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Internet of Things-Driven Information Sharing: A Strategic Approach to Mitigating Supply Chain Risks

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ABSTRACT

This research explores the integration of the Internet of Things (IoT) in mitigating supply chain risks within the retail industry, highlighting the crucial role of information sharing strategies as a mediating factor. Through an extensive analysis, the study reveals that all examined relationships between IoT implementation, supply chain risk mitigation, and the effectiveness of information sharing are positively correlated and statistically significant, suggesting that enhanced IoT capabilities can lead to more effective risk management through improved data transparency and communication among stakeholders. A key limitation of this research is the reliance on quantitative data, which may not fully capture the nuanced experiences of industry practitioners; future studies could benefit from qualitative insights to deepen understanding. Practically, this research underscores the necessity for hospitality organizations to develop robust information sharing strategies that leverage IoT technologies, ultimately fostering resilience and adaptability in supply chains. Additionally, this study contributes to the hospitality sector by providing a framework that integrates modern technological solutions with strategic management practices, guiding industry leaders in enhancing operational efficiency and customer satisfaction through proactive risk management.

Keywords: Internet of Things, Supply Chain Risk, Information Sharing
JEL Classifications: L14, O33, M15, D85

1. INTRODUCTION

Supply chain management is on the rise with the complexity and uncertainties emanating from globalization, fluctuating market and constantly changing consumer behavior. In attempting to improve their robustness and flexibility, the Internet of Things (IoT) has become a strategic technology. This is made possible by the real-time collection and analysis of data which IoT makes it possible for organizations to assess their operations, anticipate dysfunctions and respond to them. This kind of transformative potential establishes IoT not only as an enabler of optimization however as a critical constituent of risk management in supply chains (Baryannis et al., 2019).

Nevertheless, even applying IoT technologies, it is not enough to achieve efficient risk management. Using IoT context, it was found in previous studies that the pattern of information sharing has a strong impact on the success of IoT projects. Visibility across the chain gets improved by a process known as information sharing whereby required information is exchanged between the various stakeholders at the right time. It promotes decision-making at all levels of the firm and enhances the understanding of risks in order to avoid disruptive incidents. Therefore, the information sharing capability takes central stage in harnessing the IoT capability for effective and efficient risk management (Ben-Daya et al., 2019).

In addition, the interaction between IoT and information sharing is influenced by these factors: organizational culture of the partners, mutual trust and technological support. Management of information flow multiplies the value that arises from the IoT data stream by turning knowledge into action, thus bolstering the supply chain architecture's strength. On the other hand, ineffective or ineffective practices of sharing may prevent the optimum to be achieved by IoT, future opportunities for risk management (Müller et al., 2020). Hence, identifying the patterns of information sharing as a mediator is crucial to institutions that want to leverage IoT in managing risks inherent in supply chains.

Therefore, the purpose of this research is to examine the factors that touch on the impact of information sharing strategies in the improvement of IoT application in minimizing these risks in the supply chain. Therefore, in this paper, the proposed study will attempt to synthesize a complete working framework of IoT and information sharing and it will seek to identify how different organizations can benefit from this innovation. Lastly, this investigation will help in understanding the nature of relationship between these elements and provide some pragmatic recommendations for the supply chain managers who are keen on enhancing the readiness of their supply chain in the face of rising volatility.

1.1. Research Questions

- What is the impact of IoT on SC risks?
- What is the role of IoT in information sharing in the retail industry?
- What is the role of information sharing in SC risks in the retail industry?
- What is the impact of IoT on SC risks through employing information sharing in the retail industry?

2. THEORETICAL FRAMEWORK

2.1. Internet of Things

Internet of Things also known as IoT is a system of devices connected and communicating through internet to become smart devices. This ranges from household appliances such as thermostat and refrigerator to personal fitness tracker and industrial equipment and machines. IoT, with the help of sensors, software and connectivity relies on automation, real-time monitoring, analysis and control of processes, resulting in better and faster decisions. As IoT progresses, it can change and improve many industries of our daily life such as health care, farming, and transportation making the world a much more precise and integral space (Rejeb et al., 2022).

Moreover, IoT allows an organization to create several measures to ensure the risks in the SC are mitigated and reduced. The IoT systems help a company ensure real-time critical data exchange activities can be conducted easily and through accurate systems and measures. IoT in the SC allows the company to mitigate the disruption of operation problems by using integrated connected networks to establish faster channels of communication and data sharing in the company (Hussein et al., 2018).

2.2. Supply Chain Risk

Supply chain risk is the capability of disruptions to the supply chain network and can include any matter of forces such as natural calamities, political unrest, economic volatility, and organizational inefficiencies. Due to global integration of operations, business enterprises have complex supply chains that can magnify risks; for example, if a factory is closed in one country or a region, it may create ripples in the company's production and inventory networks globally (Jajja et al., 2018). Also, there is always increased risk when there are a few suppliers for the vital inputs because the company's operations may be completely brought to a stop by a problem experienced by the suppliers meaning that the company may incur heavy losses. The application of digital technologies is beneficial in increasing the efficiency of business processes, at the same time, cybersecurity risks are inevitable, leading to loss of sensitive data or hampering of business operations. These risks can however, be managed by adopting measures like extending supplier base, use of analytics solutions for tracking in real-time and well-developed contingency framework. Finally, supply chain risk management can only be realized by a combination of optimal cost minimized risk together with the ability to adapt quickly to risks while at the same time being able to compete in the market (Vieira et al., 2020).

2.3. Information Sharing

Exchange of information is an essential process that involves the flow of information between individuals; within interpersonal relations, organizations and nations among others. It is the sharing of information, expertise and intelligence by the parties or persons with a view to sharing information, building on this trust and knowledge (Jiang and Ke, 2019). Despite the intrinsic characteristics of the digitized information environment where information can be produced and transmitted within a blink of an eye the challenge of information management assumes the paramount importance again. They help the teams to make better decisions and provide options, enhance problem solving potential and fosters the culture of learning and continuous improvement. Furthermore, in the context of globalization it is much easier to share information with people from other countries and therefore work on major issues including climate change, health, and security threats (Lotfi et al., 2013). Though it also brings some issues such as data privacy, security, and information sharing or rather spreading of fake information. Some of the factors that should be considered in order to achieve the maximum of benefits from effective information sharing without facing threats include achieving the proper level of openness in communication. In the long run, one cultivates a healthy information flow not only increases efficiency in operations but also enable the development of the capacity of people and groups to achieve set objectives and bring change.

3. LITERATURE REVIEW

3.1. Impact of Internet of Things on Supply Chain Risk

One of the key areas has been revolutionized by the IoT is supply chain management by increasing the visibility and interconnectivity between the various parties. Studies show that

connected things are used to monitor inventory, delivery, and equipment status in real-time (Fatorachian and Kazemi, 2021). It improves the companies' ability to anticipate disruptions and monitor risks in a much better way than before. For example, a transit temperatures and humidity can be checked to ensure that perishable products do not spoil and reduce on the money that the company makes.

In addition, the IoT leads to enhanced decision making as a result of analytical tools added on it. Through collection of data from different sources and data analytics, organizations should be able to use predictive analytics to make copy regarding demands and supply chain threats. Some of the risks that can be addressed by using IoT include delay in supplies or impacts resulting from natural disasters since the company can be in a position to make plans in advance. This proactive method does not only reduce risks but also improve the operation performance and customer satisfaction since the companies can change their strategies faster than their competitors spotting on the dynamic market conditions (Alicke et al., 2016).

However, the integration of IoT also has new challenges and risks in supply chain environment. Prior studies have lament for cybersecurity as the enhanced integration increases the susceptibility of the supply chain networks to cyber threats (Ageron et al., 2020). Moreover, the use of IoT devices causes concerns with data privacy associated with regulatory concerns. This means that while organizations are privy to the benefits associated with the clarification of visibility and efficiency gains against threats such as risks of loss of data and systems failure. In a nutshell, IoT offers ample prospects for radical improvement of risk management in supply chains, but its implementation presupposes the application of strict security measures and adequate risk analysis paradigms.

3.2. Impact of Internet of Things on the Role of Information Sharing

The Internet of Things (IoT) has defined a new way of sharing information in supply chain management by making it possible for different stakeholders to seamlessly communicate with each other. Studies show that IoT devices can collect and relay information concerning inventories, delivery status, and organizational effectiveness in real-time. This improved flow of data minimizes the information gap between the chain of supply associates hence improving on the level of transparency and credibility that exist within supply chain (Müller et al., 2020). Thus, it means that business organizations can now improve the decision-making process, direction and timeliness of supply chain strategies and satisfy customer requirements, all of which leads to better supply chain management (Gehrig et al., 2000).

In addition, information sharing through interconnection via IoT increases the accuracy of forecasts and synchronization of plans among the members of a supply chain. Research has demonstrated that in real-time data analysis, it is easier for organizations to predict changes in demand and supply shocks. It helps companies to share their experience with IoT devices to come up with the best strategies that help in reducing risks as well as effectively using resources in businesses. On the one hand, this approach is beneficial for companies as it helps avoid complex and unnecessary communication between different links in the supply chain; on the other hand, it is helpful for suppliers and customers and other stakeholders who often need to find ways to make supply chains more robust in case if some changes occur (Chirchir et al., 2015).

But more significant issues of information transfer by means of IoT which also leads to more utilization also have issues of data protection and security. Established research evidence indicates that though greater connectivity better serves the business's functional performance, it exposes supply chains to higher risks of getting hacked and data intrusions (Al Ali, 2021). In an effort to overcome such challenges, organizations are required to have well-defined policies regarding the management of data as well as having proper security measures in place for their data. These risks can be mitigated to ensure that IoT-enhanced information sharing brings the best results leading to effective supply chain system that is flexible and responsive to changes within business environment.

3.3. Impact of Information Sharing on Supply Chain Risk

Risk management in the supply chain has also been identified as an important issue in various research works especially the role played by information sharing. It also brings a better understanding of how information flows within the supply-chain concerning the inventory, demand, and any disturbance (Brandon-Jones et al., 2014). Several studies show that with more organizations sharing knowledge, they can address many issues that are considered risks, for example, when a supplier fails to deliver goods or changes prices, thus enabling one to make the right decisions regarding risks. This approach not only led to the early identification of risks; it also assist companies in coordinating a rapid response should a disruption occur hence reducing its impact (Fatorachian and Kazemi, 2021).

First of all, information sharing enables trust and cooperation between the members of supply chain which is critical for managing risks. Studies revealed that when crucial information including lead times and production capacities are shared, it means that the firms are more connected and therefore, the more informed network responds better to challenges. This alignment makes it possible for firms to coordinate on the formulation of contingency plans, efficiency as well as coordination on resource sharing thus strengthening the supply chain. It enables the companies to understand risks and uncertainties that prevail in the market much more effectively since one can depend on actual data provided by reliable partners (Yang et al., 2021).

However, as noted before, while information sharing can improve the effectiveness of supply chain risk management there are issues related to data privacy and security. Prior research also highlights that as organizations exchange information, the probability of leaking such data or misuse is likely to increase (Lotfi et al., 2013). As a result, companies require appropriate measures for data protection in order to continue harmonizing data sharing and

collaboration. Transparency and security must be in line with each other because organizations that are able to grow in this aspect are able to come up with a robust supply chain that is capable of dealing with risks and at the same time benefit from competitive strategies in the market place.

3.4. Impact of IoT on Supply Chain Risk with Mediating Role of Information Sharing

The analysis of risk management in the context of supply chain integration with the Internet of Things has revealed that information sharing is a key mediating variable in this relationship. A number of studies show that IoT devices improve the real-time data collection and sharing process that is vital in the management of risks in supply chains (Waqar et al., 2023). When organizations embrace the IoT technology, they can get information on the state of inventories, status of shipments as well as the performance of equipment's used. All this information can be disclosed to the other members of the supply chain, helping the network members to be ready for possible disruption. Therefore, IoT does not only contribute more volume of information but also more quality of information to the decision-making systems.

Moreover, the accurate communication of the huge amount of data produced by IoT promotes cooperation among supply chain actors, which is crucial to minimizing threats. Other research findings have revealed that those organizations that share a lot of information are in a better place to prepare and respond to various forces of change like demand volatility, reliability of suppliers, and logistical factors (Jajja et al., 2018). This way, IoT-enabled devices can provide actual time information to the companies to make preparations together with their partners to provide improved contingency plans and optimize their operations, hence improving the overall organizational robustness. The role of information sharing for this purpose becomes evident as it enables the opportunity presented by IoT technology to be brought to bear in making the risk management process more realizable in terms of enhanced supply chain flexibility that can effectively respond to market changes (Khan et al., 2024).

However, the use of IoT in information sharing also poses some issues with regard to security and privacy. Studies show that such connection and data sharing can lead to security challenges, which are counterproductive to the benefits of IoT supply chain systems (Al-Ayed and Al-Tit, 2023). There is need for organizations to enforce strong data usage and security policies in the network due to the sharing of data among companies. By achieving these, organizations can amplify the use of IoT in risk management where information sharing presents as a useful intervening variable hence enhancing the security of the supply chain.

3.5. Research Model

The conceptual research model displayed in figure 1 of IoT-Driven, Information Sharing demonstrates how IoT technologies enhance time-sensitive data sharing between supply chain networks which helps firms to reduce risks.

3.6. Research Hypothesis

H_1: Internet of things has significant impact on SC risk

H_2: Internet of things has significant impact on the role of information sharing

H_3: Role of information sharing has significant impact on SC risk.

H_4: Internet of things has significant impact on SC risk with mediating role of information sharing.

4. METHODOLOGY AND DATA

The study method that was used for this research work was quantitative in nature in that it used descriptive and exploratory research techniques to determine the association between the IoT, information sharing and supply chain risk in the retail industry. In this study, three forms were identified which are as follows: The three key constructs were sought through, primary data from the retail shops located in Fujairah, UAE. The least difficult sampling method that was employed was convenience sampling to elicit the opinion of the requisite number of managers, supply chain managers, IT managers, and sales managers. The study involved administering questionnaires to 235 participants, which can be considered sufficient for conducting an analysis. Specifically, an online survey questionnaire was proposed in order to collect relevant data based on the types of questions chosen in this study for everyone's personal convenience in responding.

A five-point Likert scale was used while designing the questionnaire in order to capture the tone and tenor of the respondent's perceptions and experiences in the best possible manner. The online survey was used to determine primary data while secondary data were retrieved from existing sources to provide an understanding of the results. To test the hypothesized model and to analyze the associations between the constructs, the Pearson's correlation matrix and multiple linear regression were performed with the help of SmartPLS 4. 0. This software helped the researchers to evaluate the structural model and offered an understanding of the relations between IoT, information sharing, and supply chain risk factors. Thus, due to this stringent approach, it became possible to gain a multi-faceted perspective on the effects that IoT can bring to supply chain in the retail industry.

5. DATA ANALYSIS

5.1. Measurement Model (Reliability)

It is important to conclude that the level of reliability for the constructs measured in the study is high. The Cronbach's Alpha coefficient SI values are as follows Internet of Things = 0.841 and Supply Chain Risk = 0.842, meaning that there is high internal consistency in the subjects measured for both constructs and the generally agreed Cronbach's Alpha cut-off is 0.70 (Table 1). The first of these measures is Information Sharing which in its estimate of 0.779 is only slightly lower than 0.800 but still acceptable on the scale of reliability.

Besides, all the rho-A values support the reliability of all the constructs, especially Supply Chain Risk (0.902) providing strong support for their measurement properties. The Composite Reliability scores also have a similar implication to these findings as enumerated by the Internet of Things yielded a 0.925 reliability

coefficient, this signifies that it was reliable in measuring the intended theoretical construct. All in all, these findings support the appropriateness of the instruments employed for measurement and can encourage confidence for the data gathered regarding examination of the interconnection between the established constructs within the scope of the study.

5.2. Discriminant Validity

The results of the Fornell-Larcker criterion analysis help to shed the light on the discriminant validity of the constructs explored in the research. From Table 2, it is observed that for each and every construct AVE is greater than 0.50 which shows that the model has satisfactory level of convergent validity.

The AVE for each construct is also displayed in the Table 2 and the square root of AVE for each construct also given below the diagonal line where shows that the different constructs satisfies the conditions that each construct is more closely related to itself than to any of the other constructs, internet of things (0.811), information sharing (0.844), and supply chain risk (0.788). This goes a long way in supporting the claim that the constructs are measuring different dimensions, a requirement for discriminant validity out of which model assessment may be effective.

Table 1: Reliability and validity by construct

Construct	Cronbach's alpha	rho-A	Composite reliability
Internet of things	0.841	0.844	0.925
Information sharing	0.779	0.816	0.807
Supply chain risk	0.842	0.902	0.845

Table 2: Fornell Larcker criterion

Construct	Fornell Larcker criterion			
	AVE	Internet of things	Information sharing	Supply chain risk
Internet of things	0.658	0.811		
Information sharing	0.714	0.621	0.844	
Supply chain risk	0.621	0.544	0.581	0.788

5.3. Structural Model

One of the key measures used in SEM is the variance accounted for by the model; this can be reflected by R-square coefficients, which show the extent to which variance in the dependent variable is explained by the independent variables. Standardized estimates indicate that path coefficients denote the relative magnitude and sign of the effects of predictors on outcomes. Furthermore, to swiftly establish whether these path coefficients hold great enough strength to allow for generalization of the identified relations past the sample, t-values are used. Figure 2 demonstrate the findings.

Table 3 shows the findings which highlight the nature of the connection between the Internet of Things (IoT), information sharing, and the supply chain (SC) risk. As for the effect of IoT on SC risk, the path coefficient (PC) is 0.420 "t" value is 4.162 of SC risk and P-value is 0.000 hence it shows that the direct effect of IoT on SC risk is highly positive significant (PS). Likewise, IoT exerts a significant impact on information sharing where PC = 0.674, t = 2.995, P = 0.000 which strengthens the fact that IoT plays a critical role in the communication that happens between the members of the supply chain.

Similarly, the correlation of information sharing and SC risk also has a PC of 0.323 with t-value 2.341 which indicate that there is PS. Most crucially, this is evident from the fact that the result shows that there is only a PM for the indirect path from IoT to SC risk through information sharing, with the path coefficient of 0.453 and a t-value of 8.210, meaning that information sharing significantly explains how the influence of IoT impacts SC risk. Altogether, these studies bring into focus the importance of IoT and sharing the supply chain information to act as a foundation to improve supply chain reactiveness. Figure 3 shows the mediating effect of information sharing.

6. DISCUSSION

The results of the study offer considerable evidence to offer support for the research hypothesis that IoT influences SC risk (H_1). Many research prove that IoT solutions increase transparency and real-

Figure 1: Conceptual research model

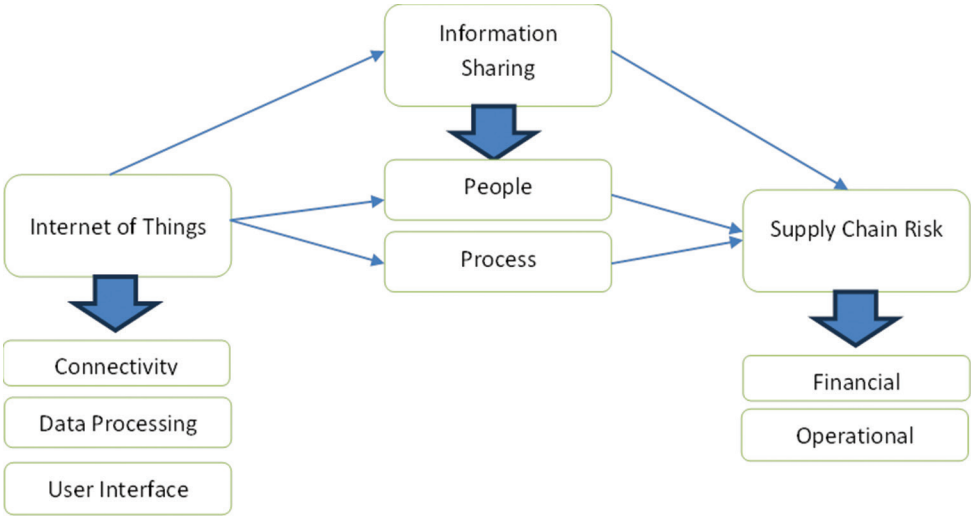


Table 3: Hypothesis test results

Hypothesis Relationship	PC	SD	t-value	P-value	Variance	Results
H_1=IoT->SC risk	0.420	0.122	4.162	0.000	0.464	PS
H_2=IoT->Information sharing	0.674	0.550	2.995	0.000	0.454	PS
H_3=Information sharing->SC risk	0.323	1.020	2.341	0.000		PS
H_4=IoT->Information sharing->SC risk	0.453	0.228	8.210	0.000	0.380	PM

PC: Path coefficient, SD: Standard deviation, PS: Positively significant, PM: Partial mediation

Figure 2: Structural model (PLS-SEM)

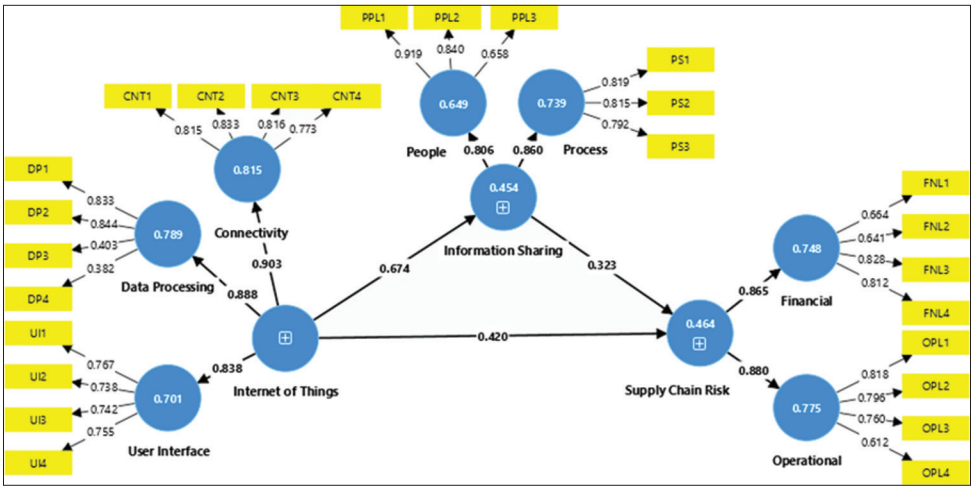
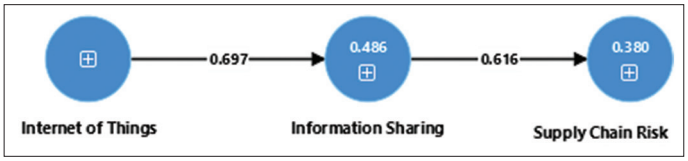


Figure 3: Indirect effect



time tracking in supply chain networks and help discover and prevent disruptions. For example, customers can use IoT-enabled sensors to monitor the condition of an object in-transit and notify a company when the goods are exposed to high temperatures or when delivery is delayed. Real-time data is not only useful in controlling risks which include spoilage or delivery delay but also useful in preventing such risks. This experience also shows that as organizations embrace IoT the resulting capability to better manage risk makes IoT foundational to supply chain security (Abdel-Basset et al., 2018).

Moreover, the study shows that IoT performs a critical effect on the function of communication and information sharing within supply networks (H_2). Because systems and objects of Internet of Things create large volumes of data, the required information can be exchanged between the organizations of the supply chain to enhance cooperation. According to research, the use of IoT in exchanges of timely data offers a company a golden chance to optimize efficiency and flexibility. For instance, when communicating partners such as suppliers, manufacturers and distributors share accurate information on inventory status and production plans, this increase efficiency through check and balance, cuts on lead time and incidence of stock outs (Alicke et al., 2016). This makes it easier for all the partners in the supply chain to improve operations while also improving the relations that exist between them, thus showing that IoT fosters a culture of openness and trust arising from the exchange of additional and better information.

Additionally, the study also confirms the first hypothesis, which postulated that supply chain risk is directly related to the role of information sharing (H_3). Studies show that sharing of information and executive cooperation between members in the supply chain can lead to the detection of risks and instigation of correct responses in good time (Tang, 2006). Organizations that values information sharing are in a better position to handle risks such as fluctuations in demand or limited supply. For instance, if firms that operate different IoT systems exchange information, an early analysis of emerging trends can be conducted to enable the formulation of contingency plans that organizations can employ in case of disruption. It does not only reduce the probability of threats actually happening but also reduces the magnitude of impacts that results from those threats (Can Saglam et al., 2020). This highlights the need to encourage the negotiation and distribution of information among supply chain partners with the view of managing and minimizing the risks involved in supply chain.

Last, the study supports the hypothesis that there is an indirect relationship between IoT and the supply chain risk in mediating by the role of information sharing. From the study, it is evident that despite increasing risk visibility and mitigations from the IoT technologies, the benefits are magnified where information sharing is practiced. Research shows that real time intelligence collected from IoT networks to have decent risk management environment into action fostered by cultures of cooperation (Büyükkarabacak and Valev, 2012). For example, organizations

that exchange information originating from the IoT networks can get ahead of disruptions to prevent the incidents, which when prevented collectively, can greatly decrease threat vulnerability. This mediating role shows that the positive outcomes are driven by the need to adopt IoT within an effective communication framework, this shows that supply chain risk management needs technology and relationship management among partners. In general, the research presents strong evidence for the relationships between IoT, information flow and supply chain risk which only underlines the importance of these factors for operational excellence.

7. CONCLUSION

Consequently, the study finds that the Internet of Things (IoT) has profound implications for supply chain risk mediated by information sharing. The analysis of the results shows that IoT technologies increase transparency and real-time information sharing that is necessary to manage risks in supply chains. Additionally, the study supports work suggesting that information sharing positively impacts supply chain decision making as well as enhancing collaboration aimed at mitigating risks of disruptions. These insights justify the fact that organizations should adopt IoT solutions and promote the culture of openness to enhance their risk management approaches.

The implication of these results for the retail industry is significant. With the adoption of IoT in supply chain, retail businesses increase their chances of efficiency in supply chain in issues like inventory, safety, and distribution. For instance, monitoring perishing products can save them from getting spoiled, while sharing of information can be used to build interconnection between suppliers and service givers. Furthermore, the implementation of information sharing can benefit organizations by providing better customer relations and enhanced cooperation given by more dependable service execution. Given the current uncertainties, forcing competitiveness in the retail segment, the management will need IoT and proper communication for improving continuity and performance.

7.1. Limitations and Future Recommendations

The research findings mentioned here have certain limitations. A major limitation is the possibility of having unbiased views by focusing on few areas in the supply chain thereby missing a more general consequence of IoT in different industries. As such, future research should focus on understanding the application of IoT and information sharing in other contexts and industries and more importantly carry out follow-up research on the long-term effects of such changes on supply chain risk management. Extending the focus of the investigation towards analyzing case studies and conducting surveys to practitioners would allow advance the understanding of real-life applications and issues regarding IoT respectively.

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