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THE EFFECTS OF SUPPLY CHAIN MANAGEMENT PRACTICES ON TECHNOLOGICAL INNOVATION: A CASE OF MANUFACTURING SECTOR OF PAKISTAN

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Abstract:

The purpose of the study is to examine the relationship between supply chain management practices (SCMP) on technological innovation in the manufacturing sector organizations of Pakistan. The supply chain management practices (SCMP) include in this study are strategic supplier partnership, information sharing, information quality, postponement and internal lean practices while technological innovation being the dependent variable. The target population for this study has been selected as the manufacturing sector in Pakistan. The study has collected 200 responses from the supply chain professionals of manufacturing firms of Karachi, Pakistan. For analysis of data, partial least square structural equation modeling (PLS-SEM) named Smart PLS version 3.2.8 has been used. The finding of the study showed that supply chain management practices have positive impact on technological innovation. Postponement have highest impact and positive relation with technological innovation, then strategic supplier partnership were found to positive and significant impact on technological innovation, while information quality have lower impact and positive relationship with technological innovation. The study suggests that manufacturing firms should implement proper supply chain management practices for making their product and process innovative. The paper will provide insights to manufacturing firm how these supply chain management practices helps in technological innovation.

Key Words:

*SCMP, Technological innovation,
Manufacturing firm, Pakistan.*

1. Introduction

The supply chain management (SCM) is a combination of different processes of business like planning, forecasting, procuring, producing, assembling, distributing, resource management and the management of processes to focus customers. The Supply chain management also arranges a complete connection between the entities of upstream management (manufacturing and supply) and the entities of downstream management (distribution side) so that competitiveness can be achieved. The supply chain management is also termed as a combination of different approaches that combine, manufacturers, suppliers, logistics and the final customers to enhance the performance of individual firms in long term and also to improve supply chain itself (Chung, 2018). In this competitive environment supply chain management becomes an important part that a company must consider in order gain competitive advantage because it emphasize to maximize overall performance of the firm by better implementing resources across the firm. To achieve a competitive advantage and better performance, supply chain management strategy need support the business strategy (Sufian, 2010). Supply chain management practices also associated with new product or process development. Innovation is the one of the important concern of management in a company but continuous improvement is challenging for company. Introducing new product that gets market success and increase profitability depends on number of factors including supply chain management practices that must be associated with innovation. Lee et al. (2018) claimed that in order to conduct research on the development of new products, such as the innovation in products, the issue of SCM must be taken into consideration. It was identified that when there is a match between the characteristics of products and supply chain strategies, the firm becomes capable to performing in a better way. In order to maintain survival in current competitive business environment, organizations have to go for adopting innovations every time. The manufacturing enterprises are facing a great pressure through global competition due to the rapid changes in market environments and technology.

In Pakistani market, there is a need to study the association between technological innovation and SCM. This paper aims to find out the suitable and relevant practices of SCM that has significant impact on TI. The past studies have identified that the innovation is enhanced by total quality management but the studies are very less showing the relationship between innovations and SCM. To focus on the literature gap, this study proposes to identify if each dimension of supply chain management has positive impact on firms' TI. The innovation capabilities of organizations increase as they collect more information and build knowledge

portfolio about their customers and the potential competitors (Kwamega, Li, & Abrokwah, 2018).

Technological innovation is one of the crucial factors for growth and survival for manufacturing companies because it enables firms to enter and develop new markets to satisfy customers need and become more competitive. One of the prior studies reveals that organizations maintain their strong positions in the existing market due to permanent investment in innovation and innovation must be executed in business process as well as in technology (Pisano, 2015). Manufacturing firms need to be efficient and balanced their supply chain while innovation of their products as well as their manufacturing process must be technologically advanced and innovative. Manufacturing firms in Pakistan are not focusing on supply chain management practices caused by this firms are facing a lot of challenges and trouble. To become competitive, firms should implement proper supply chain management practices and these practices helps manufacturing firms in technological innovation and improve their overall performance. Research have confirmed that organizational performance and competitive advantage increase with the help of effective practices of supply chain management (Feng, Yu, Chavez, Mangan, & Zhang, 2017). Furthermore this study will provide insights to manufacturing sectors in Pakistan about how supply chain management practices benefits and help in technological innovation as well as improve performance of the organizations.

2. Literature Review

Lee et al. (2018) explored the association between the technological innovation and the practices of supply chain management in the Malaysian setting of R&D manufacturing. In this study, guanxi was studied as an intervening variable. The hypotheses were examined and data was analyzed thorough (PLS-SEM). The results show that there is a significantly positive effect of strategic supplier relationship, postponement, internal operations and guanxi on the technological innovation. While it was also revealed that guanxi has mediating impact on the relationship between technological innovation and the practices of SCM.

Khalil, M., Khalil, R. and Khan, S. (2019) conducted a research to determine the relationship between supply chain management practices and organizational performance while innovation working as a mediator variable in this relationship. Results of this study revealed that strategic supplier partnership and level information sharing has no positive impact on operational performance whereas information sharing, internal supply chain process and lean practices has positive impact on operational performance. Result also shows that all these five supply chain management practices have positive and significant effects on innovation.

According to Simatupang and Sridharan (2002) the strategic supplier partnership (SSP) is a supply chain collaboration that works to attain a common objective. Procter and Gamble, Hewlett-Packard, IBM and Dell have developed long-term connections with their suppliers, and this collaboration has enabled them to reduce transactions costs and to improve their joint competitive advantage. This effective collaboration enables the companies to share risks, do assessment of their available resources, reduce the transaction cost, improve their productivity and improve their overall performance to gain higher profit and increase their competitive advantage (Mentzer et al., 2000). It can be summarized that with the help of close association with suppliers, organizations can maintain collaboration that makes them capable to increase their overall gains.

The term information sharing is known as communicating the quality information timely, adequately and accurately between SC partners (Li et al., 2005). Pereira (2009) studied that information sharing among the partners of supply chain helps to improve the coordination among organizations and quality of products. Great competitive advantage is achieved with great information. As Zhou and Benton (2007) discussed that sharing information improves manufacturing technology.

According to Monczka et al. (1998) the information quality means the adequate, timely, accurate and probable information. The information quality factors can be divided into four categories Lee et al. (2002), which are called contextual, intrinsic, accessible and representational. Lee and Strong's (2004) provide five types of information quality that include accuracy, availability, timeliness, accessibility and relevancy. The quality of information along with appropriateness brings competitive advantage. Thus the firms are very reluctant in giving information. The stronger the quality of information is the more improvement would be seen in its management. As a result, organizations can be more innovative.

Chaudhry and Hodge (2012) identified the application of this strategy in textile sector with the help of a case study. Results of this study showed that the strategy of postponement is dependent upon the product nature, SC structure and downstream demand. It is important to note here that the postponement should be according to the product type, market demands and the structure of manufacturing system. For innovative products or for high value products, postponement should be adopted.

The core thrust of lean practices are that these practices can work synergistically to create a streamlined, high quality system that produces finished products at the pace of customer demand with little or no waste (Woldemichael, 2012). Today, lean is evolving into a management approach that improves all the processes at each level of an organization (Mwale,

2014). According to Lewis (2000), the lean practice facilitates in removing all waste, stop shortages, minimize lead time, enhance stock turnover, and make sure customer satisfaction. Adopting lean practices firms can achieve numerous benefits such as increase productivity, increase profits and it can drive innovation.

Based on the above literature review, it shows that previous studies are less showing the relationship between supply chain management practices and technological innovation. This study is trying to fill out this gap. Thus the following hypotheses are developed for this study:

H1: There is significant and positive relationship between strategic supplier relationship and technological innovation.

H2: There is significant and positive relationship between information sharing and technological innovation.

H3: There is significant and positive relationship between information quality and technological innovation.

H4: There is significant and positive relationship between postponement and technological innovation.

H5: There is significant and positive relationship between internal lean practices and technological innovation.

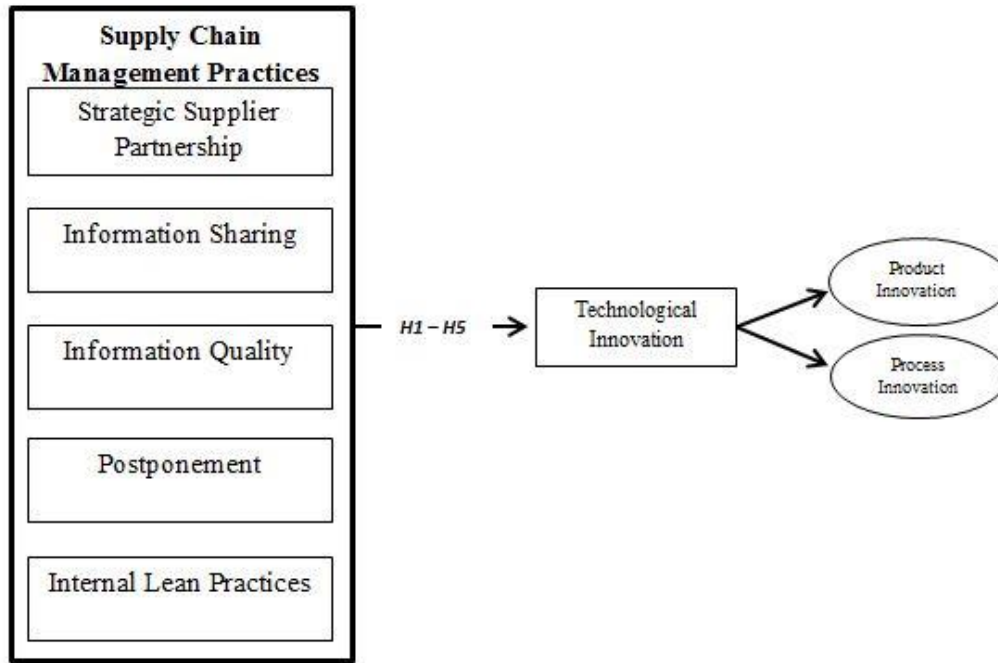
3. Research Methodology

3.1 Study population and sample

The population for this study has been selected as the manufacturing sector in Pakistan. The study has selected Karachi based manufacturing firms. The size of the sample was 200 employees working related to supply chain, production and procurement areas of manufacturing companies in Karachi.

3.2 Research Model

Figure 1: Research Framework



The figure 1 represents the research framework consist of five supply chain management practices which were adapted from Li et al. (2006) and Technological innovation was adapted from Prajogo and Sohal (2003), Singh and Smith (2004) and Hoang et al. (2006).

3.3 Sampling Technique:

The present study has gathered sample from the relevant respondents through the application of purposive sampling method. This method assists in collecting the data target population with the selection of particular respondents related to the supply chain department of the manufacturing firms of Pakistan and working at Karachi office. Moreover, the advantage of selecting purposive sampling is to collect the desired data from the most appropriate and relevant respondents of the target population as described by Etikan, Musa, and Alkassim (2016). Hence, the present study has employed purposive sampling technique.

3.4 Data Collection and Instrumentation:

Questionnaire of five point likert scale was used for the collection of primary data from target population. The scale comprised of five points denoting 1 as strongly agree, 2 as agree, 3 as neutral, 4 as disagree and 5 as strongly disagree. Some of the data were collected through web-based questionnaire and some of the data were collected through personal survey.

3.5 Instrument Reliability and Validity

Reliability of an instrument ensures the internal consistency of the questionnaire items and validity ensures the accuracy of the measure. In other words, the reliability of a research refers to the extent to which data collection methods or analysis procedures are used and the research can then only be characterized as reliable only if it yields the same results in different occasions or situations (Easterby-Smith et al., 2002). Reliability was tested by Cronbach alpha test and the study achieved both research reliability and validity.

3.6 Statistical Analysis Techniques

The study has used Smart PLS as primary data analysis technique for the estimation of results and findings. The purpose behind using PLS was that it can be easily available and can be performed all necessary statistical test and most important it is user friendly.

4. Data Analysis: Result and Discussion

4.1 Demographic profile of the Respondents

The below table illustrate the demographic profile of the participants in this study.

Table 1: Demographic Profile

Prospects	Details	Frequency	Percentage
Years	Under 2 years	80	40%
	3 to 5 years	61	30.5%
	6 to 10 years	41	20.5%
	Over 10 years	18	9%
Employees	Less than 200 employees	68	34%
	Greater than 200 employees	132	66%
Position	Upper Management	55	27.5
	Middle Management	116	58%
	Lower Management	29	14.5%

The above table 1 shows the respondents' profile on three basic aspects: 1) Years the respondent have for the company 2) No of employees in company 3) Position of the respondent in company. According to profiling 80 respondents (40 percent) working years under 2 years, 61 (30.5 percent) respondents under the category of 3 to 5 years, 41 (20.5 percent) respondents under the category of 6 to 10 years while remaining 18 (9 percent) respondents under the

category of Over 10 years. Total 132 out of 200 respondents comprising 66 percent of the sample data were based in firms with more than 200 employees while 68 respondents (34 percent) were belongs to firms having less than 200 employees. Moreover, total 55 respondents (27.7 percent) have upper management position 116 respondents (58 percent) have middle management position remaining 29 respondents (14.5 percent) have lower management position.

4.3 Content Validity

Table 2: Factor loading and cross loading

Construct	Indicators	SSP	IS	IQ	PPN	ILP	PDI	PSI
Strategic Supplier Partnership	1	0.662						
	2	0.715						
	3	0.794						
	4	0.797						
	5	0.729						
	6	0.704						
Information Sharing	1		0.539					
	2		0.659					
	3		0.772					
	4		0.754					
	5		0.793					
	6		0.750					
Information Quality	1			0.692				
	2			0.749				
	3			0.812				
	4			0.774				
	5			0.782				
Postponement	1				0.746			
	2				0.828			
	3				0.710			
	4				0.703			
	5				0.695			

Internal Practices	Lean	1					0.735		
		2					0.829		
		3					0.617		
		4					0.754		
		5					0.770		
Product Innovation		1						0.714	
		2						0.752	
		3						0.802	
		4						0.749	
		5						0.721	
Process Innovation		1							0.771
		2							0.762
		3							0.774
		4							0.771

As recommended by Hair Jr, Hult, Ringle, and Sarstedt (2016), the loaded factors loading must be higher than 0.70. In the above table 4 almost indicators have value greater than 0.70, which provided the adequate construct development.

4.4 Convergent Validity

Table 3: Convergent Validity

Construct	Indicators	Loadings	AVE	Composite Reliability	Cronbach's Alpha
Strategic Partnership	1	0.662	0.540	0.875	0.829
	2	0.715			
	3	0.794			
	4	0.797			
	5	0.729			
	6	0.704			
Information Sharing	1	0.539	0.513	0.862	0.806
	2	0.659			
	3	0.772			

	4	0.754			
	5	0.793			
	6	0.75			
Information Quality	1	0.692	0.582	0.874	0.820
	2	0.749			
	3	0.812			
	4	0.774			
	5	0.782			
Postponement	1	0.746	0.545	0.856	0.793
	2	0.828			
	3	0.71			
	4	0.703			
	5	0.695			
Internal Lean Practices	1	0.735	0.554	0.860	0.799
	2	0.829			
	3	0.617			
	4	0.754			
	5	0.77			
Technological Innovation	1	0.714	0.574	0.924	0.907
	2	0.752			
	3	0.802			
	4	0.749			
	5	0.721			
	6	0.771			
	7	0.762			
	8	0.774			
	9	0.771			

Convergent validity describes the two measures of construct should be related are, in fact interrelated. The above table 3 represents factor loadings, AVE, composite reliability (CR) and cronbach's alpha using PLS algorithm. Factors loading value as recommended by Hair Jr, Hult, Ringle, and Sarstedt (2016), the loaded factors loading must be higher than 0.70. Cronbach's alpha values of 0.7 or higher indicate acceptable internal consistency (Adadan & Savasci, 2011). The Cronbach's Alpha for Strategic supplier partnership for 6 items is 0.829 ,

Information sharing for 6 items is 0.806 , Information quality for 5 items is 0.820 , Postponement for 5 items is 0.793 , Internal lean practices for 5 items is 0.791 , Technological innovation for 9 items is 0.907 . The Cronbach's Alpha values of all variables are greater than 0.7 indicate acceptable internal consistency.

4.5 Discriminant validity

Discriminant Validity shows that reflective constructs have strong relationship with its own variables in comparison with other variables. Discriminant validity assessed the existence of variance amid research variables constructs which has been shown the separate functionality supported by theory (Hair Jr et al., 2016).

Table 4: Discriminant validity (Fornell-Larcker)

Variables	IQ	IS	ILP	PPN	SSP	TI
IQ	0.763					
IS	0.481	0.716				
ILP	0.395	0.495	0.744			
PPN	0.353	0.495	0.626	0.738		
SSP	0.360	0.702	0.518	0.500	0.735	
TI	0.433	0.502	0.488	0.540	0.512	0.758

In the above table 4 shows that relationship between variables. Thus , the results of above table provided that discriminant validity using Fornell and Larcker (1981) criterion has been achieved.

4.6 Path Analysis

Using PLS bootstrapping following table provides results of path analysis for hypotheses testing.

Table 5: Path Analysis

Variables	Original Sample	Sample Mean	Std Dev	T-statistics	P-values	Results
SSP	0.192	0.194	0.096	1.999	0.046	Sig
IS	0.096	0.106	0.079	1.211	0.226	Not Sig

IQ	0.183	0.187	0.07	2.634	0.009	Sig.
PPN	0.268	0.263	0.086	3.121	0.002	Sig
ILP	0.101	0.104	0.076	1.328	0.184	Not Sig

The above table 5 shows the results that the strategic supplier partnership, Information quality and postponement has a positive effects on technological innovation with significant P-value is less than 0.05 this provide an evidence that our hypotheses are accepted while information sharing and Internal lean practices having significant P-value greater than 0.05 showing insignificant but positive effects on technological innovation therefore our hypotheses are rejected. The finding from the table revealed highest impact was for the postponement (0.263) then strategic supplier partnership (0.194) and the lowest impact was for the information quality (0.187).

4.7 Predictive Analysis

In the following and last table of data analysis presents predictive relevance of the dependent construct in the model using PLS algorithm and PLS blindfolding.

Table 6: Predictive Analysis

	R Square	R Square Adjusted
Technological Innovation	0.420	0.405

The above table 6 shows the result that the value of R square (i.e. 0.420) indicate the total variation which is 42 percent in the dependent variable (technological innovation) by supply chain management practices.

5. Conclusion:

The study was conducted to examine the effects of supply chain management practices on technological innovation in manufacturing sector of Pakistan. The study was based on supply chain management practices, the practices were chosen are strategic supplier partnership, information sharing, information quality, postponement and internal lean practices. The finding from the research shows that strategic supplier partnership, information quality and postponement have significant and positive impact on technological innovation, therefore three out of five hypotheses of this study were accepted and the rest two were rejected. Hence there is no significant impact of information sharing and internal lean practices on technological

innovation but they have positive impact on technological innovation. This study suggests that supply chain management practices should be adopted properly by manufacturing firms as these practices influence positively and significantly on technological innovation. Therefore manufactures should work closely with their key suppliers for making innovative product and to become competitive in the market. In addition, information quality was found to be significant to improve the manufacturer process and product innovation. Firms should focus on information quality it should be delivered on time, accurate and reliable in order to achieve improvement in technological innovation. Likewise, company should focus on postponement of final products assembly until the order from the customer received and it will also enables firms to fulfill customer requirement and needs.

5.1 Limitation and Suggestion for future research

There are some limitations in this research. First, the sample size was small in this research, large sample size enhance the accuracy of the findings. Second, only Karachi has been selected in this study for data collection, it can be conducted with others cities of Pakistan. This research aims especially at examine the relationship between supply chain management practices and technological innovation of Pakistan manufacturing firms. Future research can be conducted having similar study based on different sectors like textile, electronics sectors etc. In this study only five supply chain management practices was chosen, more supply chain management practices could be increased for further research in future. Moreover future researcher can conduct further research from distinctive respondents inside the same organizations. It will help to enhance the validity of the study.

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8. Appendices

8.1 Appendix-A

QUESTIONNAIRE

The Effects of Supply Chain Management Practices on Technological Innovation: a case of manufacturing sector of Pakistan

Dear respondents, the purpose of this questionnaire is to gather data on the effect of supply chain management practices on Technological Innovation. The study is purely for academic purpose and thus not affects you in any case. So, your genuine, frank and timely response is vital for successfulness of the study. Therefore, I kindly request you to respond to each items of the question very carefully.

Part I: Demographic Information

1. The years you have worked for this company:

☐ Under 2 years ☐ (3 to 5 years) ☐ 6 to 10 years ☐ (Over 10 years)

2. Number of employees in your company:

☐ Less than 200 employees ☐ Greater than 200 employees

3. Position:

☐ Upper management ☐ Middle Management ☐ Lower Management

Part II: Instruments of Supply chain management practice

Instruction: Please tick one box for each statement below to show how much you agree or disagree with it.

SA = strongly agree; A = agree; N = neutral; D = disagree and SD = strongly disagree

Strategic Supplier Partnership	SA	A	N	D	SD
We consider quality as our number one criterion in selecting suppliers					
We regularly solve problems jointly with our suppliers					
We have helped our suppliers to improve their product quality					
We have continuous improvement programs that include our key suppliers					
We include our key suppliers in our planning and goal-setting activities					
We actively involve our key suppliers in new product development process					

Information Sharing	SA	A	N	D	SD
We inform trading partners in advance of changing needs					
Our trading partners share proprietary information with us					
Our trading partners keep us fully informed about issues that affect our business					
Our trading partners share business knowledge of core business processes with us					
We and our trading partners exchange information that helps establishment of business planning					
We and our trading partners keep each other informed about events or changes that may affect the other partners					

Information Quality	SA	A	N	D	SD
Information exchange between our trading partners and us is timely					
Information exchange between our trading partners and us is accurate					
Information exchange between our trading partners and us is complete					
Information exchange between our trading partners and us is adequate					
Information exchange between our trading partners and us is reliable					

Postponement	SA	A	N	D	SD
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Our products are designed for modular assembly					
Our production process modules can be re-arranged so that customization can be carried out later at distribution centers					
We delay final product assembly activities until customer orders have actually been received					
We delay final product assembly activities until the last possible position (or nearest to customers) in the supply chain					
Our goods are stored at appropriate distribution points close to the customers in the supply chain					

Internal Lean Practices	SA	A	N	D	SD
Our firm reduces process set-up time					
Our firm has continuous quality improvement programs					
Our firm produces only what is demanded by customers when needed (e.g. JIT)					
Our firm seldom pushes supplier for shorter lead-time (order entry to shipment)					
Our firm streamlines ordering, receiving and other paper work					

Part III: Instruments of Technological Innovation

Technological Innovation					
Product Innovation	SA	A	N	D	SD
The level of newness (novelty) of new products is high compared to our competitors					
The use of latest technological innovations in new product development is high compared to our major competitors					
The speed of new product development is high compared to our major competitors					
The number of new products introduced to the market is high compared to our major competitors					
The number of new products that is first-to-market (early market entrants) is high compared to our major competitors					
Process Innovation	SA	A	N	D	SD
The technological competitiveness of our processes is high compared to our major competitors					

The updated-ness or novelty of technology used in our processes is high compared to our major competitors					
The speed of adoption of the latest technological innovations in our processes is high compared to our major competitors					
The rate of change in processes, techniques and technology is high compared to our major competitors					