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Exploring the Relationship between Supply Chain Integration, Product Innovation, Supply Chain Performance and Firm Performance: Does Supply Chain Information Strategy Matter?

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The prime objective of the current study is to investigate the relationship between firm supply chain performance and firm performance. Meanwhile the study is also interested in investigating the moderating role of information strategy. Using a firms' knowledge-based view, it is hypothesized that higher customer, competitor, and supplier intelligence integration results in higher product innovation and supply chain adaptability. Where, intelligence integration refers to the ability of an organization to quickly modify SC in accordance with the product design and market changes; whereas, the product innovation ability refers to the proficiency of an organization to develop new and innovative products. Employing the survey-based methodology, the SEM-CBM technique is used to test the hypothesized relationships. So, the current study has used SEM-CBM as statistical tool to answer the research questions raised in this study and research objectives envisaged in the study. The findings of the study have provided support to the theoretical foundation and

proposed hypothesis of the current study. This study will be helpful for policymakers and practitioners in understanding the issues related to supply chain risk, supply chain integration and supply chain performance. In author knowledge this is among very few pioneering studies on this issue.

Key words: *Supply Chain Integration, Product Innovation, Supply Chain Performance, Firm Performance.*

Introduction

With a higher new product failure rate of 90%, researchers seek to study factors which contribute in new product development, thus continuing to improve organizational performance (Claudy, Garcia and O'Driscoll, 2015). However, Talke and Hultink (2000) stated that significant research is needed in the area of new product launching. Numerous practitioners and academics contemplate the launching of a new product as the least well administered stage in the whole process of innovation (Claudy, Garcia and O'Driscoll, 2015). Since several prior studies have observed launch strategies and tactics such as branding, pricing, distribution strategy aiming to target customers, the role of competitors and suppliers has been ignored in the literature (Chang and Taylor, 2016). This is quite surprising as several researchers have investigated benefits of competitor analysis and supplier involvement in the process of developing new product. Previous studies have emphasized how innovative capability of an organization is affected by such efforts, although they have somehow failed to observe how the information gained through SC constituents can affect the new product launching process. This explains the reason of failure of several new product launches (Marion, Eddleston, Friar and Deeds, 2015). This study aims to control this problem through observing the role of cross-supply chain intelligence, in a successful product launch, and how it affects an organization's financial performance.

In particular, the technological knowledge is usually integrated and sourced through customers, competitors, and suppliers. Whereas, traditional wisdom proposes that incorporating technological intelligence could be beneficial and would bring positive benefits. Such as, better understandings of technical expertise and technological requirements that are integrated and sourced from customers' side encourage innovating organizations for structuring and designing suitable commercialization plans (Lee, Lin, Wong and Calantone, 2011). However, this understanding also enable organizations in designing product features more efficiently and in developing promotional, distribution, and sales plans which could

structure and satisfy the customer requirements (Jalloh & Guevera 2017). Such factors considerably affect the way a new product launches successfully. In a similar manner, technological knowledge gained from competitors and suppliers provides product launch or its design strategy to be optimally used within a marketplace (Lee, Lin, Wong and Calantone, 2011). A continuous process of intelligence collection from the customers, competitors, and suppliers enables organizations to overcome various problems associated with product launch as well as enabling organizations to quickly observe the new opportunities and other problems having a potential to appear during a product launching stage.

In this regard, counterstatements have also appeared. For instance, several researchers have argued that over dependence on the limited viewpoint of competitors, suppliers and customers cause negative impacts on innovation outcomes (Kuester, Homburg and Hess, 2012). Furthermore, mixed results are obtained from empirical researches regarding external knowledge integration. However, positive effects are also found in a few researches by supplier integration whereas, other studies found insignificant or negative impacts. In the case of customer integration, both negative and positive effects were obtained (Kuester, Homburg & Hess, 2012). On the other hand, competitor intelligence is found to have a positive effect on NPD whereas negative results could appear if the competitors spread misleading information about the other market players. Pre-eminently, previous resources have failed to examine the potential SC intelligence mediators which could be the reasoning for these mixed results. However, the effect of SC intelligence integration needs to be studied further in detail, particularly concerning its impact on certain outcomes related to a successful new product launch (Schoenherr and Swink, 2015).

Using a firms' knowledge-based view, it is hypothesized that higher customer, competitor, and supplier intelligence integration results in higher product innovation and supply chain adaptability. Where, intelligence integration refers to the ability of an organization to quickly modify SC in accordance with the product design and market changes, whereas, the product innovation ability refers to the proficiency of an organization to develop new and innovative products (Hughes, Le Bon and Rapp, 2013). Therefore, positive effects appearing from these are expected to positively influence the successful launch of a new product, defined with the context of how a successful product launch meets the requirements of a firm's timeline, budget goals, and commercialization. Moreover, supply chain adaptability is likely to have a positive influence on product innovation. Precisely, together these factors explain the essential mediating role of product innovation and supply chain adaptability. The formulated hypotheses are tested using a structural equation modelling, by employing a large-scale survey data (Iyede, Onah & Agu 2018). Post-hoc analyses are performed for having an insight of the underlying dynamics which leads to a successful new product launch. Finally,

the findings have shown that greater success in launching a new product improves the organizations' financial performance (Helm, Krinner and Schmalfuß, 2014).

Hypothesis Development

Impact of the customer, competitor, and supplier intelligence integration on product innovation capability and supply chain adaptability.

A degree of an organizations' customer, competitor and supplier intelligence integration is positively linked to its proficiency in developing innovative products and to quickly modify SC structure in accordance with the product design and market changes. Firstly, this study is parallel to the works which considered that information gained through external entities is a significant constituent in developing the ability of quickly responding against downstream and upstream markets (Helm, Krinner and Schmalfuß, 2014) and in offering competitive and innovative products, continuously (Williams, Roh, Tokar,and Swink, 2013). In addition, external SC entities may have unique knowledge which can contribute in improving organizational efficiency with respect to changes in market, thus motivating organizations' innovation endeavors. Presently, such externally gained intelligence is valuable, attributed with rapidly changing technologies, more demanding customers, faster clock-speeds, and shorter product lifecycles (Chen, Preston and Swink, 2015). Therefore, such intelligence are needed to be incorporated which facilitate organizations regarding the status of its product relative to product lifecycles and technology, and allow organizations to predict and sense opportunities, challenges and developments, and to deal with them proactively.

The association of intelligence with product innovation capability and supply chain adaptability has been viewed under KBV' principle, concerning that the requirement of newly gained information is needed to apply and transfer knowledge in the firms' context. Operations involving customer, competitor, and supplier intelligence integration are integral for application processes and knowledge transfer. In addition, since analysis and intelligence gathering are expensive to undertake as well as they are dependent upon certain conditions for becoming successful, such as special association among partners, thus, externally sourced intelligence is considered to be rare. Moreover, it is also thought to be non-substitutable and inimitable in case when it constitutes of rarely available knowledge. As in resource-based view, such attributes signifies that SC intelligence satisfies the requirements of exploring knowledge-based resources (Flynn, Koufteros and Lu, 2016). However, each intelligence based source provide unique insights which facilitates innovative decision-makers in modifying SCs. Firstly, organizations largely rely on constraints and supplier's capabilities, particularly in present times, when several organizations are outsourcing various non-core

operations. Such reliance explains the worth of efforts that are made for integrating and collecting supplier knowledge about improved product design, factor market variations, and capacity constraints. Customer intelligence, just like supplier intelligence, addresses market requirements and technological opportunities and notify organization about the required changes under appropriate time, and providing benefits to the decision makers. Integrating customer intelligence provide valuable insights about future and emerging market opportunities, pricing strategies, and customer preferences, thus, facilitating firms in optimizing demand and supply resource management (Craighead, Blackhurst, Rungtusanatham and Handfield,2007).

Finally, incorporating customer intelligence also improved the supply chain adaptability of an organization, particularly with regards to positioning. Whereas, competitor intelligence encourages to easily and quickly respond to changes caused by competitors, competitive offerings as well as variations caused by customers, where competitor intelligence involves customer insight which could not be detected by organization (Hafeez, Basheer, Rafique and Siddiqui, 2018). Therefore, obtaining intelligence from these sources significantly affects the process of firm's strategy development, such as SC adaptation plans. Resultantly, decision makers who successfully integrate intelligence forms a basis to identify and overcome SC issues quickly in response to market variations.

H1: Supply chain adaptability is positively related with integration of customer, competitor, and supplier intelligence.

Numerous researches have highlighted the positive roles played by the customer, competitor, and supplier intelligence integration on the performance of organization's product innovation. Each intelligence source gives unique insights to improve product innovation capability of an organization. Suppliers also present new materials, technological advances, product component design and process ideas for the well-being of innovation practices by the firm. Customers' dislikes and likes can be revealed through customer intelligence allowing firm in modifying and fine-tuning its innovative and new product launch (Lawson and Samson, 2001). Finally, integrating competitor intelligence offers strategic insights regarding how firm distinguish its new innovative product relative to its competitors, therefore providing temporary benefits to the organization. Some researchers have incorporated all three SC intelligence measures separately as well as simultaneously. Therefore, present study provides opportunities to clarify inconsistent outcomes. Thus, a positive attitude is employed to state that integrating large numbers of customer, competitor, and supplier intelligence by a firm creates valuable wealth and rare stocks of knowledge, encouraging firms to establish faster and improved quality product innovation practices Wong, Boon-Itt and Wong, 2011).

H2: Product innovation capability is positively related with customer, competitor, and supplier intelligence integration.

The supply chain of an organization serves either as a resource or as a restriction on the process of production innovation. Since preceding discussion largely emphasized upon knowledge that is obtained from SC relationships. Therefore, significant innovation challenges causing by inertia in SC structures and relationships must also be observed. Supply chain inflexibility can crack down slow innovation operations and product ideas (Callahan and Lasry, 2004). Such as, incompatibilities among existing SC distribution network and cost structures and new product design can develop non-profitable or nonviable attractive product development concept. Alternatively, adaptable and flexible SC structures enable product designers in becoming innovative for yielding range of possibilities.

Supply chain adaptability arises from flexibilities that are developed from relational and structural choices and investments (Basheer, Siam, Awn and Hassan, 2019) on the other hand, product innovation capability is somewhat more specific and focused. Such as, the former offer firms a context to refine and develop product innovation capability, it is in line with a study which stated that under new product development, dynamic capability enables organization to quickly adjust its structure which could be adaptable with the changing market environment, alternatively, innovation capability specifically relates with the actual product development. Therefore, it can be stated that supply chain adaptability provides more efficient and faster new innovative product development, since it remove firms' restrictions, supply chain relationships, and mandatory process technologies (Baker and Sinkula, 1999).

H3: Product innovation capability is positively related with supply chain adaptability.

Impact of Product Innovation Capability and Supply chain adaptability on successful new product launch

Supply chain adaptability, a powerful dimension of overall supply chain agility, refers as the ability of quickly and efficiently responding against technological and market variations (Schoenherr and Swink, 2015). Adaptable SC managers quickly make necessary alignments for achieving successful product initiation. Such as greater SC adaptability help decision makers for making adjustments in placement strategies, promotions, and product designs, immediately after the emergence of enhanced sales information from the product launch (He, Lai, Sun and Chen, 2014). Moreover, abilities to resolve SC issues, acquiring inputs for innovative product and quickly applying engineering changes must be helpful in yielding

improved outcomes from the launch. Supply chain adaptability implies lesser risk during product launch, as an organization could only depend on SC resources for responding appropriately against market changes (Jin, Vonderembse, Ragu-Nathan and Smith, 2014).
Product innovation capability established based on a firm's capability to exploit ideas and information, to produce a new product quickly and effectively. Product innovation capability is valuable, enabling organization to keep pace with the modern technological and creative developments, as well as providing advantage of first mover during the new product launch and yielding strategic renewal and competitive advantage (Stevenson and Spring, 2007). Organizations which are skilled in terms of development and new production innovation are more likely to have the process and organizational knowledge that is required for new product launch and commercialization. Still, previous studies have shown no consistent relation among development and new product innovation (Swafford, Ghosh and Murthy, 2006). The simultaneous consideration of product innovation capability and supply chain adaptability enable us to isolate the impacts of both competencies on successful new product launch.

H4: New product launch success is positively related to supply chain adaptability.
H5: New product launch success is positively related to product innovation capability.

Product innovation capability and supply chain adaptability as a mediator
The figure 1 explains the underlying argument that it is essential to combine knowledge with capabilities before having its influence on the performance of organization. It is stated that innovative capabilities and the supply chain of a firm acts as a mediator among successful new product launch and SC intelligence integration, making practical and theoretical sense of their roles (Liao, Hong and Rao, 2010). According to KBV, intelligence integration forms the basis for capabilities, which can influence performance, such as successful new product launch. As external knowledge should be appropriated, absorbed and transferred, it is generally rooted under particular organizational setting (Wong, 2013). In case of this research, innovation capability and supply chain adaptability shows the ways through which appropriations can be achieved. According to practical viewpoint, SC intelligence is generally distributed beyond contrasting organizations. Therefore, initially supply chain intelligence needs to be combined with capabilities before it could influence the performance results (Rao, Chandy and Prabhu, 2008). The following set of hypotheses explains that mediating roles of product innovation and supply chain adaptability allows for the generative role of certain capabilities by which SC intelligence integration affects the new product launch success.

H6: Product innovation capability acts as a mediator in the relation among successful new product launch and integration of customer, competitor, and supplier intelligence.
H7: Supply chain adaptability acts as a mediator in the relation among successful new product launch and integrating customer, competitor, and supplier intelligence.

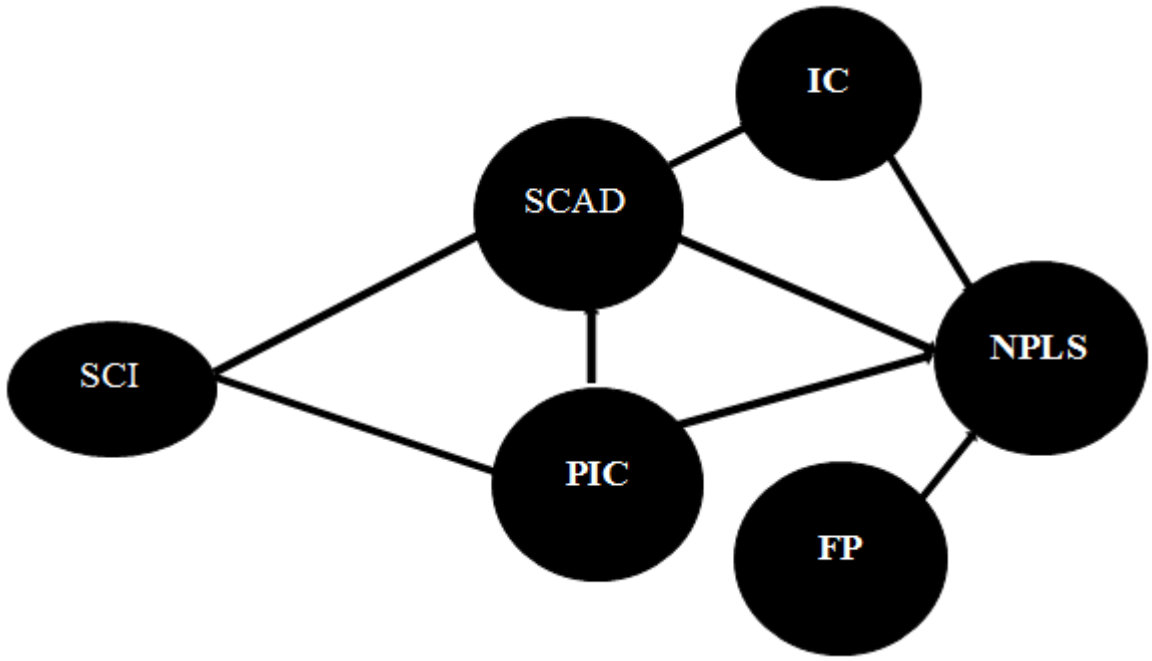
With regards to dynamic capability's view, it is suggested that dynamic capability and supply chain adaptability indirectly increases the new product launch success through affecting its product innovation capability. With reference to (Calantone, Harmancioglu and Droge, 2010) supply chain adaptability is viewed as a general and wider capability which is capable of bringing unrefined operational capabilities in the form of product innovation, in order to provide benefit to the new product launch success. Correspondingly, besides the indirect impact poses by supply chain adaptability through product innovation capability on new product launch success, this mediating hypothesis would allow to separately analyse the indirect and direct impacts of supply chain adaptability.

H8: innovation capability acts as a mediator in the relation among new product launch success and supply chain adaptability.

The literature on new product development suggests that performance of new products significantly affect the financial performance of an organization (Chiang, Kocabasoglu-Hillmer and Suresh, 2012) addition, achieving launch performance excellence is essential for the overall new product performance Under customer-oriented environment having a motto of better, faster, cheaper customer demand, it became essential for a firm to survive in a market. In context of this study, it is stated that efficiency and effectiveness of new product launch must directly transform into firm's greater financial performance (Langerak, Hultink and Robben, 2004). Particularly, financial performance of an organization is expected to enhance when the commercialization performance and product launch budget, execution and timeline are carried out together as compared to its planned objectives.

H9: Financial performance of a firm is positively related with new product launch success.

Figure 1. Conceptual framework



Methodology

The research employed the method of a questionnaire survey for data collection. For this, a total of 431 questionnaires were distributed in various construction organizations. To achieve a high response rate, several reminders were given through phone calls and SMS (Swafford, Ghosh and Murthy, 2006). These efforts results in 295 questionnaires. Almost 17 out of 295 were not completed or useable. These questionnaires lack important responses and information by the participants. Almost 278 questionnaires were processed for further analysis. This response rate is considered somehow sufficient for this research study. According to (Liao, Hong and Rao (2010) the sufficient level of response rate for surveys is considered about 30 percent. The Structural Equation Modelling (SEM) is employed for the present study. It has the ability to simultaneously deal with both linear and multiple regression, assuming that the estimation of variables exhibits no errors. Although, Structural Equation Modelling undertakes factor analysis and multiple regression analysis, therefore, it exhibits more effective means to simultaneously measure the estimators of multiple regression equations (Chiang, Kocabasoglu-Hillmer and Suresh, 2012).

It is a dynamic tool for modelling and analyzing inter-linkages and is capable of handling the analysis involving multiple and non-linear latent independents, correlated independents, measurement errors, latent dependents having multiple determinants, and interrelated error terms. While considering the simultaneous estimation of dependent relationships, it is a powerful tool to deal with measurement errors and can precisely determine the degree of association among the factors. In addition, confirmatory factor analysis is preferred over exploratory factor analysis. Therefore, employing Structural Equation Model for analyzing the invariability of data enables researcher to incorporate number of measures to represent the constructs and carefully handling the specific errors, thus making it easier to prove the validity of a construct.

The present study determines the multiple variables in the form of indirect paths, path analysis, and predictor variables (Langerak, Hultink and Robben, 2004). The questionnaire is designed by including ratio and interval scales as well as adding the measures of constructs, both conceptual and hypothetical in nature. For instance, the selection of SEM was inevitable for the present study. Moreover, it also helps to observe the causal relation among the variables and highlights the unobserved variables and complexity in the analysis.

Results

This study adopts the Structural Equation Modelling (SEM) for analysis due to several reasons. SEM is considered to have equal ability with multiple and linear regression analysis which assumes that variables are evaluated with no errors. Even though SEM involves multiple regression and factor analyses, it has a more effective way of estimating instrument for a number of separate multiple regression equations which it evaluates concurrently (Najafi-Tavani, Najafi-Tavani, Naudé, Oghazi and Zeynaloo, 2018). It is more potent in analyzing and modelling interactions and better in dealing with analysis associated with correlated independents, non-linearity and multiple latent independents correlated error terms and measurement errors, (measured through multiple indicators) and latent dependents with multiple indicators. Equally, when it comes to estimating multiple dependent relationships concurrently, it has a better capacity to take care of measurement errors and the strength of relationship between factors can be determined more precisely. Besides, a confirmatory method of data analysis is more preferred than using exploratory factor analysis, testing hypotheses is also easier. Using SEM to analyse data invariably allows the researcher the use of multiple measures to denote or represent constructs and takes care of specific error which makes it easier to substantiate validity of the constructs under study. Being that this study measures multiple underlying variables as predictors, indirect paths and path analysis. Additionally, with the design of questionnaire which comprised of interval and ratio scales

and also measures of constructs which are highly hypothetical and conceptual in nature such as this study, the choice of SEM becomes inevitable. Furthermore, it helps to show the causal relationship between variables and further explains the complexity and the unobserved variables in the analysis (Najafi-Tavani, Najafi-Tavani, Naudé, Oghazi and Zeynaloo, 2018).

In line with (Hair, Gabriel and Patel (2014) suggestion, a new variable was created as "Respono" in SPSS numbering from beginning to the end of all variables (1 to 502). Standing on the backing of authorities such as deletion of multivariate cases of outliers using SPSS was adopted after running the regression analysis (Hameed, Basheer, Iqbal, Anwar and Ahmad, 2018). The results of regression analysis was computed with respondent number "Respono" as the dependent variable which produced the residual statistics that revealed the minimum Mahanolobis reading (D2) as 2.464 and maximum 277.074 . The value of D 2 which is higher than $\chi 2$ is considered as outliers. Since there are 54 variable items in the research model, the value of $\chi 2$ is 103.442 215 (p=0.000).

Table 1: Reliability

	CR	**AVE**	**Cronbach Alpha**
SCI	0.975	0.872	0.885
SCAD	0.934	0.843	0.874
PIC	0.702	0.737	0.924
IC	0.960	0.871	0.893
FP	0.802	0.832	0.916
NPLS	0.840	0.873	0.943

The aim of evaluating the overall model fit is to ascertain the degree to which formulated hypothesized model is in consonance with the dataset. Goodness of fit (GOF) is an essential aspect of SEM analysis because it ascertains the validity of measurement model (Najafi-Tavani, Najafi-Tavani, Naudé, Oghazi and Zeynaloo, 2018). The purpose of goodness of fit measure is to know if model-based covariance matrix is akin to the observed covariance or not. Some scholars are of the view that there are three indicators of goodness of fit: (1) absolute fit, (2) incremental fit and (3) parsimonious fit. Following the reasoning of most scholars on this note, they suggested that at least one or more measure should be used to determine model fit from each of the type's available to assess the fitness of model. Hence, the three types of indices are briefly explained below. Confirmatory factor analysis was carried out on individual constructs, exogenous and endogenous variables. After this, the researcher tested the Measurement Model of the combined variables. The measurement

model comprised of five exogenous (perceived green knowledge, green perceived value, government regulations, green price sensitivity and green availability) and four endogenous (green purchase intention, green trust, environmental consciousness and perceived behavioural control). The discussion and models for each of these are presented in Appendix I However, having been subjected to CFA, the measurement model came out with a goodness of fit indices such as, Chi-square= 205.265, df =173, Ratio=1.187, CFI = 0.993, GFI = 0.959, TLI=0.990, PNFI=0.715, RMSEA = 0.21 and p= value =0.047; This demonstrates compatibility of the model with data since the indices are in line with acceptable thresholds [34].

The discriminant validity in this study is ascertained through the correlation values and average variance extracted (AVE). According to (Najafi-Tavani, Najafi-Tavani, Naudé, Oghazi and Zeynaloo (2018) the guiding principle to attain the acceptable requirement is that the average variance extracted of two variables being measured should be greater than the square of correlation existing between the constructs under examination.

Bootstrapping is used to test the significance of o indirect effect. Scholars such a (Craighead, Blackhurst, Rungtusanatham and Handfield (2007); (Hameed, Basheer, Iqbal, Anwar and Ahmad (2018) opined that bootstrapping is more rigorous and stronger test than Sobel. In stimulation studies some author's confirmed that bootstrapping has more potency than Sobel test and also the causal steps taken in testing the effect of the mediating variable.

Table 2: Direct Effect

	(β)	**SD**	**T-value**	**P-Values**
H1	0.211	0.135	3.211	0.000
H2	0.357	0.152	3.678	0.000
H3	0.321	0.178	3.321	0.000
H4	0.342	0.165	3.234	0.000
H5	0.453	0.187	3.768	0.000
H9	0.211	0.135	3.211	0.000

Absolute Fit Indices This measure directly shows how well a specified model replicates the observed data. Absolute fit indices provide the most basic assessment of how well the researcher's model fits the supposed data to the degree of replicating actual correlation among constructs. Each model is evaluated independently without exactly comparing the

GOF of other specified models. This type of fit index comprises of statistically non-significant chi-square ($\chi 2$) associated with degree of freedom (df), Goodness of Fit (GFI) and Root Mean Square Error of Approximation (RMSEA). For this study absolute fit indices which will be reported are Chi-square ($\chi 2$), degree of freedom (df), Goodness of Fit (GFI) and Root Mean Square Error of Approximation (RMSEA).

Table 3: Indirect Effect

	(β)	**SD**	**T-value**	**P-Values**
H6	0.211	0.135	3.211	0.000
H7	0.357	0.152	3.678	0.000
H8	0.353	0.287	3.768	0.000

These are relationships which exist between two constructs having a single path which connects them and is referred to as a direct effect. The critical ratio and the p-value are used in order to make certain that paths in the model are supported; to assess this, the CR parameter estimate is divided by estimate of its standard error and the acceptable value is 1.96 (Tabachnick and Fidell, 2014). That is to say that the path is accepted or the hypothesis is supported only if the CR value is up to 1.96. The p-value also stands as another indicator to ascertain if the direct effect is statistically substantiated or not.

Conclusion

Impact of customer, competitor, and supplier intelligence integration on product innovation capability and supply chain adaptability. A degree of organizations' customer, competitor and supplier intelligence integration is positively linked to its proficiency in developing innovative products and to quickly modify SC structure in accordance with the product design and market changes. Firstly, this study is parallel to the works which considered that information gained through external entities is a significant constituent in developing the ability of quickly responding against downstream and upstream markets (Chienwattanasook and Jermsittiparsert, 2018). The prime objective of the current study is to investigate the relationship between firm supply chain performance and firm performance. Meanwhile the study is also interested in investigating the moderating role of information strategy. Using a firms' knowledge-based view, it is hypothesized that higher customer, competitor, and supplier intelligence integration results in higher product innovation and supply chain adaptability (Iyede, Onah and Agu, 2018). Where, intelligence integration refers to the ability of an organization to quickly modify SC in accordance with the product design and market

changes; the product innovation ability refers to the proficiency of an organization to develop new and innovative products. Employing the survey-based methodology, the SEM-CBM technique is used to test the hypothesized relationships. So, the current study has used SEM-CBM as a statistical (Jalloh and Guevera, 2017) tool to answer the research questions raised in this study and research objectives envisaged in the current study. The findings of the study have provided support to the theoretical foundation and proposed hypothesis of the current study. The study will be helpful for policymakers and practitioners in understanding the issues related to supply chain risk, supply chain integration and supply chain performance. To the author's best knowledge this study is among very few pioneering studies on this issue.

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