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THE EFFECT OF INFORMATION ENABLED LOGISTICS INTEGRATION ON OPERATIONAL PERFORMANCE OF AN FMCG MANUFACTURING FIRM IN KARACHI: THE MEDIATING ROLE OF SUPPLY CHAIN RISK MANAGEMENT

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Abstract

Researchers and industry professionals agree that well-integrated supply chain partners are essential to high-performing supply chains. Material and information flow are the two main directions in these partnerships. Information integration and logistics integration have been the subject of distinct studies in the past but seldom considered together. This study investigates how Information, technology, and logistics integration affect the operational efficiency of a manufacturing firm in Pakistan with the influence of Supply chain risk management. A quantitative approach has been used to analyze data from over 36 fast-moving consumer goods (FMCG) companies in Karachi demonstrating that logistics integration has a significant impact on operational performance. Risk management enables a firm to tackle uncertainties and increase performance in the ever-changing corporate environment. In addition to bridging the gap between logistics integration and operational performance, supply chain risk management is recognized as a crucial component of every successful supply chain. Information and supply chain integration have indirect effects on operational effectiveness. This research examines how advances in IT have altered supply chain risk management and, ultimately, the outcomes of operations. Managers and business owners can use this study's findings to inform their decision-making. This research identifies the positive impact of IT implementation in logistics integration to improve operational performance and minimize risks. These findings will help future researchers to consider logistics as a separate entity from a supply chain when determining the performance of a firm.

Key Words: Logistics integration, Information technology, Information sharing, Risk management, Supply Chain Integration.

Introduction

The two important flows identified are goods flowing from the upstream and information that flows in both directions are the most important flows that have been identified in many supply chain integration theories (Huang, Uppal, & Shi 2002; Pagell 2004). Because of the increasing globalization and manufacturing firms no longer working in isolation, competition is changing to supply chain rather than company to company This will facilitate better communication and cooperation between the company's logistical operations, suppliers, and end users. If the business is more integrated than its rivals, its logistics will be superior (Stock, Greis, & Kasarda 2000). Collaboration, coordination, and cooperation of the supply chain for some organizations may simply mean working with other firms, however, for some, it is a complete principle of systematically working with strategic partners around the globe at multiple nodes of the supply chain. Geographical distance is of major importance as it creates an individual point of interaction between the partners, the greater the collaboration is, the lower will be the individual nodes (Holweg et al. 2005; Matopoulos et al. 2007).

Logistics management is the organizing and synchronization of processes involved in the systematic flow of material from point of initiation (supplier) to the point when it is made available for purchase or consumption (customer). There is a great deal of difference between logistics integration and supply chain links, where supply chain links are the supply and distribution channel, and logistics integration is managing the flow of material from origin to consumption all over the value addition chain (Stock et al. 2000). Logistics ensures that manufacturing companies always have the correct stock at the right time, giving them the freedom to operate wherever and whenever they need to (La Londe & Masters 1994).

To successfully integrate logistics and the supply chain (inside the firm, with customers, and with suppliers), it is necessary to synchronize and share information at all levels (Fan et al. 2017a; Munir et al. 2020). Supply chain risk management cannot be successful without complete integration (Kauppi et al. 2016). This study examines how IT-enabled logistics integration can fill the void left by traditional approaches to supply chain risk management and boost a firm's operational performance. It also demonstrates how the literature evaluations of (Fabbe-Costes and Jahre 2008) do not support the idea that supply chain integration has a favorable influence on operational performance. Lacking specificity, the concept of supply chain integration (Munir et al. 2020) does not address the integration of information sharing and logistics.

Scope of the Study:

It has been identified that logistics integration has rarely been under observation when studying the impact of supply chain integration on the operational performance of a firm. It is apparent that the business world is diversifying and it is becoming difficult for businesses to survive. The primary question that drove this research is why logistics integration is integral for better operational performance.

Questions

1. Does Logistics integration improve with technology and information sharing?
2. Does logistics integration improve the firm ability for risk management?
3. How operational performance is improved with logistics integration with the supporting role of supply chain risk management?

Objectives

1. To study the impact of logistics integration under the influence of information sharing

and information technology on the operational performance of a firm.

2. To understand the mediating role of supply chain risk management between logistics integration and operational performance.

Literature Review

The competitive environment in the business world has forced an organization to enhance its own functions such as production processes or stock management and has also led the firms toward external partners being integrated into the supply chain. The material supplier's ability to deliver their customers with utility gives the firm ability to be competitive has been identified in many studies. Providing a firm with a smooth and synchronized flow of material from external partners (suppliers) enables an organization to efficiently carry out its manufacturing operations.(Frohlich & Westbrook 2001). This level of integration between an organization and its partners causes the border of functions performed between them to become obscure.(Stock, Greis, & Kasarda 1998; Stock et al. 2000). Integration of logistics can deal with a variety of issues such as the bullwhip effect (Geary, Disney, &Towill 2006), it can also aid in implementing a lean system (lowering the number of inventories kept, reducing wastage and improving order completion).

(Cagliano, Caniato, &Spina 2006; Schonberger 2007). Firms and their suppliers and customers can perform their operations as one unit through a high level of logistics integration which will ultimately increase the focal firm's operational performance. This can also be viewed as achieving vertical integration without actually having it and reaping benefits like improved quality, cost efficiency, effective operations, and increased level of interdependence, through the implementation of logistics integration.(La Londe &Masters 1994).

The level of service a firm provides are enhanced, the demand and availability of its products are increased (Seidmann &Sundararajan 1997), the costs it incurs are reduced (Nooteboom 1992), the operations it performs are made efficient and its response time to the market is improved (Liu et al. 2002), these are some the operational benefits that are realized through extensive logistics integration.

Increasing the control of management both internally and externally in the firm is necessary to achieve supply chain integration. Cross-function integration within a firm helps regulate information about the risk to other departments and on the other hand integration or collaboration with supply chain partners enhances the quality of risk information shared among the firms and enables them to stay agile and attentive to deal with any disturbances caused to the supply chain (Liu and Lee 2018).

Upon reviewing the literature to support the variable under study in this research, two important parts are identified for the integration of information technical aspects and social aspects. Technical aspects are implementing information technology connections to integrate information among supply chain partners. This is supported by different studies presented by (Devaraj, Krajewski, &Wei 2007; Frohlich 2002; Gunasekaran &Ngai 2004; Narasimhan &Kim 2001). Social aspects according to the research of (Carr &Kaynak 2007); (Narasimhan &Nair 2005); (Sezen 2008; Yu, Yan, and Edwin Cheng 2001; Zhou & Benton 2007) are aimed at the pivotal role of information sharing and communication between supply chain entities. Information integration aspects (technical and social) are essential because logistics integration will not be possible without the ability to share important information along the supply chain which will render the use of technology useless and there will be no point in being coordinated. Firms that aim to reap

the fruits from logistics integration needs to be proficient enough to achieve information integration's both aspects that are technical and social (Chae, Yen, &Sheu 2005; Fawcett et al. 2007).

Three vital roles of information technology have been identified in supply chain management, which is as follows.

- The First aspect enables an organization to process a greater quantity of information irrespective of its intricacy and exchange it with its supply chain partners.
- The second aspect allows a firm to be able to properly maintain and monitor its activities by providing information in real time about the supply chain.
- Lastly, firms and their partners can better synchronize with each other by coordinating their operations and forecasting functions through information technology.

Information sharing is when people or parts of an organization share information between different members or functions in an organization. Using information technology to share important information between different parts of the supply chain can be thought of as information integration along the value stream. Information integration enables real-time exchange and process of information which can be proven useful in taking supply chain decisions (Prajogo &Olhager 2012). Transmitting information promptly can help an organization manage its inventory effectively by making decisions like how many inventories to keep and avoid any shortages, this also aids in reducing costs.

Information technology bridges the gap of coordination between firms which is more often than not caused by differences in time and distance (Prajogo & Olhager 2012). IT has opened the gates towards various technologies being introduced in supply chains to improve communications between supply chain partners. Technologies help connect different firms through the internet, aids in cross-functional communication through the Ethernet, and also provide visibility through Point of sales data through electronic devices. Much attention has been given to IT integration in supply chains and research shows that using IT technologies enhance the flow of material among supply chain partners by improving coordination (Soliman &Youssef 2001). Information technology is vital for information integration but features of the information decide the usefulness of the information. These features include the complexity, the amount and frequency and the reliability of shared information (Prajogo &Olhager 2012).

(Alam et al. 2014; Fugate, Mentzer, &Stank 2010; Kache &Seuring 2014) discuss in their papers that an increased level of logistics integration between the focal firm and its supply chain partners increases the logistics performance of the firm resulting in reduced costs, improved service levels, and enhanced firm's operational performance. A high level of logistics integration improves logistics performance which consequently results in the firms becoming capable of resisting disturbances and disruptions which are caused by supply chain risks. Enhanced logistics integration and performance equip the firm with better supply chain risk management strategies (Ghadge, Dani, &Kalawsky 2012; Golgeci &Y. Ponomarov 2013; Scholten, Sharkey Scott, &Fynes 2014).

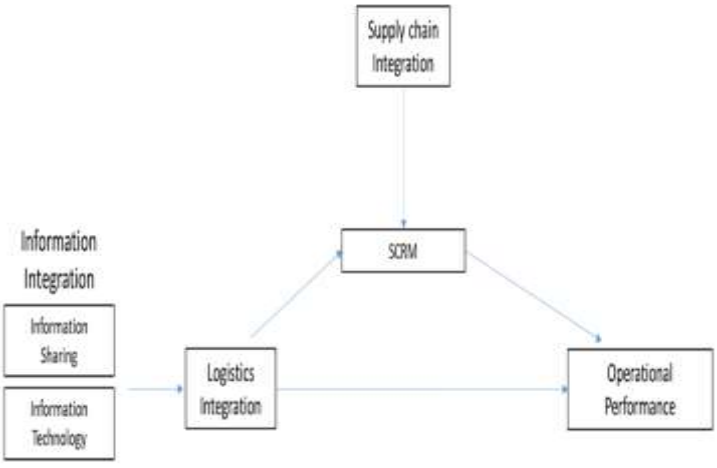
Normally participants of a simple supply chain include a supplier, manufacturer, or focal firm and customer which take part in both flows which are the flow of products and services from the upstream side and information flow from the downstream (Jüttner 2005; Mentzer et al. 2001). A firm is better able to manage and mitigate supply chain risks and uncertainties by improving the collection and processing of information

about operational functions through the integration of internal and external partners. Exchanging crucial details, making combined decisions and consolidating processes are some of the many procedures available for external integration that are utilized in reducing and mitigating the effects of supply chain risks (Munir et al. 2020). Willingness to share crucial information by coordinating and synchronizing systems firms can reduce bullwhip effect, use lean strategies and employ practices like CPFR and VMI which can reduce risks and costs and improve product demand (Danese, Romano, and Formentini 2013).

Due to globalization value chain have become more complicated and increased competition have made the business environment volatile, this results in organizations becoming more prone to the unpredictable situation and unfavorable conditions (Bode and Wagner 2015). Supply chain risk management involvement in improving the operational performance of an organization through reducing loss during operations, improving lead time and protecting against the uncertainties in the supply chain has been identified by existing studies (Manuj, Esper, &Stank 2014; Ritchie &Brindley 2007; Thun &Hoenig 2011). In a study by (Munir et al. 2020), it is contended that the steps of supply chain risk management (risk identification, risk avoidance, response to risk, and recovery from risk) are the firm's ability to collect and process information from the supply chain partners. Hence, supply chain risk management aids in reducing the chances of a risky event by acting as a function that processes information (Fan et al. 2017a) and thus positively impacts a firm's performance (Kauppi et al. 2016).

The better integration of logistics between supply chain partners the better will be the supply chain performance which will indirectly reduce costs incurred and enhance the level of service provided (Alam et al. 2014). Higher levels of logistics performance are better at resisting the disturbances from the supply chain risks (Ghadge et al. 2012) and firms with better external and internal integration are better at identifying, evaluating and handling uncertainties and supply chain risks (Chae et al. 2005; Kauppi et al. 2016).

Theoretical Framework



A study carried out (Prajogo & Olhager 2012) indicated that information and logistics integration have a notable impact on the operational performance of the firm either directly or indirectly. But the integration of logistics activity can be difficult without proper information flow. According to (Munir et al. 2020) supply chain integration has a positive impact on supply chain risk management which ultimately improves operational performance. Supply chain risk management is a highly information-sensitive procedure and requires accurate, timely, and reliable information to minimize or neutralize the risks (Fan et al. 2017a)

SCRM provides the ability to quickly identify risks that can be timely mitigated improving delivery times and forecasting ability (Wieland &Marcus Wallenburg 2012). Supply chain risk management also provides

flexibility in performance, improved customer service, and reduces product recalls and failures. This ultimately improves the operational performance of the firm.(Fan et al. 2017b; Munir et al. 2020; Wieland &Marcus Wallenburg 2012).

***Hypothesis Development*:**

H1: Operational performance is positively influenced by increased logistics integration

H2: Information integration between supply chain partners is positively related to logistics integration.

H3: Logistics integration has a positive impact on Supply chain risk management

H4: Supply chain Integration has a positive relation with Supply chain risk management.

H5: Supply chain Risk management positively impacts supply chain performance.

H6: Supply chain risk management positively mediates the relationship between logistics management and operation performance.

Methodology

Data Collection:

To collect data from employees of FMCG firms in Karachi specifically under departments that are linked to the operations of the firm, purposive sampling was used. Individuals were directly approached via social media platforms (LinkedIn) and through personal meetings. A sample size of 130 was selected using G-Power and responses were collected from 218 respondents to get 130 viable responses.

Screening questions were placed in the survey to determine the experience of employees. Respondents with 1 year or less of experience were excluded from the data set.

Experience Level	No. of Responses	Response %age
0 to 1 Year	89	40.83%
2 to 5 Years	104	47.70%
More than 5 Years	25	11.47%

Figure 1: Response Summary

Measures:

The questionnaire was developed from items and constructs which are relevant to the variables and research questions. These constructs have been adopted from (Dellana et al. 2019; Munir et al. 2020; Prajogo & Olhager 2012). A quantitative research technique has been adopted to analyze the collected data. The statistical technique used to analyze the data and extract results a Partial least squares-structural equation modeling or PLS-SEM is used.

Results and Analysis:

According to (Hair et al. 2019) all factors having loading above 0.708 are considered to be accepted as it means that the construct explains the variance of indicators by more than 50 percent. In table 1 it can be seen that all factor loadings are above 0.708 and hence are acceptable.

The collinearity between variables is determined using the VIF "Variance Inflation Factor". The value of all factors should be near

Scales	Items	Loadings	VIF
Information Integration	Transaction Processing	0.757	2.450
	Electronic Fund Transfer	0.86	2.139
	Track and Expedite Shipments	0.844	1.738
	Sharing sensitive information	0.717	2.425
Logistics Integration	Inter-organizational logistic activities	0.857	1.687
	Integration with suppliers' logistics activities	0.866	2.014
	Seamless Integration	0.813	1.908
	Our logistics integration is characterized by excellent distribution, transportation, and/or warehousing facilities	0.71	2.120
	The inbound and outbound distribution of goods with our suppliers is well integrated	0.807	1.613
Supply chain Risk Management	We can detect risks early.	0.837	1.916
	Identification of logistic bottlenecks helps us manage risk	0.823	1.752
	We take appropriate measures to respond to operational risks.	0.896	1.881
Supply Chain Integration	We develop collaborative approaches with key suppliers	0.771	2.121
	Involving customers to make collaborative approaches.	0.826	2.914
	We make customers a part of decision-making.	0.714	1.666
	We share critical information internally (Sales, purchase, and manufacturing departments.)	0.827	2.033
	Cross-departmental collaboration in making strategies and taking decisions.	0.748	2.160
Operational Performance	Logistics integration improves our product performance.	0.815	2.094
	Our production cost decreases with better Logistics integration.	0.896	1.611
	The quality of our products increases with SCRM	0.842	1.808
	We can provide better customer service with LI and SCRM.	0.846	2.235

Table 1: VIF

3 but not more than that. Values that are above more than 5 represent that there is a collinearity problem between the factors

(Mason &Perreault 1991). The table clearly shows that all values are less than 3 but greater than 1.5, which means that there is no problem in collinearity.

Cronbach Alpha and composite reliability can be used to ascertain whether items and construct are reliable or not. The average variance (AVE) should be greater than 0.5 (Fornell & Larcker 1981) and Composite reliability must be greater than 0.7 and Cornbach's alpha is acceptable at a value greater than 0.7 (Hair et al. 2019).

Reliability any higher than 0.95 is considered incorrect as they become as they reduce construct validity. The below table reflects that all values of Cronbach Alpha are above 0.7 and lower than 0.9, all AVEs values are greater than 0.5, and composite reliability values lie between 0.7 and 0.95. Table 2 signifies that all values of reliability and validity are within an acceptable range.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	The average variance extracted (AVE)
Information Integration	0.832	0.864	0.887	0.663
Logistics Integration	0.871	0.888	0.906	0.660
Operational Performance	0.872	0.874	0.912	0.723
Supply Chain risk Management	0.812	0.820	0.889	0.727
Supply Chain Integration	0.837	0.847	0.884	0.605

Table 2: Reliability

Discriminant validity tells how constructs and items are different from other constructs and items in the same structural model. it can be determined using HTMT (heterotrait-monotrait ratio) and Fornell and Larcker method.(Hair et al. 2019). The limit for HTMT values is less than 0.900 anything above 0.900 means validity issues.

Table 3 shows that all value fall under the limit for HTMT. To establish the occurrence of discriminant validity in the model concluded Heterotrait-Monotrait Ratio (HTMT) table checked the standards of each relation are endorsed to be less than 0.9. A value near to 1 specifies the deficiency of discriminant validity(Gold, Malhotra, & Segars 2001). All Values of Fornell and larcker are also within a reasonable range.

Heterotrait-monotrait ratio (HTMT) - Matrix

	Information Integration	Logistics Integration	Operational Performance	SCRM	Supply chain Integration
Information Integration					
Logistics Integration	0.577				
Operational Performance	0.445	0.792			
SCRM	0.743	0.822	0.849		
Supply chain Integration	0.673	0.727	0.823	0.872	

Fornell-Larcker criterion

	Information Integration	Logistics Integration	Operational Performance	SCRM	Supply chain Integration
Information Integration	0.814				
Logistics Integration	0.512	0.812			
Operational Performance	0.393	0.704	0.850		
SCRM	0.613	0.709	0.719	0.853	
Supply chain Integration	0.572	0.640	0.706	0.778	0.814

Table 3: Validity

Structural Model

The Coefficient of Determination or R2 explains the model's power to describe to explain the variance of each construct.(Hair et al. 2019). It describes how much of an effect there is on the dependent variable from the independent variables. The R2 value ranges from 0 to 1 where a value closer to 1 is considered good. The calculated adjusted R2 for this study can be seen in table 4. The value above 0.987 reflects that the model explanatory power is sizeable.(Hair, Ringle, and Sarstedt 2011). R-Square value of 0.987 means that the models explain 98.7% of the variations between dependent and independent variables.

	R2	Adjusted R2
Operational Performance	0.993	0.987

Table 4: Adjusted R2

Model fit can be determined by using SRMR and NFI. SRMR takes into view the actual correlation and estimated correlation

and calculate the difference among them. The value of NFI can range from 0 to 1 however a good fit is the one where NFI value is greater than 0.9 (Lohmöller 1989). Both values of SRMR and NFI are satisfactory meaning that the model is a good fit.

	Saturated Model	Estimated Model
SRMR	0.072	0.075
NFI	0.91	0.9

Table 5: Model Fit

Hypothesis Testing

In this research hypothesis testing is done by using the Bootstrapping technique, it takes random observation from the original data and create multiple copies of the sample and runs the data to calculate confidence intervals, standard errors, T-value and P-Value.

Values that are more than +2 and less than -2 are acceptable for T-values and values less than 0.05 are good for P-Values *(Hair et al. 2019).*

The values set for bootstrapping were sub samples 5000, test type two tailed and significance level was kept at 0.05.

Following results were obtained after the bootstrapping procedure.

	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Information Integration -> Logistics Integration	0.513	0.089	5.762	0.000
Logistics integration -> Operational performance	0.384	0.112	3.493	0.000
Logistics integration -> SCRM	0.311	0.082	3.893	0.000
SCRM -> Operational Performance	0.448	0.116	3.816	0.000
Supply Chain Integration -> SCRM	0.618	0.062	9.816	0.000

Table 6: Hypothesis Testing

H1: P-value<1 and equals to zero, accepted. **Ho1:** Rejected.

H2: P-value<1 and equals to zero, accepted. **Ho2:** Rejected

H3: P-value<1 and equals to zero, accepted. **Ho3:** Rejected.

H4: P-value<1 and equals to zero, accepted. **Ho4:** Rejected.

H5: *P-value<1 and equals to zero, accepted.* ***Ho5:*** *Rejected.*

H6: *P-value<1 and equals to zero, accepted.* ***Ho6:*** *Rejected*

Discussion

Today's economic climate is rapidly changing and becoming increasingly difficult resulting it being harder for supply chains to operate in (Chen, Sohal, & Prajogo 2013). The globalization of markets and the adoption of more sophisticated procedures and strategies by businesses all contribute to an already precarious supply chain. Businesses around the world are responding to the increasing number of supply chain risks by implementing collaborative supply chain risk management solutions (Kauppi et al. 2016).

(Frohlich & Westbrook 2001) highlighted the important aspects of information flow and how it is necessary for improving the performance of a firm through the integration of those flows in the supply chain, however, it did not highlight the importance of logistics in firm performance.

This research shines the light on the operational performance of a firm by undertaking logistics integration, SCRM, SCI, and Information integration. In the eyes of many astute individuals, supply chain risk management is a method that takes into account the entire supply chain. These experts argue that a robust, versatile, and adaptable supply chain is necessary for effective risk management for a firm's supply chain to avoid any hindrances (Durach, Wieland, and Machuca 2015; Wieland and Marcus Wallenburg 2012).

This study also defines that the risks that arise from the market situation and increased competition can be effectively met and reduced through supply chain risk management. SCRM can only be implemented with effective information exchange between different supply chain partners as well as internally within the organization. It is crucial that the firm internal activities are well

coordinated and on the same page as it reduces the chances of any mishappenings. Supply chain integration becomes extremely important when implementing SCRM within the firm because without proper coordination all external partners and internal departments will be operating in Silos which will automatically impact the operational outcome.

Finally, this study explains that logistics integration along with supply chain risk management greatly impacts the operations of the firm. The difficulties that the firm faces in logistic integration cause them to be impacted by different kinds of uncertainties which can be effectively countered by an SCRM system.

Conclusion

SCRM plays a vital role in eliminating the risks and uncertainties faced by a supply chain but it needs to be integrated with both external and internal parties to be effective. Integrated logistics integration and SCRM increases operational performance by reducing the problems that may have occurred if not for the efficient exchange of information. This study gives sufficient proof that operational performance increases the more integration between supply chain entities increases. Logistics integration was seldom considered as part of supply chain integration, this study makes the point that it is an important component that needs to be taken into account when discussing the relationship between SCI and operational performance.

Limitations and Implications:

Limitations faced by this study include the long-term relationship with supply chain partners that are needed for effective sharing of information is not highlighted. Without this aspect of trust will be missing and both parties will be hesitant to share information. This research also does not take into account the cost factor that might be involved in the integration of technology and activity which may impact operational costs negatively. Another shortcoming of this research is that it is restricted to the population of Karachi and may be different for other areas.

This research will prove useful for studies focusing on firms that use third-party logistics services. This study highlights both flows of information and material along the supply chain and can be used by future researchers studying the effects of green supply chains, waste reduction, and recycling of waste. Future studies can expand on this research by undertaking the supplier and customer side while expanding their field of population.

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