massive datasets. (Agresti and finlay 2008).

The notable advancements in information technology and communication, notably the internet, have had a profound impact on various social and economic activities. This global phenomenon underscores the imperative for organizations to improve, cultivate, and incorporate technology into their operations, methodologies, and information systems. Traditional systems have proven insufficient in meeting the requirements of the transition to a digital knowledge community that underscores knowledge dissemination and accessibility. Consequently, integrating technology into the information systems and processes of organizations has become essential.

This integration offers qualitative advantages across diverse work domains, elevating performance levels and enhancing sustainability and competitive capabilities in both local and global markets. Organizations are increasingly acknowledging the significance of leveraging the analytical potential provided by big data, particularly in supporting functions such as green supply chain management (Raut et al., 2021; Seyeden and Mafakeri, 2020; Hong et al., 2017; Raut et al., 2021).

Currently, big data analysis has become one of the most important resources in organizations, given its potential to improve the organization's ability to rapidly respond to competitive pressures and cope with tremendous technological developments, particularly in the domain of green supply chain management. In this way, organizations can respond more quickly to customers, increase their operational flexibility, and improve their competitive ability based on the capabilities of big data analysis that provide decision-makers with information in the domain of supply chain management and operations management. This would enhance the sustainability of the supply chain by improving the performance abilities of the chain, reducing uncertainty, reducing production time, satisfying customer requirements, and enhancing the ability and flexibility of supply chain operations. Accordingly, organizations have to use the instruments of data analysis and processing and employ them as added value to customers (Manadel, 2018; Govindan et al., 2018; Yu et al., 2021).

Appropriate operational decisions depend on evaluating and utilizing suitable information technology. Therefore, the role of big data analysis has gained more importance in developing the capabilities of supply chain management and improving responses to competitive pressures (Bamelm & Bamel, 2020; Shokouhyar et al., 2020; Oncioiu et al., 2020), as well as (Akhter et al., 2016; Wamba et al., 2018; Arunachalam et al., 2018).

The study aims to bridge the gap between big data analysis, green supply chain management, and information technology. By including information technology as a moderating variable, the research acknowledges the role of technology in shaping the relationship between big data analysis and green supply chain practices.

2. Literature Review

The role of information technology is not limited to changing an organization's products and operations; it has also extended to transforming supply chain operations as a whole (Abdel-Basset et al., 2018). The Big Data technique, with its distinctively developed digital and automated operations, as well as the use of electronics and information techniques in manufacturing, is viewed as one of the most important new methodologies applicable in this domain. Indeed, this technique provides users with access to a wide range of data, applications, and instruments that can be leveraged to create more effective economic value for all the parties participating in the supply chain. This technique helps organizations establish Big Data rules in the form of a data store that enables the flow of data across the supply chain (Moyano-

Fuentes et al., 2019; Reddy Reinartz and Moyano, 2017). (Tan et al., 2015) confirmed that organizations' ability to utilize big data rules directly affects their competitive advantage, provided these organizations possess the technological infrastructure to analyze such extensive data.

2.1. The Effect of Big Data Analysis and Green Supply Chain Management

(Jable et al., 2018) verified that the predictive and analytical capabilities of data have a positive impact on improving the economic, social, and environmental performance of a sustainable supply chain, as they enhance the organization's decision-making abilities and flexibility.

(Zhan and Tan, 2020) suggested that integrating potentials and capacities by utilizing various resources of data from social media sites and smartphone applications, organized in databases known as "big data stores," will enable the supply chain to generate new ideas, make accurate decisions, and provide clear paths for decision-making to optimize operational outcomes. In their study, (Shokouhyar et al., 2020) aimed to develop a conceptual model to investigate the impact of big data analysis on the sustainability of the supply chain. The results revealed that the capabilities of big data analysis have a significant effect on the sustainable performance of the supply chain, contributing to the achievement of a competitive advantage by improving the institution's flexibility. Several studies have confirmed that information technology and flexibility in the organization's internal processes serve as indicators for the speed of the supply chain, enhancing the processing and efficiency of operational management (Swafford et al., 2008).

Additionally, the internal integration (multi-function operations) with external integration (suppliers and customers) influences the organization's ability to exhibit flexibility within its supply chains (Braunscheidel and Suresh, 2009). Some studies underscore the importance of focusing on internal capabilities, such as information technology infrastructure, functional flexibility, and multi-functional cooperation, to maintain and develop organizational flexibility. Swafford et al. (2008) suggested that information technology has a positive effect on the flexibility of the supply chain, (while Srinivasan & Swink, 2017) proposed that the flexibility of the supply chain is considered a fundamental condition for determining and developing the analytical capabilities of big data, and vice versa.

(Gunasekaran et al., 2017) suggested that organizations investing in the development of supply chain flexibility are likely to also invest in enhancing their abilities to analyze big data. (Dubey et al., 2018) proposed a positive correlation between identifying supply chain and its flexibility. Information technology, according to their findings, aids managers in recognizing rapid environmental changes, enabling them to formulate consistent plans for swift responses. This, in turn, enhances supply chain performance. (Ghasemaghaei et al., 2017) confirmed the potential improvement of an organization's flexibility through big data analysis, emphasizing its positive impact on rapid response and decision-making. The success of this approach is contingent upon the utilization of information technology to align tasks among employees, managers, and shareholders in the supply chain.

(Fernando et al., 2018) suggested a positive impact of big data analysis on an organization's ability to manage data securely, as well as an enhancement in prediction and decision-making capabilities. (Dubey et al., 2019) conducted a study exploring the relationship between big data's analytical capabilities and supply chain flexibility. The results indicated a positive effect of these analyses on green supply chains. (Abu Khashaba, 2021) aimed to identify the impact of big data analysis capabilities on the dimensions of supply chain flexibility and operational flexibility. The results revealed a positive effect of big data analysis capabilities on supply chain flexibility, although no such effect was observed on operational flexibility in the investigated organizations.

2.2 The Effect of technology and Green Supply Chain Management

(Guo Wei, 2023) This theoretical paper delves into the utilization of information technology (IT) to execute integrated green supply chain management strategies in China. The paper examines the fundamental principles and objectives of green supply chain management, the existing challenges and

prospects associated with the implementation of environmentally-friendly practices, and the contribution of IT in fostering sustainable initiatives.

(Ruben Wahyu Santoso et al., 2022) this study examines the advantages of integrating ERP technology and implementing green supply chain management to enhance operational performance within the manufacturing industry. It is crucial in offering valuable insights to manufacturers, shedding light on the implications and advantages associated with green supply chain practices and the adoption of ERP technology in the context of current challenges posed by environmental concerns pandemic. The findings indicate that embracing ERP systems facilitates environmentally conscious purchasing, production, distribution, and overall operational efficiency.

(Abdullah M.H et al., 2015) The current paper aims to fill this gap and provides the results of this study on the adoption of The Role of Green Information and Communication Technology Practices towards Sustainable Supply Chain Management the tools used of the results show that the GICT has contributed to sustainable supply chain management.

(Lee Khai Loon et al., 2018). This research offers a distinctive theoretical framework designed to assist both researchers and practitioners in cultivating a deeper comprehension of the connections among information technology capability, the adoption of supply chain technology, and the operational performance of the supply chain. Following the discussion, the study presents survey results elucidating the correlation between IT capability, supply chain technology adoption, and supply chain operational performance. The findings indicate that the adoption of supply chain technology acts as a mediator in the relationship between IT capability and the operational performance of the supply chain

2.3 Summary of past research

The summarized reveals a consistent theme of the positive impact of data analytics, big data analysis, and information technology on the sustainability, flexibility, and operational performance of supply chains. Jable et al. (2018) emphasize the positive effects of predictive and analytical data capabilities on economic, social, and environmental aspects of sustainable supply chains. Shokouhyar et al. (2020) and other studies stress the significant influence of big data analysis on sustainable supply chain performance, contributing to competitive advantages by improving flexibility. Internal and external integration, as highlighted by Braunscheidel and Suresh (2009), and the role of information technology, according to Swafford et al. (2008), are identified as key factors in enhancing supply chain speed and efficiency. Guo Wei's (2023) theoretical paper explores the role of information technology in implementing green supply chain management in China, while Santoso et al. (2022) highlight the advantages of integrating ERP technology and green supply chain practices in the manufacturing industry. Abdallah et al. (2015) and Lee Khai Loon et al. (2018) further contribute to the discourse by demonstrating the positive impact of green information and communication technology practices and the mediating role of supply chain technology adoption in enhancing operational performance. Overall, the research collectively underscores the crucial role of technology, data, and green practices in advancing sustainable and efficient supply chain management.

3. Study Gap

The problem statement identifies a research gap related to the impact of big data analysis on green supply chain management and information technology as Moderating variable. The existing literature is categorized into two research directions:

One focusing on integrating big data analysis into supply chain activities and operations, and the other emphasizing the generation of flexibility within the supply chain.

While previous studies have explored the advantages of big data analysis, the specific link between big data analysis, green supply chain management, and information technology is underexplored. (Bag et al., 2020; Zhan and Tan et al., 2020; Yu et al., 2021) (Chae et al., 2014; Tan et al., 2017; Ghasemaghaei et al., 2020; Dubey et al., 2019; Mandel, 2018; Bag et al., 2021; Bamel & Bamel, 2020;

Wamba et al., 2018; Yu et al., 2021), chain (Claycomb et al., 2005; Gligor and Holcomb, 2012). The study proposes to address this research gap by introducing the concept of Information Technology as a moderating variable in the relationship between big data analysis and green supply chain management within the National Industry Company in the Kingdom of Saudi Arabia. This expansion of variables and context contributes to the existing literature in several ways:

National Industry Company Context: Focusing on the National Industry Company in the Kingdom of Saudi Arabia provides a specific and contextualized setting for the study. This approach recognizes that the impact of big data analysis on green supply chain management may vary across different industries and regions, offering a nuanced perspective.

The introduction of Information Technology as a moderating variable is a novel aspect of the study. This suggests an intention to explore how the interaction between big data analysis and green supply chain management is influenced or moderated by the specific characteristics of data usage within the organization.

Addressing Early Stage of Big Data Analysis Implementation: The acknowledgment that the concept of big data analysis is still in its early stages, particularly in developing countries, adds another layer of significance to the research. This implies that the study is not only contributing to existing literature but also addressing a current and evolving phenomenon. (Tan et al., 2015; Fernando et al., 2018; Moktadir et al., 2019; Zhan Tan, 2020; Alaska et al., 2020; Saleem et al., 2020).

In summary, the study seeks to enhance the understanding of the relationship between big data analysis and green supply chain management by introducing the moderating variable of information technology, within the specific context of the National Industry Company in the Kingdom of Saudi Arabia. This approach fills a research gap by providing a more nuanced and comprehensive perspective on the integration of big data analysis into green supply chain practices, especially in the context of information technology.

4. Model of the Study

The conceptual framework proposes Big Data (BDA) Analysis as the predictor variable, with Information Technology (IT) serving as the moderating variable. The anticipated outcome in this framework is the manifestation of Green Supply Chain Management (GSCM).

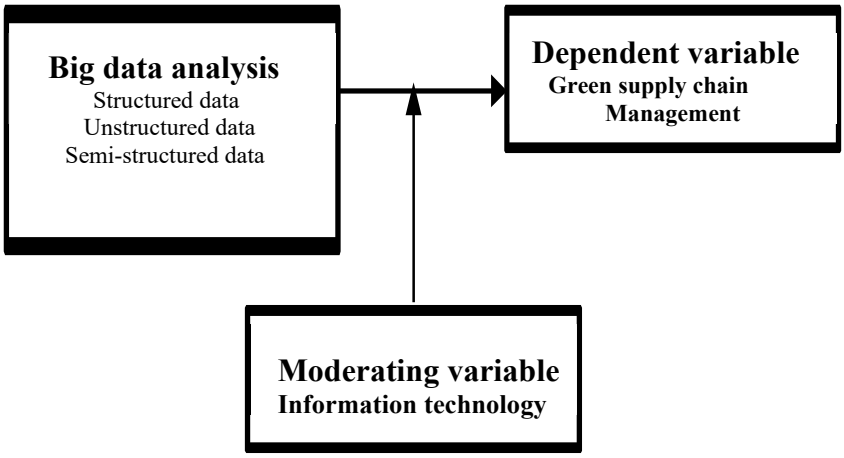

Fig 1 Model of the Study

Study Hypotheses

Based on the results of previous studies concerning the analysis of the relationships between the proposed variables, and in the light of the study problem and objectives, a number of hypotheses were

cited to achieve the study objectives as follows:

Ho1: There is no relationship between Big Data Analysis (Structured data, unstructured data, and Semi-structured data) and Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia.

Ho2: There is no impact of Big Data Analysis (Structured data, unstructured data, and Semi-structured data) in Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia.

H03: Information technology has no moderation effect on the relationship between Big Data Analysis (Structured data, unstructured data, and Semi-structured data) and Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia.

5. Research Methodology

In pursuit of the study objectives, the researcher adopted an analytical descriptive approach. This methodology entails elucidating a real-world phenomenon, testing study hypotheses, and scrutinizing data to derive conclusions. The data collection process encompassed two distinct resources. Secondary resources, including pertinent literature and previous studies, underwent comprehensive review. Primary resources were acquired through a meticulously designed questionnaire tailored to assess the study hypotheses.

This questionnaire, developed in accordance with scientific principles and informed by preceding research, served as the primary instrument for gathering data from the sampled individuals.

The researcher heavily relied on the questionnaire to amass primary data from the selected sample, Crafted with precision based on insights from prior studies, the questionnaire's design adhered closely to scientific standards, ensuring accuracy and relevance in capturing the essential data for the study. Data were collected from the study sample through a survey. The questionnaire comprised three sections:

First, the section aimed to measure the three dimensions of big data analysis (Structured data, unstructured data, Semi-structured data).

Second, the section measured the dependent variable (Green supply chain Management).

Third, the section measured the moderating variable (Information technology).

Various statistical methods were employed to analyse the collected data. To test the study model, the researcher employed Smart PLS 3, a statistical tool selected for its suitability in assessing the relationships and moderating effects under investigation. This approach sought to establish a robust foundation for drawing meaningful conclusions regarding the impact of information technology on the interaction between big data analysis and green supply chain management in the specified industrial context.

5.1. The Study Population and Sample:

The research was conducted among the workforce of the National Industrial Company, encompassing a total of (360) individuals in top and middle management roles. The National Company stands as one of the leading industrial entities in the Kingdom of Saudi Arabia and the wider region, being among the (100) largest companies in Saudi Arabia. The company operates in (5) strategic units, housing a total of (11) factories. For this study, a random sampling approach was employed. These respondents included individuals in top and middle management positions across the (11) factories of the National Industrial Company in the Kingdom of Saudi Arabia, spanning various industrial sectors. Data collection was carried out using a semi-structured questionnaire, distributed electronically to each manager.

The appropriate sample size for a population size of (360) is (196). According the recommended Krejcie and Morgan (1970), as suggested by Sekaran and Bougie (2010), In order to lessen sample size

error and putting into consideration the occurrence of non-response by some respondents, the sample size was increased by 40% percent of the required size as suggested by Barlett, et al. 2001). Therefore, the sample size of this study had become by (196 + 78 = 274). Hence, (274) questionnaires distributed to the targeted

(255) questionnaires were recovered with a recovery rate of 93 percent; however, 35 questionnaires were excluded because they were invalid for analysis, leaving (220) questionnaires that were valid for analysis. This rate of 93% is considered acceptable for this society.

Table 1: the strategic units belonging to the National Company

The Strategic Units Belonging to the National Company	
1	Al-Watania Plastic industry, which includes two factories in Riyadh
2	Al-Watania Paper industry, and includes (3) factories; two in Riyadh and one in Jeddah
3	Al-Watania Bowl industry , and includes two factories: one in Riyadh and one in Jeddah
4	Al-Watania International Cap: one factory in Dubai
5	Al-Watania Bricks: one factory in Dhurma
7	Al-Watania Polyflex: one factory in Dhurma

6. Validity & Reliability Tests

To assess the research instrument's reliability, we conducted an internal consistency reliability test on all the items to calculate the Cronbach's Alpha coefficient. This method was chosen as appropriate for assessing internal consistency, especially when employing multiple Likert scale questions, as indicated by (Saunders et al. in 2009).

Table 2: Cronbach's Alpha

Variables	Dimension	Cronbach's Alpha Value
Independent variable	Big Data Analysis (BDA)	0.882
Dependent variable	Green Supply Chain Management (GSCM)	0.876
Moderating variable	Information Technology (IT)	0.900

These results, as documented by Njoroge, Bula, and Wanyoike in 2020, indicate that the questionnaire demonstrated strong internal consistency. All items achieved a coefficient value exceeding 0.7, aligning with the recommended threshold in the literature (Hair et al., 2012).

7. Data Analysis and Discussion

Two-stage regression model

Table 3: Regression output

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.813[a]	.733	.726	.438
2	.931[b]	.865	.855	.441

a. Predictors: (Constant), independent variable (IV) BDA, moderator (Mo) IT
b. Predictors: (Constant), BDA, IT, Int IT BDA,
c. Dependent Variable: GSCM

Table 3: indicates that the value of R square increases for the second model from 0.733 to 0.865, which reflects that the model including the interaction effect of big-data analytics and Information Technology gives a better explanation of the variation in Supply Chain Management.

7.1 Hypothesis testing

7.1.1 There is no relationship between Big Data Analysis and Green Supply Chain Management

Ho1: There is no relationship between Big Data Analysis (Structured data, unstructured data, and Semi-structured data) and Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia

However, the null hypothesis was rejected as the results indicate a statistically significant positive correlation between Big Data Analysis constructs and Supply Chain Management, with a p-value less than 0.05 at a 95% confidence level. These findings suggest a positive linear relationship between Big Data Analysis and Supply Chain Management, aligning with previous studies that have identified a correlation between Big Data Analysis indicators and Supply Chain Management (Moyano -Fuentes et al 2019; Reddy Reinartz and Moyano, 2017).

7.1.2 Effect of Big Data Analysis in Green Supply Chain Management

Ho2: There is no impact of Big Data Analysis on Green Supply Chain Management within Al-Watania for Industries in the Kingdom of Saudi Arabia.

The impact of Big Data Analysis on Green Supply Chain Management was further explored through regression analysis, revealing an R-squared value of 0.312. This implies that the Big Data Analysis variables (Structured data, unstructured data, Semi-structured data) collectively account for 31.2% of the variation in Green Supply Chain Management.

The ANOVA test results, with a significance level of p (0.00) < 0.05, indicate that the regression model for Big Data Analysis effectively predicts Green Supply Chain Management. Additionally, the regression coefficients for Structured data (β = 0.252), Unstructured data (β = 0.287), and Semi-structured data (β = 0.123), with p-values (0.00) < 0.05, affirm that these variables significantly predict Green Supply Chain Management. The regression model can be expressed as Y = 2.968 + 0.252X1 + 0.287X2 + 0.113X3.

The null hypothesis, stating that Big Data Analysis has no influence on Green Supply Chain Management within Al-Watania for Industries in the Kingdom of Saudi Arabia, was rejected. This rejection occurred because all three components of Big Data Analysis significantly forecasted Green Supply Chain Management with a confidence level of 95%. These results align with existing empirical studies that have demonstrated the predictive power of Big Data Analysis in the context of Green Supply Chain Management.

These findings are consistent with past studies on the Effect of Big Data Analysis in Green Supply Chain Management (Shokouhyar et al., 2020; Braunscheidel and Suresh, 2009; Ghasemaghaei et al.,

2017; Fernando et al., 2018; Dubey et al., 2019; Abu Khashaba, 2021).

(Shokouhyar et al., 2020) Strengths: Determine specific contributions of Big Data in optimizing green supply chain processes. Weaknesses: May lack generalizability if the study focuses on a specific industry or region. (Braunscheidel and Suresh, 2009) Strengths: Being an early study, it might provide foundational insights. Weaknesses: The fast-evolving nature of technology may limit the applicability of the findings to the current context.

(Ghasemaghaei et al., 2017) Strengths: Investigates the integration of Big Data in the context of green supply chain management. Weaknesses: Potential biases in data collection and analysis methods may affect the reliability of the results. (Fernando et al., 2018) Strengths: Offers insights into the potential environmental benefits of integrating Big Data into supply chain management. Weaknesses: The time frame for analysis may not capture the long-term impacts and sustainability of the proposed practices.

(Dubey et al., 2019) Strengths: Likely to provide contemporary insights into the evolving landscape of Big Data in green supply chain management. Weaknesses: Findings might be influenced by the specific technological and industry context during the study period. (Abu Khashaba, 2021) Strengths: Recent studies are crucial for understanding the current state of affairs. Weaknesses: May lack historical context and might be focused on specific technologies or practices that could quickly become obsolete.

7.1.3 Moderation Effect of Information Technology

H03: Information technology has no moderation effect on the relationship between Big Data Analysis (Structured data, unstructured data, and Semi-structured data) and Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia.

Using multiple regression analysis, test for moderation involved first determining whether there was an overall relationship between big Data Analysis and Green Supply Chain Management to moderate.

Table 4: Coefficients for Big Data Analysis and Green Supply Chain Management.

Unstandardized coefficients		Standardized coefficients			
Model	B	Std. Error	Beta	T	Sig
(Constant)	1.648	.493	.429	3.343	.000
Big Data Analysis	.386	.077		5.012	.000

Dependent Variable: Supply Chain Management

The results indicated that there was an effect to moderate, intercept, $\beta 0 = 1.648$, p (0.00) < 0.05; Big Data Analysis, $\beta\ 11 = 0.386$, p (0.00) < 0.05 as shown in table (4).

Table 5: Coefficients of moderation analysis

Model				coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.733	2.147		7.328	.000
	Big Data Analysis	.087	.025	.387	3.480	.000
	Information Technology	11.269	1.216	.936	9.267	.000
2	(Constant)	19.365	1.972		9.820	.000
	Big Data Analysis	.034	.021	.244	1.619	.199
	Information Technology	7.506	1.685	.478	4.455	.000
	OL*OC	.067	.014	.516	4.786	.000

Dependent Variable: Supply Chain Management

Table 5: reveals intriguing insights. In the realm of Big Data Analysis, the coefficient β stands at 0.034, and with a p-value of 0.199 (greater than 0.05), it suggests that Big Data Analysis serves as a predictor of Green Supply Chain Management. Meanwhile, in the domain of Information Technology, the β coefficient is 7.506, and the p-value is 0.000 (less than 0.05), indicating that Information Technology isn't a predictor variable but rather a moderator variable.

The interaction term's coefficient, β = 0.067, with a p-value of 0.000 (less than 0.05), suggests that Information Technology acts as a moderator in the relationship between Big Data Analysis and Green Supply Chain Management, yielding a total effect of 0.067. As for the moderation hypothesis (H03), which posits that Information Technology doesn't moderate the relationship between Big Data Analysis and Green Supply Chain Management, it was refuted. The evidence, with a coefficient of β = 0.067 and a p-value of 0.000 (less than 0.05) at a 95% confidence level, supports the notion that Information Technology indeed plays a moderating role in this relationship. These findings align with previous studies that also identified the moderation effect of Information Technology on the connection between Big Data Analysis and Green Supply Chain Management.

These findings are consistent with past studies on The Effect of technology and Green Supply Chain Management (Guo Wei, 2023; Ruben Wahyu Santoso et al., 2022; Abdullah M.H et al., 2015; Lee Khai Loon et al., 2018). The intersection of technology and Green Supply Chain Management (GSCM) has become a focal point for researchers and practitioners alike, as organizations strive to balance economic goals with environmental sustainability. The mentioned studies by Guo Wei (2023), Ruben Wahyu Santoso et al. (2022), Abdullah M.H et al. (2015), and Lee Khai Loon et al. (2018) shed light on the relationship between technology and GSCM. This critical analysis aims to evaluate the findings of these studies, emphasizing their contributions, methodologies, and potential implications for businesses and the broader supply chain landscape.

The consistency across the studies suggests a growing consensus on the positive impact of technology on GSCM. Guo Wei (2023), Ruben Wahyu Santoso et al. (2022), Abdullah M.H et al. (2015), and Lee Khai Loon et al. (2018) all underscore the role of technology in enhancing environmental performance within the supply chain. Whether through improved monitoring, data analytics, or communication, technology appears to offer solutions that contribute to more sustainable practices.

8. Conclusions

The results of this study provide evidence that there is positive correlation and predictive influence between Big Data Analysis and Green Supply Chain Management. It is evident that (Structured data, unstructured data, and Semi-structured data) are critical drivers of Green Supply Chain Management. This implies that adoption of measures used for Big Data Analysis is critical to improvement of Green Supply Chain Management

This echoes empirical literature that view Big Data Analysis as a panacea for high Green Supply Chain Management in the industry. Further the study establishes that Information technology has a moderating effect on the linkage between Big Data Analysis and Green Supply Chain Management.

9. Limitations and recommendations for future studies

This research has a few constraints.

First is that the examination was restricted to in the National Industry Company in the Kingdom of Saudi Arabia. In light of the discoveries of this research, the learning of Green Supply Chain Management organizations in is beginning as the organizations are in the primary stage.

Second, this study does not include service organizations.

Thirdly, executive managers at both the senior and middle management levels must work towards supporting industries in the Kingdom of Saudi Arabia by implementing the following:

Invest in Cutting-edge Analytical Technologies: Embrace advanced IT analytics tools and technologies to leverage the potential of Big Data. This encompasses the adoption of predictive analytics, machine learning algorithms, and data visualization tools that can furnish actionable insights into the various facets of supply chain processes.

1. Incorporate Big Data into Supply Chain Operations: Big Data to augment visibility throughout the supply chain. Sensors, RFID tags, and other IoT devices to collect real-time data on the movement and condition of goods. Analyze this information to optimize logistics, minimize waste, and enhance overall operational efficiency.
2. Develop a Holistic Data Strategy: Devise a comprehensive data strategy delineating how data will be collected, stored, processed, and analyzed. Ensure adherence to data protection regulations and establish robust data governance practices to uphold data integrity and security.
3. Employee Training in IT Analytics: Implement training programs for employees to enhance their proficiency in utilizing IT analytics tools. This ensures that the workforce is adept at harnessing data insights for informed decision-making and continual process improvement, particularly in the realm of green supply chain management.

Future investigations utilizing the Variables proposed by the can be an opportunity for researchers to propel this theme Different studies that expand this exploration field could be with respect to the Moderating Effect of Information Technology on the Relationship between Big Data Analysis and Green Supply Chain Management in the National Industry Company in the Kingdom of Saudi Arabia.

As a prospective endeavor, conducting multiple case studies across various market sectors to examine the impact of Information Technology on the correlation between Big Data Analysis and Green Supply Chain Management would be intriguing. These case studies aim to validate and refine the existing framework. Furthermore, they can serve as valuable reference models and examples for applying the framework, thereby contributing to a reduction in time, costs, and potential failures during its implementation.

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