



THE IMPACT OF SUPPLIER STRATEGIC PARTNERSHIP IN SUPPLY CHAIN ON ORGANIZATIONAL PERFORMANCE: AN EMPIRICAL STUDY OF SUPPLY CHAIN MANAGEMENT IN AN EMERGING ECONOMY

Tahir Mumtaz Malik¹, Syed Mahmmod Hassan², Muhammad Tufail²

1) Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology, SZABIST, Islamabad, Pakistan

2) NED University of Engineering and Technology Karachi, Pakistan

ABSTRACT. Background: The purpose of this study is to create a theoretical framework for analyzing the causal relationship between supply chain management practices and firm performance, in the FMCG sector of Pakistan. A quantitative research approach was adopted, in which a multi-item scale Web-based survey using a structured online questionnaire was utilized to collect the primary data. A total of 232 questionnaires were collected from a sample of Karachi-based FMCG companies in Pakistan. Confirmatory Factor analysis and internal consistency were used to test the reliability and fitness of the measurement model, and structural equation modeling-SEM was employed to test the proposed hypotheses. Empirical findings reveal that there is a significant positive relationship between SCM practices and firm performance. However, the results of the individual-level analysis of SCM practices appear to vary from practice to practice. Of various SCM practices, supplier strategic partnership SSC with the highest beta value (i.e., $\beta = 0.488$; $t\text{-value} = 32.381$; $p < 0.000$) was found to have the greatest impact on firm performance, followed by information sharing customer relationship, and finally the outsourcing. This study will guide supervisors with a more in-depth understanding of SCM practices and their potential contribution to firm performance. The findings also encourage managers to place supplier strategic partnerships and information systems on high priority, on both inter-firm and intra-firm relationships, as prerequisites for achieving superior firm performance. The propositions and results of the study provide managers with guidelines about effective management of upstream supply chain networks and awareness of the potential synergies that arise from suppliers and the information system. This article further enriches the literature in an evolving area of supply chain management practices. Two key factors facing supply chain managers and scholars are addressed, and establish their ability to drive firm performance.

Keywords: Supply chain management (SCM) practices, Supplier strategic partnership, customer relationship, Information system, outsourcing, organization performance

INTRODUCTION

The present business environment is highly competitive, vibrant, and globalized. Therefore, to survive in this challenging arena, organizations are moving toward implementing various supply chain strategies such as supply chain integration, customer relationship management, outsourcing, etc. It is because better practices in the supply chain stimulate responsiveness in the supply chain and help organizations gain a better competitive advantage (Abdul-Hamid et al., 2020). However,

companies are connecting their supply chain partners by integrating them and also connecting their internal operations, because internal operations act as mediators between SCM practice and firm performance (Doan, 2020). Furthermore, in the previous decade, the key rationales behind market competitiveness were to provide great services along with quality products delivered at the required place at the right time on the cheapest way. But now organizations realize that these aspects are not just enough to enhance a firm's capabilities, rather their entire supply chain has to be refocused and made competitive (Niknejad &

Petrovic, 2016). Therefore, the implementation and adaptation of SCM practices are very essential to remain competitive and survive in this global market and for increasing profitability (Blonska et al., 2013; Flöthmann et al., 2018). Furthermore, several organizations have paid more attention to the supply chain, as it has been observed and realized in the end that they cannot survive in a competitive market without an effective relationship with their customers, as well as a supplier or other entities in the supply chain network (Ghalem et al., 2018). As stated by (Chavez & Seow, 2012; C. S. Tang, 2006) that, recently organizations do not compete separately as independent entities without having an appropriate supply chain. Therefore, organizations realized that an effective supply chain is essential to stay competitive in the local and global markets. This can be possible if a firm adopts and implements various SCM practices, such as the use of updated information and communication systems across the supply chain network and building relationships with the customer and the supplier using the Internet or social media platforms (Basnet et al., 2003; Chand, 2021; Langdon et al., 2021). According to (Betts & Johnston, 2005; Rehman Khan & Yu, 2019), the implementation of SCM practices increases return on investment to the optimized desired level, the organizations are financially benefited from an effective supply chain which also enhances competitiveness. In this regard, SCM practices have played a pivotal role in the effectiveness of any organization because more than an era, it presents its competitive advantage toward this success (Pujawan & Geraldin, 2009). (Choy & Lee, 2002) explained the importance of adopting SCM practices and concluded that effective SCM practices improve the firm's performance and also contribute up to 50% of profitability by cost reduction. In Pakistan, manufacturing companies are lagging in the implementation of SCM practices, so this study deals with this problem and provides frameworks that identify key SCM practices that improve firm performance by identifying their impact. Therefore, the objective of the study is to investigate the different SCM practices implemented in different FMCG companies and to determine their influence on firm performance.

The rest of this paper is structured as follows. Section 2 presents the literature review and hypothesis development, which lay the basis for developing the proposed conceptual framework. In Section 3, the research methodology used in this study is explained along with the support of materials and methods. Section 4 presents the data analysis and results of the proposed theoretical framework using structural equation modeling (SEM) using smart PLS 4, and finally, the discussion and conclusions are given in Section 5, along with the limitations and implications.

LITERATURE REVIEW

Theoretical Background

The main theoretical foundation for developing the proposed framework is derived from the resource-based view (RBV), which conceives a distinctive set of means possessed by organizations that are more likely to clarify variations in firm performance (Barney, 1991) that also incorporate firm competencies. In this research, SCM practices are viewed as the capabilities of the firm to form long-term relations with suppliers, thus establishing strategic partnerships, the ability to share information with key stakeholders, developing strong customer relationships, and outsourcing various firm operations. (Attri et al., 2017; Hussein Zolait et al., 2010) proposed that SCM practices affect firm performance and quality performance. The theory of transactional cost economics TCE (Bendoly & Kaefer, 2004) concerning SCM provides a natural fit because it centers on creating the potential for opportunism and SCM practices provide that opportunity, which when implemented will improve firm performance.

Empirical Studies

Supply Chain Management Practices (SCMP)

In the present era, due to the highly competitive market, organizations are adopting various practices in the supply chain just to improve their performance, which helps them to survive in this competitive market. Several

organizations adopt different supply chain practices and some commonly used practices are also mentioned given above in Table 1. SCMP is the set of actions within the firm that enhances the performance of the organization in its supply chain department (Amling & Daugherty, 2020; Koh et al., 2007). An exploratory study conducted by a researcher (Omain, 2017) argued, based on previous research, that the execution of SCMP varies based on the nature of organizations and their country's different management styles, and differences in cultures. This concludes that organizations of different countries have different sets of SCMP, due to the

information that various managerial concepts that how SCM elements are related to the organization and itself. For that reason, there is no constant set of SCMPs used in all organizations in different countries. For example (Chow et al., 2008; Lin et al., 2005) tried to form and authorize major instruments to measure various SCMPs. It includes postponement, information sharing, internal lean, supplier strategic partnership with the supplier, quality of information, and relationship with the customer. Similarly, Table 1 shows the dimensions of SCMP discussed in various pieces of literature:

Table 1 SCM Practices Dimensions

Researchers	Dimensions
(Nag & Ferdausy, 2021)	Strategic Supplier Partnership, Customer Relationship, Sharing information at different levels along with Quality aspects and Delays.
(Owiti et al., 2017)	Benchmarking, Employee involvement, supplier integration, outsourcing.
(Niknejad & Petrovic, 2016)	Supplier and customer relationship, Internal Operations, Information sharing.
(Sukati et al., 2011)	Strategic Supplier Partnership, Customer Relationship, and Information Sharing.
(Flynn et al., 2010)	Integration of Suppliers, Internal Integration, Functional Integration, and Integration with Customers.
(Jharkharia & Shankar, 2004)	Buyer-Supplier relationship, Inventory Management, Supply chain integration.

In analyzing and merging the study, four different features of the practices of SCM are chosen: Strategic Supplier Partnership, Customer Relationship, Information Sharing, and Outsourcing to measure practices of SCM in the local aspect. These practices cover the forward/downstream (toward the customer), backward/upstream (supplier strategic partnership) of both sides of the supply chain, and the flow of information between members. So, it covers the SCM practices from a local context to enhance the performance of organizations.

Hypothesis Development

Impact of Supplier Strategic Partnership (SSP) on Firm Performance.

Research conducted by (Nag & Ferdausy, 2021) proposes that all suppliers are not considered strategic or tactical suppliers. Researchers argue that initially suppliers must be observed strategically to decide on suppliers that contribute their expertise, capabilities, and attractive advantages to buying organization (Dey et al., 2015; Yeung et al., 2013). The SSP needs an effective connection stage between the suppliers and the organization. These entities must have the ability and propensity to create long-term linkages while maintaining an effective relationship with service or parts providers that creates value for each supplier's party (Li et al., 2020; Trent & Monczka, 2003). The Strategic Relationship of suppliers is fully explained as a long-term strong link between the organization and its suppliers. SSP encourages organizations to achieve mutual goals by

encouraging shared efforts to solve problems and longtime coordination between parties. As these strategic relationships help to encourage mutual benefits between partners and constant contribution in many major strategic regions such as market, technology advancement, and product development (Ali et al., 2017; Amoako-Gyampah et al., 2019). Tactical partnerships with vendors or suppliers enable organizations to perform more effectively with some major supplier parties that are capable to allocate accountability for the achievement of the best results. The effective supplier participation results in cost-effective design choices, helps in assessments of designs, help in the selection of better technologies and components, and also helps in design evaluation. An organization that uses the strategic alliance concept can perform mutually and also reduce inefficient effort and periods (Li et al., 2006). Thus, the given above discussion shows that if an organization develops a strategic partnership with its supplier, then it can improve its performance.

Hypothesis 1 H1: *Strategic supplier partnership is positively related to firm performance.*

Impact of Customer Relationship on Firm Performance.

Organizations now become aware of their customers or clients, as they have a different or unusual economic value to the firm. Therefore, associations concentrate on a customer-centric approach while moving away from Product-centric marketing (Munir et al., 2020). Few organizations take the issue of managing relationships with customers as a priority. Organizations believe in investment in software and technology, while other companies consider CRM programs additionally in increasing sound & creative relationships among customers. In addition, few organizations have established programs to manage customer relationships to a higher level than other organizations. Therefore, it is evident to recognize types of activities and programs that manage the relationship with customers while relating to the performance of companies and their profitability. Organizations must interact with customers or their clients differently while managing relationships with them at each stage (Reinartz et al., 2004).

Comprise all collections of practices that are in use to organize the complaints of customers, construct a long-term relationship with consumers & improving their satisfaction level (Gligor et al., 2019; Hsiao et al., 2010). Researchers (Azad & Ahmadi, 2015) believe CRM (customer relationship management) is an essential practice within SCM. Secure relationships with customers permit organizations to distinguish its product from rivals. This also helps to maintain customer faithfulness and severely widen the importance they offer to their consumers. SCMP-like relationships with customers and suppliers are expected to improve or increase a firm's market share and improve the whole competitive position and ROI or Return on Investment (Chowdhury & Quaddus, 2015; Shekhar & Uma Maheswari Devi, 2015). Healthy relationships with supply chain members, including consumers or customers, are required for the booming implementation of supply chain programs (Mbutia, M. G & Rotich, 2014). Therefore, this study is proposed as follows:

Hypothesis 2 H2: *Customer relationship is positively related to firm performance.*

Impact of Information Sharing on Firm Performance

The sharing of information is one more decisive element for the achievement of the execution of SCM. Misrepresentation of evidence that weakens the overall performance of a company is a major problem in developing economies (Mahmud et al., 2021). The sharing of information has two sides, quality and quantity. These two aspects mutually play an important role in practicing SCM. In previous studies on supply chains, the information sharing has been used as an individualistic construct (Owiti et al., 2017; Shibin et al., 2020). Flawless information sharing between different players in the supply chain needed the support of the information technology (Ye & Wang, 2013). The exchange of information among the supply chain players is the way that the data can be reached to associate firms by equally confirmed exchange of communication. The allocation of resources along with the relevant information among different players in SCM is an essential condition

or requirement for an effective alliance (Olorunniwo & Li, 2010). According to some empirical studies, the connection among the supply chain generates the capacity and ability to share and exchange information between the firms or partners. (Kochan & Nowicki, 2018; Prajogo & Olhager, 2012). To achieve higher firm performance, sharing relevant information frequently and openly will conclude the level of sharing which happens ((Fawcett et al., 2007). (Flynn et al., 2010) recommended that the performance of an organization be distinguished based on the use of information. The criteria for using information make a difference in the performance or profitability of the firms (Zhou & Benton, 2007). The literature discussed above illustrates the positive association between information sharing and firm performance.

Hypothesis 3 H3: *Information sharing is positively related to firm performance.*

Impact of Outsourcing on firm performance

Today, outsourcing the organization's functions of the organization has become an essential mechanism to become aware of the firm's goals and objectives. It is because outsourcing lessens capital investment in convinces, information technology, equipment, and manpower. Outsourcing makes firms flexible in adapting to changes in the marketplace and approaching the important edge of technology (C. H. Tang & Wang, 2021). The organization only requires to contract for the essential level of service to fulfill the latest demand of the customer. When demand flows away from the potential of a firm to fulfill, the concept of outsourcing or a third party helps the firm to fulfill that demand (Bradley, 1994; Yang et al., 2016). (Ma & Wong, 2018) explained that third-party logistics, contract logistics, and outsourcing generally mean a similar thing. However, it must be noticed that outsourcing or third-party logistics may be limited to providing a particular type of service like warehousing (Dekker et al., 2009; Lieb & Bentz, 2004). It is important to emphasize that, like a consistent supplier of parts and materials, contracted

logisticians should always provide a high level of services to maintain the level of customer satisfaction, which is how they can keep their clients as strong competitors ((Bustinza et al., 2010; Kenyon et al., 2016). So, the outsourcing of any noncore function significantly increases the firm performance financial as well as nonfinancial (i.e., productivity) (Hsiao et al., 2010). The effect of the relationship between logistic outsourcing and customer services on the competitiveness of organizations states that they hold their functions carefully to achieve their potential goals in the form of competitive advantage (Hsiao et al., 2010; D. Kumar et al., 2010; Rajaguru & Matanda, 2019). The rising popularity and fame of JIT or the just-in-time concept is another main factor of outsourcing promotion. By shifting to just-in-time delivery, control of logistics and inventory has become more critical to operations distributions and manufacturing (Green et al., 2019). The cost of operation in a just-in-time concept environment prompts most of its possible adopters to increase their expertise and resources by using outside sources from their firm structure. Therefore, this study is proposed as follows:

Hypothesis 4 H4: *Outsourcing is positively related to firm performance*

Theoretical Framework

The extended literature review reveals that various supply chain scholars have different views on SCMP and their impact on firm performance. However, the common SCMPs were outsourcing, information sharing, and managing supplier and customer relationships. The extent to which the literature states these SCMPs positively contribute to achieving better firm performance, by enabling to achieve competitive advantages. Due to these techniques, there are various benefits such as low price/cost, reliable demand, product innovation, and quick time to market. The figure given below shows the proposed conceptual framework proposed for this study.

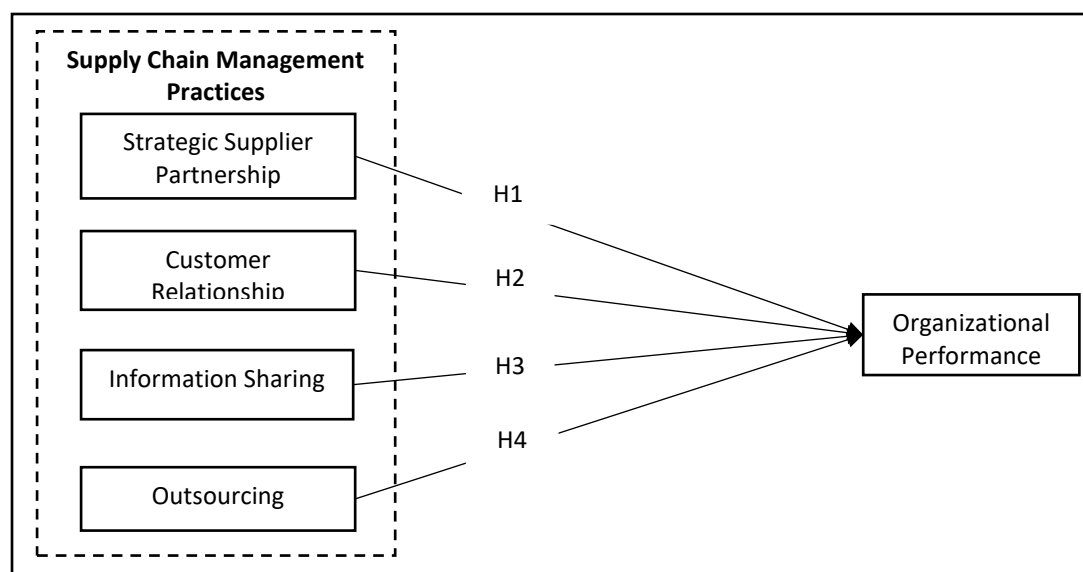


Fig. 1 Conceptual Framework

RESEARCH METHODOLOGY

The purpose of this study is to study how SCMP influences firm performance. On the basis of positivist ontologies, quantitative research is the preferred method. (Ryan, 2018; Wilhite et al., 2014). The primary data for this descriptive research study were gathered from the relevant department of FMCG companies in Pakistan and the research design was cross-sectional.

Sample

The target population for this study was experienced individuals working in various supply chain-related departments of FMCG companies in Karachi, such as general managers and managers in some cases assistant managers who have extensive experience and belong to departments like planning and supply chain, production, finance, purchase, logistics, or their equivalent. To distribute the questionnaire more broadly and widely, extensive collaborative efforts were begun with several supply chain professionals. A list of contacts of FMCG companies from the members of the Pakistan FMCG Association (PFMCGA) is developed for data collection purposes. As a result of joint

efforts, a total of 2000 questionnaires were distributed to various FMCG companies, of which only 317 were received but only 231 were useable. This represents only a 11.6 percent response rate which is quite less than similar studies carried out in the specific area of SCMP and firm performance (Machado et al., 2019; Pournader et al., 2019) but in the acceptable range of more than 10%, as per (Cohen, 2013; Mugenda & Mugenda, 2003).

Data Collection and Instrument development;

In this research study, data was collected through a structured questionnaire using an online survey through a google form. Respondents were only contacted once and only received a maximum of two reminders for responses. The data for this cross-sectional study were collected during a period of 4 months (Feb 2022 to May 2022). The instrument was constructed to facilitate covering a spectrum of responses, from one extreme to the other. Therefore, a five-point Likert scale was used. To improve the instrument's validity and reliability, the data for the research variables were taken from a total of 20 different measurement items adapted from established instruments already employed in prior studies see Table -2.

Table -2 Instrument development.

Constructs	No of Items	Sources
SCM Practices		
Supplier strategic partnership	4	((Sukati et al., 2011)
Customer Relationship	5	(Shekhar & Uma Maheswari Devi, 2015)
Information Sharing	4	(Nag & Ferdausy, 2021)
Outsourcing	3	(Owiti et al., 2017)
Organizational Performance		
Organization Performance	4	(Omain, 2017)

DATA ANALYSIS AND RESULTS

The confirmatory factor analysis (CFA) approach is applied due to its conceptual strengths (Hu & Bentler, 1999). Survey items, CFA factor loadings and model fit statistics are shown in Figure 2, and all are under permissible levels as suggested by (Joe F. Hair et al., 2011). Although the model fitness indices, the RMSEA is 0.063, which is very close to 0.06, indicating a very good fit. The true value of RMSEA using a 90% confidence interval, its value must lie between 0.055 and 0.078, which is still below the cutoff value of 0.08, which further supports the model fit. The goodness of the fit of the model is further affirmed by normed chi-square = 1.52, below 2.0 and CFI = 0.94, indicating a very good fit. The value of SRMR is 0.063, which is above the conservative threshold of 0.05, but still very much below 0.09, which indicates an acceptable

fit for a modal with more than 30 items and CFI > 0.92 (Joe F. Hair et al., 2020). These results show the unidimensionality of the scale as well.

Validity and reliability

Reliability was evaluated from Cronbach's alpha (CA) value and composite reliability (CR). The values of Cronbach's alpha in this model ranged from a minimum of 0.754 to a maximum of 0.831, which is quite above the minimum acceptable benchmark value of 0.7 (Du, 2010). Similarly, the composite reliability values were also well above the minimum required value of 0.7, ensuring that the measures were reliable (Babin et al., 2016). Further, Dijkstra-Henseler's rho (RhoA) was used as opposed to Cronbach's alpha and Composite Reliability generates a more precise estimation of data consistency (Ringle et al., 2020). To ensure the validity of the construct, multiple criteria were used.

Table 3. Constructs Cronbach Alpha (CA), composite reliability (CR), RhoA, and AVE.

Construct	CA	CR	rhoA	AVE
SCM Practices				
Strategic Supplier Partnership (SSP)	0.801	0.821	0.812	0.712
Customer Relationship (CR)	0.792	0.815	0.805	0.752
Information Sharing (IS)	0.827	0.832	0.830	0.811
Outsourcing(OS)	0.754	0.791	0.774	0.713
Organization Performance				
Organization Performance (OP)	0.831	0.852	0.842	0.792

Convergent validity, which describes the cohesiveness of indicators with their relevant measure, was assured from the values of outer loadings and average variance extracted (Williams et al., 2010). Also, all the values of outer loadings that measure indicator reliability were above the benchmark value of 0.6. The average variance extracted - AVE, the values of the third measure of convergent validity, are above the minimum required values of 0.5 (Liengaard et al., 2021). All the values of dependent and independent variables and their significance are shown in Table 4.

Results of the structural model analysis

To test the purposed hypothesis, we use structural equation modeling (SEM) on (SmartPLS-4). Figure 2 shows the result of the

structural model analysis. The Index for the goodness of fit for the model under study is: $\chi^2 = 939.12$; with $df = 604$; normed chi-square = 1.52; RMSEA = 0.053 90% confidence level for RMSEA (0.055 - 0.078); NNFI = 0.93; CFI = 0.94; SRMR = 0.059, these statistics represent a good model fit (Joe F. Hair et al., 2020). The values of the coefficient of determination (R^2) represent the variances explained in each dependent variable and the predictive accuracy. The values of R^2 for the dependent variable OP are closer to 0.5 showing good strength for the structural model (Joseph F. Hair et al., 2019). Also, the value of the f-square effect size is verified by effect size values; it shows the degree of importance of each path in terms of f-square values. The values of Q-square also help to show good predictive relevance of the model, since the values of all paths are above zero (Joe F. Hair et al., 2011).

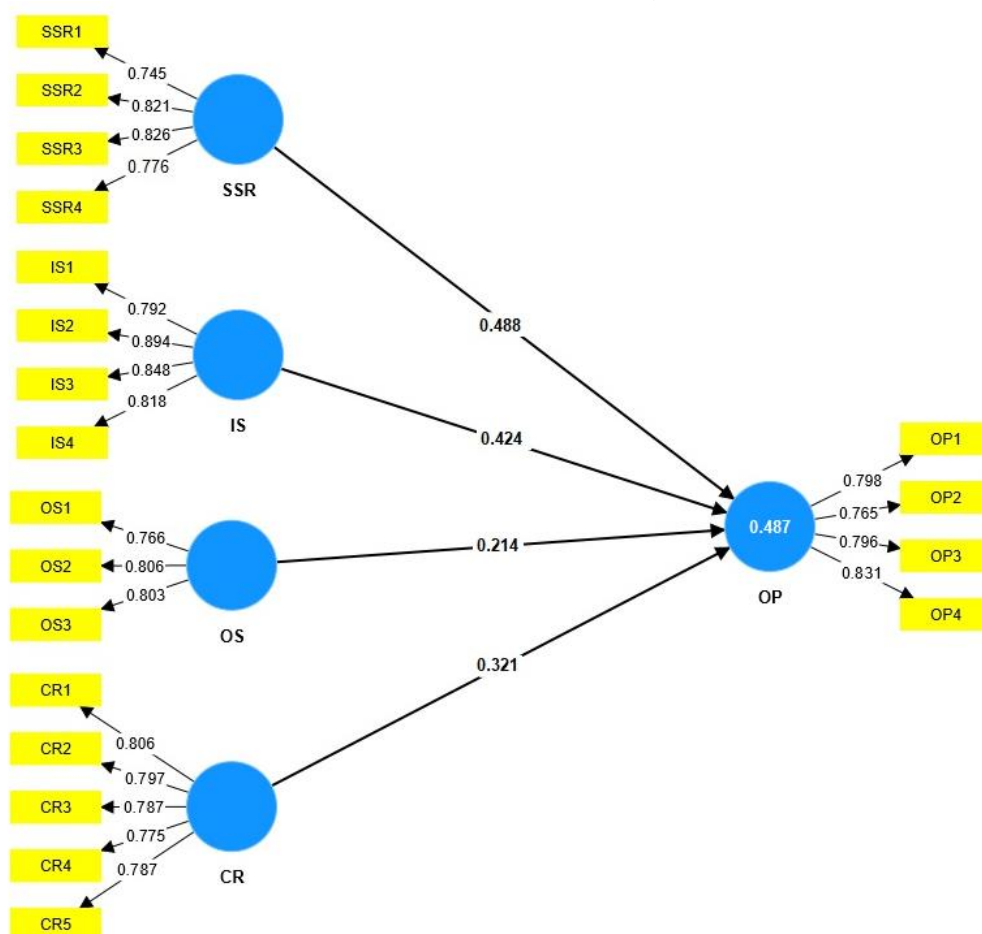


Fig. 2. Results of the structural model analysis. $\chi^2 = 939.12$; $df = 604$; normed chi-square = 1.52; RMSEA = 0.053; NNFI = 0.93; CFI = 0.94; SRMR = 0.059. * $p < 0.01$;

Final Model with Standardized Path Coefficient

In SmartPLS-4, the technique of blindfolding uses to compute Q-square. The Q-

square results become more stable when the blindfolding technique was used at the omission distance of 7 and was found to be fairly higher than zero (Henseler et al., 2015). Since for each path the values of both Q-square and R-square are positive, hence the structured model is strong and of good quality (see Figure 2).

Table 4: Path Coefficients

Hypothesis	Structural path	Beta Value	(STDEV)	t -Values	p -values	Result
H1	SSP → OP	0.488	0.029	32.381	0.000	Accepted
H2	CR → OP	0.321	0.021	28.524	0.000	Accepted
H3	IS → OP	0.424	0.032	31.714	0.000	Accepted
H4	OS → OP	0.214	0.021	29.512	0.000	Accepted

The results obtained fully support the study expectations and the performance impact of SCM practices in FMCG organizations. In particular, the standardized path coefficients highlighted in Table 6 ensure a significant positive linkage between SCMP and firm performance and indicated that all proposed hypotheses are accepted by the current study. Especially the strongest path of supplier strategic partnership and organization performance in particular, with $\beta = 0.488$, p-value < 0.01 , with a t-value of 32.381. However, on the other hand, the weakest among the studied constructs of SCMP is outsourcing with $\beta = 0.214$, p-value < 0.01 , with a t-value of 29.512.

DISCUSSION AND CONCLUSION

Discussion

Based on a thorough study of the literature, it is estimated that integrating SCMP across the network will enhance the firm performance of FMCG companies in Pakistan. In this context, the primary goal of this study was to investigate the relationship between SCMP and firm performance. This proposition was investigated and validated by empirical evidence and it was determined to be significant. This study advances the literature on SCMP in several ways. First, we can prioritize the identified antecedents of SCMP specifically the FMCG

industry. This study reveals that strategic partnership, customer relationship, information systems, and outsourcing increases the performance of companies that participate in the FMCG sector of the economy, which is also in alignment with previous studies. For example, according to (Kusi-Sarpong et al., 2016; Rehman Khan & Yu, 2019), the strategic supplier partnership (SSP) has a strong level of impact on firm performance, thereby creating the ability to achieve long-term relationships with suppliers. Additionally, organizations that seek strategic alliances with their key suppliers can work together and lower product costs while simultaneously raising supplier standards of enthusiasm, innovation, and product quality by reducing cost and time barriers (R. Kumar et al., 2014; Nag & Ferdousy, 2021). Further healthy relations with the customer are expected to increase the firm's market share, improve the competitive position, and ROI (Return On Investment) (A. Kumar et al., 2020). It is because information sharing connects one individual to other individuals (i.e., supply chain partners) and shares relevant information, so it ultimately enhances the overall firm performance (Guerola-Navarro et al., 2021) and also the outsourcing of any noncore function significantly increases the firm performance, both financially as well as non-financially (i.e. productivity). Thus, when SCMPs are embedded strongly in the firm strategy, firm performance is ultimately improved (Machado et al., 2019; Sukati et al., 2011). Second, organizations related to FMCG

and implementing SCMP across their supply chain operations can demonstrate a considerable improvement in their performance (Alkalha et al., 2019; Gewald & Hinz, 2004). When organizations implement various SCMPs, the return on investment (ROI) can be increased to the desired optimized level, which helps the organization to achieve competitiveness. Moreover, FMCG companies need to strive to gain new cutting-edge competitiveness in highly agile manufacturing and short product life cycles, and to do so SCMP can prove to be very helpful. So, SCMP emerges as a tool to perform efficiently and effectively in today's competitive global market. Although SCMP helps organizations enhance their performance in several ways, companies also face certain hindrances and need investments for their implementation as well. But if organizations invest in effective ways to implement these practices, then firms would be able to achieve higher performance standards and competitiveness. On the other hand, if struggling organizations want to enhance their performance, they must adopt SCMP. Additionally, in the current global challenging competitive market, supply chain managers are compelled to improve the efficiency of their department; therefore, these SCMPs must be implemented effectively. On the contrary, for instance, the firm is under performance and unable to manage its supply chain network, indicates that various SCMP are either not followed or maybe not implemented in the true sense. Therefore, managers can use this model to identify the imbalances that hinder firms to perform at their full potential. Therefore, managers must use only those SCMP that can be adjusted according to their business needs and supply chain requirements, together with other practices that will consequently contribute to increasing firm performance. Furthermore, this study can be beneficial for organizations in understanding the critical impact of strategic supplier partnership and other SCMPs to improve firm performance. Despite the fact that SCMP can be adjusted according to firm needs, this study will prove to be a guide for managers and supervisors of organizations, by creating a deeper understanding of SCMP and its potential contribution to firm performance.

Conclusion

This research is a survey-based study to investigate the relationship between SCM practice and firm performance. The perspective considered in this study is aligned with the theory of resource-based view (RBV), which emphasizes that a unique set of resources owned by organizations is more likely to explain the variations in firm performance (Barney, 1991). Cross-sectional data were collected from FMCG companies in the largest metropolitan city of Pakistan. Due to too many competitors in the same product category, a shorter product life cycle and varying consumer demand make the firms unable to perform at their full potential (Rogers et al., 2016). In this study, various SCMPs, such as strategic supplier relationships, customer relationships, information systems, and outsourcing, are considered based on a resource-based view. Empirical findings reveal that SCMP has a significant positive impact on firm performance. Moreover, the findings reveal that among them, SSP and IS are the most important dimension of SCMP in the FMCG sector with 31.9% and 32.4%, respectively, of the variance in firm performance has been significantly explained. Therefore, if FMCG companies in developing countries want to improve their performance, should take into consideration these SCMPs and while taking various strategic moves, place special emphasis on supplier strategic partnership, customer relationship management, information system and outsourcing.

Research Limitations and Future Implications

Although the results of this study are comprehensive and justifiable, some limitations should be taken into account. First, the use of cross-sectional data restricts researchers to depict the entire materialization of both SCMP and organization performance. On the other hand, longitudinal data are more beneficial when studying performance variations over time. Second, this study considers four widely used SCMPs in Pakistan, but in future research, other

important SCMPs such as integration, quality consideration, and postponement should be considered. Third, this study only considers the FMCG industry, whereas to make this model more generalized it should be applied to other industries as well as other cities throughout the country. Therefore, the results of the current study are limited to a particular area and industry. Future researchers are advised to focus on various industries and geographical areas to draw more detailed answers.

ACKNOWLEDGMENTS

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

- Abdul-Hamid, A. Q., Ali, M. H., Tseng, M. L., Lan, S. & Kumar, M. (2020). Impeding challenges on industry 4.0 in circular economy: Palm oil industry in Malaysia. *Comput Oper Res*, 123, 105052. <https://doi.org/10.1016/j.cor.2020.105052>
- Ali, M. H., Zhan, Y., Alam, S. S., Tse, Y. K. & Tan, K. H. (2017). Food supply chain integrity: The need to go beyond certification. *Industrial Management and Data Systems*, 117(8), 1589–1611. <https://doi.org/10.1108/IMDS-09-2016-0357>
- Alkalha, Z., Reid, I. & Dehe, B. (2019). The role of absorptive capacity within supply chain quality integration. *Supply Chain Management*, 24(6), 805–820. <https://doi.org/10.1108/SCM-10-2018-0375>
- Amling, A. & Daugherty, P. J. (2020). Logistics and distribution innovation in China. *International Journal of Physical Distribution and Logistics Management*, 50(3), 323–332. <https://doi.org/10.1108/IJPDLM-07-2018-0273>
- Amoako-Gyampah, K., Boakye, K. G., Adaku, E. & Famiyeh, S. (2019). Supplier relationship management and firm performance in developing economies: A moderated mediation analysis of flexibility capability and ownership structure. *International Journal of Production Economics*, 208, 160–170. <https://doi.org/10.1016/j.ijpe.2018.11.021>
- Attri, R., Singh, B. & Mehra, S. (2017). Analysis of interaction among the barriers to 5S implementation using interpretive structural modeling approach. *Benchmarking*, 24(7), 1834–1853. <https://doi.org/10.1108/BIJ-07-2016-0110>
- Azad, N. & Ahmadi, F. (2015). The customer relationship management process: Its measurement and impact on performance. *Uncertain Supply Chain Management*, 3(1), 43–50. <https://doi.org/10.5267/j.uscm.2014.9.002>
- Babin, B. J., Griffin, M. & Hair, J. F. (2016). Heresies and sacred cows in scholarly marketing publications. *Journal of Business Research*, 69(8), 3133–3138. <https://doi.org/10.1016/J.JBUSRES.2015.12.001>
- Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
- Basnet, C., Corner, J., Wisner, J. & Tan, K. C. (2003). Benchmarking supply chain management practice in New Zealand. *Supply Chain Management*, 8(1), 57–64. <https://doi.org/10.1108/13598540310463369>
- Bendoly, E. & Kaefer, F. (2004, 1. October). *Business technology complementarities: Impacts of the presence and strategic timing of ERP on B2B e-commerce technology efficiencies*. Omega; Pergamon. <https://doi.org/10.1016/j.omega.2004.02.004>

- Betts, J. M. & Johnston, R. B. (2005). Just-in-time component replenishment decisions for assemble-to-order manufacturing under capital constraint and stochastic demand. *International Journal of Production Economics*, 95(1), 51–70. <https://doi.org/10.1016/j.ijpe.2003.10.020>
- Blonska, A., Storey, C., Rozemeijer, F., Wetzels, M. & de Ruyter, K. (2013). Decomposing the effect of supplier development on relationship benefits: The role of relational capital. *Industrial Marketing Management*, 42(8), 1295–1306. <https://doi.org/10.1016/j.indmarman.2013.06.007>
- Bradley, P. (1994). Contract logistics: It's all about costs. *Purchasing*, 117(6), 276–288.
- Bustinza, O. F., Arias-Aranda, D. & Gutierrez-Gutierrez, L. (2010). Outsourcing, competitive capabilities and performance: an empirical study in service firms. *International Journal of Production Economics*, 126(2), 276–288. <https://doi.org/10.1016/j.ijpe.2010.03.023>
- Chand, M. (2021). Strategic assessment and mitigation of risks in sustainable manufacturing systems. *Sustainable Operations and Computers*, 2, 206–213. <https://doi.org/10.1016/j.susoc.2021.07.004>
- Chavez, P. J. A. & Seow, C. (2012). Managing food quality risk in global supply chain: A risk management framework. *International Journal of Engineering Business Management*, 4(1). <https://doi.org/10.5772/46116>
- Chow, W. S., Madu, C. N., Kuei, C. H., Lu, M. H., Lin, C. & Tseng, H. (2008). Supply chain management in the US and Taiwan: An empirical study. *Omega*, 36(5), 665–679. <https://doi.org/10.1016/j.omega.2006.01.001>
- Chowdhury, M. M. H. & Quaddus, M. A. (2015). A multiple objective optimization based QFD approach for efficient resilient strategies to mitigate supply chain vulnerabilities: The case of garment industry of Bangladesh. *Omega (United Kingdom)*, 57, 5–21. <https://doi.org/10.1016/j.omega.2015.05.016>
- Choy, K. & Lee, W. (2002). On the development of a case-based supplier management tool for multi-national manufacturers. In *Measuring Business Excellence*, 6(1). Christopher, M. (2011). *Logistics & supply chain management (4. ed)*. Harlow: Financial Times (pp. 15–22). <https://doi.org/10.1108/13683040210420501>
- Cohen, J. (2013). Statistical Power Analysis for the Behavioral Sciences. *Statistical Power Analysis for the Behavioral Sciences*. <https://doi.org/10.4324/9780203771587>
- Dekker, R., Van Asperen, E., Ochtman, G. & Kusters, W. (2009). Floating stocks in FMCG supply chains: Using intermodal transport to facilitate advance deployment. *International Journal of Physical Distribution & Logistics Management*, 39(8), 632–648. <https://doi.org/10.1108/09600030910996297>
- Dey, P. K., Bhattacharya, A., Ho, W. & Clegg, B. (2015). Strategic supplier performance evaluation: A case-based action research of a UK manufacturing organisation. *International Journal of Production Economics*, 166, 192–214. <https://doi.org/10.1016/j.ijpe.2014.09.021>
- Doan, T. T. T. (2020). Supply chain management drivers and competitive advantage in manufacturing industry. *Uncertain Supply Chain Management*, 8(3), 473–800. <https://doi.org/10.5267/J.USCM.2020.5.001>
- Du, R. Y. (2010). Research Reliability and Validity. *Wiley International Encyclopedia of Marketing*. <https://doi.org/10.1002/9781444316568.WIEM02008>
-

- Fawcett, S. E., Osterhaus, P., Magnan, G. M., Brau, J. C. & McCarter, M. W. (2007). Information sharing and supply chain performance: The role of connectivity and willingness. *Supply Chain Management: An International Journal*, 12(5), 358–368. <https://doi.org/10.1108/135985407110776935>
- Flöthmann, C., Hoberg, K. & Wieland, A. (2018). Competency requirements of supply chain planners & analysts and personal preferences of hiring managers. *Supply Chain Management*, 23(6), 480–499. <https://doi.org/10.1108/SCM-03-2018-0101>
- Flynn, B. B., Huo, B. & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management*, 28(1), 58–71. <https://doi.org/10.1016/J.JOM.2009.06.001>
- Gewald, H. & Hinz, D. (2004). *A Framework for Classifying the Operational Risks of Outsourcing Integrating Risks from Systems, Processes, People and External Events within the Banking Industry*. <http://aisel.aisnet.org/pacis2004/84>
- Ghalem, Okar, C., Chroqui, R. & Semma, E. (2018). Air Traffic Management Performance framework Case Study: Morocco. *IFAC-PapersOnLine*, 51(11), 1–6. <https://doi.org/10.1016/j.ifacol.2018.08.225>
- Gligor, D., Gligor, N. & Maloni, M. (2019). The impact of the supplier's market orientation on the customer market orientation-performance relationship. *International Journal of Production Economics*, 216, 81–93. <https://doi.org/10.1016/j.ijpe.2019.04.022>
- Green, K. W., Inman, R. A., Sower, V. E. & Zelbst, P. J. (2019). Comprehensive supply chain management model. *Supply Chain Management*, 24(5), 590–603. <https://doi.org/10.1108/SCM-12-2018-0441>
- Guerola-Navarro, V., Oltra-Badenes, R., Gil-Gomez, H. & Iturricha Fernández, A. (2021). Customer relationship management (CRM) and Innovation: A qualitative comparative analysis (QCA) in the search for improvements on the firm performance in winery sector. *Technological Forecasting and Social Change*, 169, 120838. <https://doi.org/10.1016/j.techfore.2021.120838>
- Hair, Joe F., Howard, M. C. & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, 109, 101–110. <https://doi.org/10.1016/J.JBUSRES.2019.11.069>
- Hair, Joe F., Ringle, C. M. & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19(2), 139–152. <https://doi.org/10.2753/MTP1069-6679190202>
- Hair, Joseph F., Sarstedt, M. & Ringle, C. M. (2019). Rethinking some of the rethinking of partial least squares. *European Journal of Marketing*, 53(4), 566–584. <https://doi.org/10.1108/EJM-10-2018-0665>
- Henseler, J., Ringle, C. M. & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135. <https://doi.org/10.1007/S11747-014-0403-8>
- Hsiao, H. I., Kemp, R. G. M., van der Vorst, J. G. A. J. & (Onno) Omta, S. W. F. (2010). *A classification of logistic outsourcing levels and their impact on service performance: Evidence from the food processing industry*. *International Journal of Production Economics*. <https://doi.org/10.1016/j.ijpe.2009.09.010>

- Hu, L. T. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Hussein Zolait, A., Razak Ibrahim, A., Sundram, V. P. K. & Chandran, V. G. R. (2010). Supply chain integration: An empirical study on manufacturing industry in Malaysia. *Journal of Systems and Information Technology*, 12(3), 210–221. <https://doi.org/10.1108/13287261011070830>
- Jharkharia, S. & Shankar, R. (2004). Supply Chain Management: Some Insights From Indian Manufacturing Companies. *Asian Academy of Management Journal*, 9(1), 79–98.
- Kenyon, G. N., Meixell, M. J. & Westfall, P. H. (2016). Production outsourcing and operational performance: An empirical study using secondary data. *International Journal of Production Economics*, 171, 336–349. <https://doi.org/10.1016/j.ijpe.2015.09.017>
- Kochan, C. G. & Nowicki, D. R. (2018). Supply chain resilience: a systematic literature review and typological framework. In *International Journal of Physical Distribution and Logistics Management* (Vol. 48, Issue 8, pp. 842–865). Emerald Group Publishing Ltd. <https://doi.org/10.1108/IJPDLM-02-2017-0099>
- Koh, S. C. L., Demirbag, M., Bayraktar, E., Tatoglu, E. & Zaim, S. (2007). The impact of supply chain management practices on performance of SMEs. *Industrial Management and Data Systems*, 107(1), 103–124. <https://doi.org/10.1108/02635570710719089>
- Kumar, A., Singh, R. K. & Modgil, S. (2020). Influence of data-driven supply chain quality management on organizational performance: evidences from retail industry. *TQM Journal*. <https://doi.org/10.1108/TQM-06-2020-0146>
- Kumar, D., Singh, O. M. P. A. L. & Singh, J. (2010). an Analytical Framework for Critical Literature Review of Supply Chain Design. *International Journal*, 6(3), 293–317.
- Kumar, R., Singh, R. K. & Shankar, R. (2014). Strategy development by Indian SMEs for improving coordination in supply chain an empirical study. *Competitiveness Review*, 24(5), 414–432. <https://doi.org/10.1108/CR-06-2012-0016>
- Kusi-Sarpong, S., Sarkis, J. & Wang, X. (2016). Green supply chain practices and performance in Ghana’s mining industry: A comparative evaluation based on DEMATEL and AHP. *International Journal of Business Performance and Supply Chain Modelling*, 8(4), 320–347. <https://doi.org/10.1504/IJBPSM.2016.081290>
- Langdon, R. J., Yousefi, P. D., Relton, C. L. & Suderman, M. J. (2021). Epigenetic modelling of former, current and never smokers. *Clinical Epigenetics*. <https://doi.org/10.1186/s13148-021-01191-6>
- Li, S., Qiao, J., Cui, H. & Wang, S. (2020). Realizing the environmental benefits of proactive environmental strategy: The roles of green supply chain integration and relational capability. *Sustainability (Switzerland)*, 12(7). <https://doi.org/10.3390/su12072907>
- Lieb, R. C. & Bentz, B. A. (2004). The use of third-party logistics services by large American manufacturers: The 2003 survey. *Transportation Journal*, 43(3), 24–33. <https://doi.org/10.2307/20713595>

- Lienggaard, B. D., Sharma, P. N., Hult, G. T. M., Jensen, M. B., Sarstedt, M., Hair, J. F. & Ringle, C. M. (2021). Prediction: Coveted, Yet Forsaken? Introducing a Cross-Validated Predictive Ability Test in Partial Least Squares Path Modeling. *Decision Sciences*, 52(2), 362–392. <https://doi.org/10.1111/DECI.12445>
- Lin, C., Chow, W. S., Madu, C. N., Kuei, C. H. & Pei Yu, P. (2005). A structural equation model of supply chain quality management and organizational performance. *International Journal of Production Economics*, 96(3), 355–365. <https://doi.org/10.1016/j.ijpe.2004.05.009>
- Ma, H. L. & Wong, W. H. C. (2018). A fuzzy-based House of Risk assessment method for manufacturers in global supply chains. *Industrial Management and Data Systems*, 118(7), 1463–1476. <https://doi.org/10.1108/IMDS-10-2017-0467>
- Machado, M. C., Telles, R., Sampaio, P., Queiroz, M. M. & Fernandes, A. C. (2019). Performance measurement for supply chain management and quality management integration. *Benchmarking: An International Journal*, 27(7), 2130–2147. <https://doi.org/10.1108/BIJ-11-2018-0365>
- Mahmud, P., Paul, S. K., Azeem, A. & Chowdhury, P. (2021). Evaluating supply chain collaboration barriers in small and medium-sized enterprises. *Sustainability (Switzerland)*, 13(13). <https://doi.org/10.3390/su13137449>
- Mbuthia, M. G. & Rotich, G. (2014). Effects of supply chain management practices on competitive advantage in retail chain stores in Kenya, a case study of Nakumatt Holding Limited. *European Journal of Business Management*, 2 (1), 336-349.
- Mensah, C., Diyuoh, D. and Oppong, D. (2014). *Asses. Journal*, Vol.2, No.(1), 336–349.
- Mugenda, O. & Mugenda, A. (2003). *Research methods: Quantitative and qualitative Approaches*. Nairobi: African Centre for Technology Studies. In *Open Access Library Journal* (Vol. 2, Issue 2). African Centre for Technology Studies. <https://doi.org/10.12691/education-2-11A-5>
- Munir, M., Jajja, M. S. S., Chatha, K. A. & Farooq, S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. *International Journal of Production Economics*, 227. <https://doi.org/10.1016/j.ijpe.2020.107667>
- Nag, T. & Ferdausy, D. S. (2021). Supply Chain Management Practices and Supply Chain Performance in the Manufacturing Industries of Bangladesh. In *Logistics & Supply Chain Review* (Vol. 2, Issue 1). Monash University Faculty of Business and Economics. <https://doi.org/10.38157/logistics-supply-chain-review.v2i1.192>
- Niknejad, A. & Petrovic, D. (2016). A fuzzy dynamic Inoperability Input-output Model for strategic risk management in Global Production Networks. *International Journal of Production Economics*, 179, 44–58. <https://doi.org/10.1016/j.ijpe.2016.05.017>
- Olorunniwo, F. O. & Li, X. (2010). Information sharing and collaboration practices in reverse logistics. *Supply Chain Management*, 15(6), 454–462. <https://doi.org/10.1108/13598541011080437>
- Omain, S. Z. (2017). Supply Chain Management Practices in Malaysia Palm Oil Firm. *The 11th Asia Pacific Industrial Engineering and Management Systems Conference*, 1(1), 287–295.
- Owiti, I., Ombwayo, K. & Atambo-, W. N. (2017). Effects of Supply Chain Quality Management Practices on Performance of SACCOs in Nakuru County, Kenya. *Imperial Journal of Interdisciplinary Research*, 3(3), 959–982.

- Pournader, M., Kach, A., Fahimnia, B. & Sarkis, J. (2019). Outsourcing performance quality assessment using data envelopment analytics. *International Journal of Production Economics*, 207, 173–182. <https://doi.org/10.1016/j.ijpe.2016.07.004>
- Prajogo, D. & Olhager, J. (2012). Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. *International Journal of Production Economics*, 135(1), 514–522. <https://doi.org/10.1016/j.ijpe.2011.09.001>
- Pujawan, I. N. & Geraldin, L. H. (2009). House of risk: A model for proactive supply chain risk management. *Business Process Management Journal*, 15(6), 953–967. <https://doi.org/10.1108/14637150911003801>
- Rajaguru, R. & Matanda, M. J. (2019). Role of compatibility and supply chain process integration in facilitating supply chain capabilities and organizational performance. *Supply Chain Management*, 24(2), 315–330. <https://doi.org/10.1108/SCM-05-2017-0187>
- Rehman Khan, S. A. & Yu, Z. (2019). Introduction to supply chain management. In *EAI/Springer Innovations in Communication and Computing*. Prentice-Hall. https://doi.org/10.1007/978-3-030-15058-7_1
- Ringle, C. M., Sarstedt, M., Mitchell, R. & Gudergan, S. P. (2020). Partial least squares structural equation modeling in HRM research. *International Journal of Human Resource Management*, 31(12), 1617–1643. <https://doi.org/10.1080/09585192.2017.1416655>
- Rogers, H., Srivastava, M., Pawar, K. S. & Shah, J. (2016). Supply chain risk management in India – practical insights. *International Journal of Logistics Research and Applications*, 19(4), 278–299. <https://doi.org/10.1080/13675567.2015.1075476>
- Ryan, G. (2018). Introduction to positivism, interpretivism and critical theory. *Nurse Researcher*, 25(4), 14–20. <https://doi.org/10.7748/nr.2018.e1466>
- Shekhar, B. R. & Uma Maheswari Devi, P. (2015). Supply Chain Management Practices in Indian Electronics Industry. *Developments in Marketing Science: Proceedings of the Academy of Marketing Science*, 267–272. https://doi.org/10.1007/978-3-319-11806-2_115
- Shibin, K. T., Dubey, R., Gunasekaran, A., Hazen, B., Roubaud, D., Gupta, S. & Foropon, C. (2020). Examining sustainable supply chain management of SMEs using resource based view and institutional theory. *Annals of Operations Research*, 290(1–2), 301–326. <https://doi.org/10.1007/s10479-017-2706-x>
- Sukati, I., Hamid, A. B., Baharun, R., Huam, H. T. & Said, F. (2011). An empirical investigation on consumer goods industry in Malaysia. *Journal of Financial Reporting and Accounting, ahead-of-p*(ahead-of-print), 166–176.
- Tang, C. H. & Wang, Y. W. (2021). Transportation outsourcing problems considering feasible probabilities under stochastic demands. *Computers and Operations Research*, 126. <https://doi.org/10.1016/j.cor.2020.105109>
- Tang, C. S. (2006). Robust strategies for mitigating supply chain disruptions. *International Journal of Logistics Research and Applications*, 9(1), 33–45. <https://doi.org/10.1080/13675560500405584>
- Trent, R. J. & Monczka, R. M. (2003). Understanding integrated global sourcing. *International Journal of Physical Distribution and Logistics Management*, 33(7), 607–629. <https://doi.org/10.1108/09600030310499286>
- Wilhite, A., Burns, L., Patnayakuni, R. & Tseng, F. (2014). Military supply chains and closed-loop systems: Resource allocation and incentives in supply sourcing and supply chain design. *International Journal of Production Research*, 52(7), 1926–1939. <https://doi.org/10.1080/00207543.2013.787173>

Williams, L. J., Hartman, N. & Cavazotte, F. (2010). Method variance and marker variables: A review and comprehensive cfa marker technique. *Organizational Research Methods*, 13(3), 477–514.

<https://doi.org/10.1177/1094428110366036>

Yang, Q., Zhao, X., Yeung, H. Y. J. & Liu, Y. (2016). Improving logistics outsourcing performance through transactional and relational mechanisms under transaction uncertainties: Evidence from China. *International Journal of Production Economics*, 175, 12–23.

<https://doi.org/10.1016/j.ijpe.2016.01.022>

Ye, F. & Wang, Z. (2013). Effects of information technology alignment and information sharing on supply chain operational performance. *Computers and Industrial Engineering*, 65(3), 370–377.

<https://doi.org/10.1016/j.cie.2013.03.012>

Yeung, K., Lee, P. K. C., Yeung, A. C. L. & Cheng, T. C. E. (2013). Supplier partnership and cost performance: The moderating roles of specific investments and environmental uncertainty. *International Journal of Production Economics*, 144(2), 546–559.

<https://doi.org/10.1016/j.ijpe.2013.04.008>

Zhou, H. & Benton, W. C. (2007). Supply chain practice and information sharing. *Journal of Operations Management*, 25(6), 1348–1365.

<https://doi.org/10.1016/j.jom.2007.01.009>

Tahir Mumtaz Malik ORCID ID: <https://orcid.org/0000-0002-3359-4349>

Faculty of Management Science,

Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology,

SZABIST, Islamabad, **Pakistan**

e-mail: tahir.mumtaz@szabist.edu.pk

Syed Mahmmod Hassan

Faculty of Industrial and Manufacturing Engineering,

NED University of Engineering and Technology Karachi, **Pakistan**

e-mail: syed.m.hasan@hotmail.co.uk

Muhammad Tufail ORCID ID: <https://orcid.org/0000-0001-8540-6509>

Faculty of Industrial and Manufacturing Engineering,

NED University of Engineering and Technology Karachi, **Pakistan**

e-mail: mtufail@neduet.edu.pk