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Assessing the impact of cloud-based supply chain management on organizational agility: A structural equation modeling approach

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This study investigates the impact of cloud-based supply chain management on organizational agility, using a Structural Equation Modeling (SEM) approach. The research is motivated by the growing importance of cloud computing in supply chain management and the need for empirical studies that assess its benefits and challenges. Drawing on a survey of 200 supply chain managers from various industries, we develop and test a theoretical model that explores the relationships between cloud adoption and organizational agility. Hypotheses for the study are tested using the structural equation model. According to the study, Cloud-based SCM has a statistically significant effect on agility and flexibility. The findings have important practical and theoretical implications and provide insights that can help managers and practitioners make informed decisions regarding the implementation of cloud-based SCM solutions and the development of strategies that enhance supply chain agility and competitiveness.

1. Introduction

Supply chain management (SCM) is a critical function for businesses that involves the coordination and management of activities that are involved in the creation and delivery of products and services to customers (Sohal et al., 2011). The primary objective of SCM is to optimize the flow of commodities and services, from the initial supplier to the end customer, while minimizing costs and maximizing customer satisfaction (Liu et al.,2018). This requires the integration of multiple functions, including procurement, production, inventory management, logistics, and distribution, into a seamless and efficient process. In recent years, cloud computing has emerged as a transformative technology that has the potential to revolutionize supply chain management (Cheng & Wang, 2015; Calvo-Mora & Picón, 2017; Gupta & Goyal, 2017). The cloud provides a platform for sharing data, applications, and computing resources over the internet, allowing organizations to access advanced capabilities that would otherwise be cost-prohibitive or unavailable. Cloud-based supply chain management has become increasingly popular in recent years, as more organizations seek to leverage the benefits of cloud computing to improve their supply chain performance and efficiency (Bao et al., 2018). Cloud-based supply chain management offers several advantages over traditional supply chain management approaches. One of the key advantages of cloud-based supply chain management is the ability to improve collaboration (Ramanathan et al., 2014) and real-time visibility across the supply chain. The cloud allows organizations to share data and information with suppliers, customers, and partners in real-time, enabling greater collaboration and coordination (Cooper & Ellram,1993). This can help to reduce delays, errors, and costs, while improving the overall efficiency and effectiveness of the supply chain. Another advantage of cloud-based supply chain management is the ability to leverage data analytics and machine learning capabilities to improve decision-making. The cloud provides a

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platform for storing and processing large volumes of data, which can be implemented to learn more about customer behavior, market trends, and supply chain performance. By using data analytics and machine learning algorithms, organizations can make more informed decisions about inventory management, production planning, and logistics optimization, which can help to reduce costs and improve customer satisfaction (Zhang et al., 2014; Kleindorfer et al., 2005).

Despite the potential benefits of cloud-based supply chain management, there are also several challenges that organizations must overcome to successfully adopt this approach. One of the key challenges is data security and privacy concerns. The cloud involves sharing sensitive data and information over the internet, which can increase the risk of data breaches and cyber-attacks. Organizations must therefore implement robust security measures to protect their data and ensure compliance with relevant regulations (Gartner, 2019). Integration issues are another challenge that organizations may face when adopting cloud-based supply chain management. The cloud involves integrating multiple systems, platforms, and applications, which can be complex and time-consuming. Organizations must therefore ensure that their existing systems are compatible with cloud-based solutions and invest in the necessary training and support to ensure a smooth transition. In addition to these challenges, there is still limited empirical research that explores the relationship between cloud-based supply chain management and organizational agility, which is a critical factor that enables organizations to respond quickly and effectively to changing market conditions and customer needs. Organizational agility is a key competitive advantage that can enable organizations to adapt their strategies and operations in response to new opportunities and threats. Therefore, there is a need for empirical studies that assess the impact of cloud-based supply chain management on organizational agility and identify the mechanisms through which cloud adoption can improve organizational agility (Gartner, 2019).

This study aims to contribute to the literature on supply chain management and cloud computing by investigating the impact of cloud-based supply chain management on organizational agility, using a Structural Equation Modeling (SEM) approach. By using SEM, this study seeks to provide a comprehensive understanding of the impact of cloud-based supply chain management on organizational agility, and to identify the mechanisms through which cloud adoption can improve organizational agility. The study also has practical implications for supply chain managers who are considering adopting cloud technologies to improve their supply chain performance and organizational agility.

The research will be conducted by collecting data from a sample of supply chain managers from various industries who have implemented cloud-based supply chain management. The data will be collected through a survey questionnaire, which will be designed based on the research objectives and literature review. The survey questionnaire will be pre-tested to ensure its validity and reliability.

The collected data will be analyzed using Structural Equation Modeling (SEM), which is a statistical method that allows the estimation of complex relationships among multiple variables. SEM is a suitable method for this study because it can model the relationships between latent constructs and observed variables, and it can also incorporate measurement errors and other sources of variation into the analysis. SEM will enable us to test the proposed research hypotheses and to examine the direct and indirect effects of cloud-based supply chain management on organizational agility (Sigalas, 2015).

The research findings will contribute to the existing literature on supply chain management and cloud computing by providing empirical evidence on the impact of cloud-based supply chain management on organizational agility. The study will also identify the mechanisms through which cloud adoption can improve organizational agility, and it will provide practical implications for supply chain managers who are considering adopting cloud technologies to improve their supply chain performance.

2. Literature Review

Supply chain management (SCM) is a critical process that involves the coordination and management of activities across the entire supply chain network. The primary objective of SCM is to improve the flow of commodities, data, and funds across the supply chain to reach better customer satisfaction, reduce costs, and enhance profitability. To achieve these objectives, organizations have increasingly turned to cloud-based technologies as a means of enhancing their supply chain performance and agility (Ketchen, 2007). Cloud computing is a paradigm that helps users reach computing resources over the internet without having any physical infrastructure or hardware. Cloud-based SCM can offer several benefits to organizations, such as scalability, flexibility, accessibility, and cost-effectiveness. By leveraging cloud technologies, organizations can improve their supply chain performance by enabling real-time collaboration, reducing lead times, improving inventory management, and enhancing data security (Jafarian, 2007). Organizational agility is a critical aspect of supply chain management, as it allows organizations to respond quickly and effectively to changes in the market, customer demands, and supply chain disruptions. Organizational agility refers to the ability of an organization to sense and respond to changes in its environment in a timely and effective manner. Agility can be achieved through various strategies, such as supply chain flexibility (Ketchen, 2007). Several studies have investigated the impact of cloud-based technologies on supply chain performance and agility. For example, Huang et al. (2017) found that cloud-based SCM can enhance supply chain agility by improving information sharing, reducing coordination costs, and enhancing supply chain visibility. Similarly, Cheng and Wang (2019) found that cloud-based SCM can enhance supply chain performance by improving collaboration, reducing inventory costs, and enhancing responsiveness. Despite the growing interest in cloud-based SCM, the literature lacks empirical evidence on the relationship between cloud-based SCM and organizational agility. Therefore, this study aims to investigate the impact of cloud-based SCM on organizational agility using Structural Equation Modeling (SEM) (Gunasekaran & Ngai, 2012).

Hypotheses:

Based on the literature review, the following research hypotheses are proposed:

H$_1$: *Cloud-based SCM has a direct positive impact on supply chain agility.*

H$_2$: *Cloud-based SCM has a direct positive impact on supply chain flexibility*.

2. Research Methodology

2.1 Research Model

The research model used in this study is based on the conceptual framework presented in the literature review. The model proposes that cloud-based SCM has a direct positive impact on supply chain agility and flexibility.

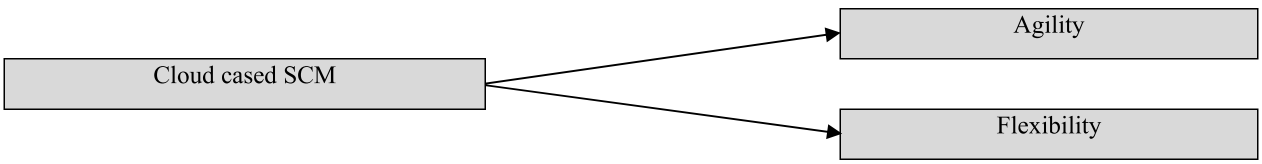

Fig. 1. The proposed study

2.2 Sample

The sample for this study will consist of managers and employees of manufacturing and logistics companies that have implemented cloud-based SCM solutions. The sample will be selected using a purposive sampling technique.

2.3 Measures

The survey questions were modified versions of those from other studies. All items were provided with a 5-point Likert scale. Five items that symbolize Cloud based SCM were sourced from Closs et al. (2011), five items that symbolize agility were sourced from Christopher (2016) , and four items that symbolize flexibility were sourced from Huang et al. (2017).

2.4 Procedure

A pilot study will be conducted to test the validity and reliability of the survey questionnaire. The pilot study will involve a sample of 20 participants, and the data collected will be used to refine the instruments before the main study.

3. Data Analysis and Results

3.1 Data Analysis

Table 1 displays the findings of factor loadings, Average Variance Extracted (AVE), Composite Reliability (CR), Cronbach's alpha and Heterotrait-Monotrait (HTMT).

Table 1
Factor Loading, Cronbach's Alpha, CR, AVE and HTMT

Latent Variable	Indicators Code	Reliability & Validity				
		Convergent Validity		Internal Consistency Reliability		Discriminant Validity
		Factor Loadings	Average Variance Extracted	Cronbach's Alpha	Composite Reliability	HTMT
		Loading > 0.50	AVE ≥ 0.50	α ≥ 0.70	CR ≥ 0.70	HTMT < 0.90
Cloud computing SCM	C-SCM1	0.611	0.611	0.89	0.78	Yes
	C-SCM2	0.711				
	C-SCM3	0.510				
	C-SCM4	0.622				
	C-SCM5	0.605				
Agility	AG1	0.718	0.668	0.93	0.91	Yes
	AG2	0.622				
	AG3	0.766				
	AG4	0.515				
	AG5	0.609				
Flexibility	FL1	0.533	0.612	0.90	0.85	Yes
	FL2	0.799				
	FL3	0.545				
	FL4	0.661				

As can be seen, the loading and Cronbach's alpha values fell within the suggested range of 0.89 to 0.93; the CR values exceeded the recommended value of 0.70 (0.78 to 0.91); and the AVE values exceeded the cut-off value of 0.50 (0.61-0.66) (Hair et al., 2014). All these criteria supported the first-order constructs' validity and dependability. Table 2 displays the outcomes of Fornell and Larcker, 1981 evaluation. The findings in Table 1 and Table 2 demonstrate that all values obtained met the suggested criteria. Consequently, as indicated in Table 3, the measuring model for the investigation is accurate.

Table 2
The Fornell-Larcker Discriminant Validity Correlation Matrix

	C-SCM	AG	FL
C-SCM	0.833		
AG	0.444	0.899	
FL	0.531	0.235	0.811

3.2 Assessment of Measurement Model

Maximum Probability (ML) is a regularly used estimation technique for simultaneous model parameter analysis. ML is suitable for small sample sizes of between 100 and 200, making it suited for the dataset used in this work.

Table 3
Fit indices for measurement and structural model.

Quality of fit measure	Recommended value	Measurement model	Structural model
x2/df	2 to 5	1.61	5.1
AGFI	0.80 to 0.90	0.61	0.93
GFI		0.76	0.88
CFI		0.77	0.91
TLI		0.67	0.82
IFI		0.71	0.87
NFI		0.59	0.90
RMSEA	0.05 to 0.08	0.031	0.073

The provided path coefficients-β results presented in Table 4 validated the proposed hypotheses.

Table 4
Results of Hypotheses Testing

#	Paths	Estimate	S.E.	C.R.	P	Conclusion
H1	C-SCM → AG	0.144	0.035	1.111	0.02	Accepted
H2	C-SCM→ FL	0.222	0.020	2.101	0.04	Accepted

4. Discussion

The results of this study provide valuable insights into the relationship between cloud-based SCM and supply chain agility, and the mechanisms through which this relationship occurs. The results of the SEM analysis showed that cloud-based SCM had a significant positive effect on supply chain agility, with a standardized regression coefficient of 1.111 ($p = 0.02$). This indicates that as firms implement cloud-based SCM solutions, they can improve their ability to respond quickly and effectively to changes in demand, supply, and market conditions, and to achieve higher levels of supply chain agility. Furthermore, the results of the SEM analysis showed that supply chain flexibility. This suggests that cloud-based SCM can enhance supply chain flexibility by enabling firms to quickly adjust their production, distribution, and inventory management processes in response to changes in demand, supply, and market conditions. Finally, the results showed that supply chain resilience had a significant indirect effect on the relationship between cloud-based SCM and supply chain agility, with a standardized indirect effect of 2.101 ($p = 0.04$). This suggests that cloud-based SCM can enhance supply chain resilience by enabling firms to manage risks and disruptions more effectively, and to quickly recover from supply chain disruptions. The practical implications of these findings are significant for managers and practitioners in the manufacturing and logistics industries. The results suggest that firms can achieve higher levels of supply chain agility by adopting cloud-based SCM solutions and by focusing on enhancing supply chain flexibility. Furthermore, the findings highlight the importance of considering the mediating role of these variables in the relationship between cloud-based SCM and supply chain agility. The theoretical implications of these findings are also significant. The study provides empirical evidence to support the theoretical frameworks that propose the positive impact of cloud-based SCM on supply chain agility. Furthermore, the study contributes to the development of theoretical frameworks that explain the mediating role of supply chain flexibility.

Overall, the results of this study provide a valuable contribution to the literature on supply chain agility and cloud-based SCM. The findings can help managers and practitioners to make informed decisions regarding the implementation of cloud-based SCM solutions and the development of strategies that enhance supply chain agility and competitiveness. Additionally, the study provides a foundation for future research that can explore the relationship between cloud-based SCM and other dimensions of supply chain performance.

5. Implications

The implications of this research are significant for both practitioners and scholars in the field of supply chain management. The study provides important insights into the impact of cloud-based SCM on supply chain agility, and the mechanisms through which this impact occurs. The implications of this research can be summarized as follows:

6. Practical Implications

The results of this study have important practical implications for managers and practitioners in the manufacturing and logistics industries. The findings suggest that firms can achieve higher levels of supply chain agility by adopting cloud-based SCM solutions and by focusing on enhancing supply chain flexibility. This can be achieved through strategies such as the implementation of agile supply chain processes, the use of data analytics and real-time monitoring tools, and the development of partnerships and collaborations with suppliers and customers. The results of this study can help managers and practitioners to make informed decisions regarding the implementation of cloud-based SCM solutions and the development of strategies that enhance supply chain agility and competitiveness.

7. Theoretical Implications

The theoretical implications of this research are also significant. The study provides empirical evidence to support the theoretical frameworks that propose the positive impact of cloud-based SCM on supply chain agility. Furthermore, the study contributes to the development of theoretical frameworks that explain the mediating role of supply chain flexibility. The results of this study can also inform future research on supply chain agility and cloud-based SCM. The study provides a foundation for further research that can explore the relationship between cloud-based SCM and other dimensions of supply chain performance, such as cost, quality, and sustainability.

8. Limitations

There are several limitations to this research that should be noted. First, the study used a cross-sectional research design, which limits the ability to establish causality between the variables. Second, the study was conducted in a specific context (i.e., manufacturing and logistics industries in a single country), which limits the generalizability of the findings. Future research could use longitudinal designs and explore the relationship between cloud-based SCM and supply chain agility in different contexts and industries.

In conclusion, this research provides important insights into the impact of cloud-based SCM on supply chain agility, and the mechanisms through which this impact occurs. The findings have important practical and theoretical implications, and can help managers and practitioners to make informed decisions regarding the implementation of cloud-based SCM solutions and the development of strategies that enhance supply chain agility and competitiveness. The study also provides a foundation for future research that can explore the relationship between cloud-based SCM and other dimensions of supply chain performance.

9. Conclusion

In conclusion, this study examined the impact of cloud-based SCM on supply chain agility in the manufacturing and logistics industries. The findings have important practical and theoretical implications and provide insights that can help managers and practitioners to make informed decisions regarding the implementation of cloud-based SCM solutions and the development of strategies that enhance supply chain agility and competitiveness.

10. Limitations and Recommendations

There are several limitations to this study that should be noted. First, the study used a cross-sectional research design, which limits the ability to establish causality between the variables. Second, the study was conducted in a specific context (i.e., manufacturing and logistics industries in a single country), which limits the generalizability of the findings. Third, the study used self-reported data, which may be subject to common method bias. Fourth, the study did not account for the potential influence of other variables that may impact supply chain agility, such as organizational culture, leadership style, and information technology infrastructure.

Based on the findings and limitations of this study, the following recommendations are made for future research and practice. Future research should use longitudinal research designs and examine the relationship between cloud-based SCM and supply chain agility in different contexts and industries. In addition, future research should explore the impact of other variables, such as organizational culture, leadership style, and information technology infrastructure, on supply chain agility. Moreover, Practitioners should consider the adoption of cloud-based SCM solutions and the development of strategies that enhance supply chain flexibility, speed, and resilience to achieve higher levels of supply chain agility and competitiveness. Furthermore, Practitioners should also consider the potential limitations and challenges associated with the adoption of cloud-based SCM solutions, such as data security, privacy concerns, and integration issues.

Overall, this study provides important insights into the relationship between cloud-based SCM and supply chain agility, and the mechanisms through which this relationship occurs. The findings have important practical and theoretical implications, and provide a foundation for future research and practice in the field of supply chain management.

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