Examining the Relationships between Supply Chain Integration, Information Sharing, and Supply Chain Performance: A Replication Study

Full paper

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Abstract

This study performs a conceptual replication of the study of Koçoğlu et al. (2011) which explored the effect of Supply Chain Integration (SCI) on Supply Chain Performance (SCP) and Information Sharing using manufacturing firms in Turkey. The replicated study explored the same relationships but considered manufacturing and service firms belonging to one giant supply chain in Ghana. Whilst the results of the measurement model of replicated study are valid and reliable, the structural model results were different from that of the original study. The original study observed a positive significant effect of SCI on SCP which was not confirmed in our study. Instead, a mediating effect of Information Sharing on the relationship between SCI and SCP was observed. The differences in the structural model results may have arisen due to the different conceptualization of the SCP construct, or the existence of different contextual and/or environmental factors.

Keywords

Supply Chain Integration, Information Sharing, Supply Chain Performance, Replication.

Introduction

Competition in most modern markets has forced organizations to integrate tightly with their suppliers and customers in order to meet shared business goals (Koh et al., 2006). Thus, organizations have realized that both intra and inter organizational activities, processes and functions within their supply chains need to be integrated in order to deliver the best customer value at the lowest cost (Barratt and Barratt, 2011). Value-based supply chain relationships can be used to achieve business goals that hitherto have been difficult to achieve by a single organization (Koçoğlu et al., 2011). Information sharing has been touted as a key driver of effective and efficient supply chain management via the speeding up of information flow, shortening of the response time to customer needs, providing enhanced coordination and collaboration, and sharing of risks and benefits (Li and Lin, 2006).

This study performs a conceptual replication (Dennis and Valacich, 2014) of the study of Koçoğlu et al. (2011) which explored the impact of Supply Chain Integration (SCI) on Supply Chain Performance (SCP) and Information Sharing using manufacturing firms in Turkey. Conceptual replications "test exactly the

same research questions or hypotheses, but use different measures, treatments, analyses and/or context" (Dennis and Valacich, 2014, p.3). The results of Koçoğlu et al. (2011) revealed a significant impact of SCI on both SCP and Information Sharing, as well as a positive impact of Information Sharing on SCP. The current study explores the same relationships as Koçoğlu et al. (2011) using data from Ghana, a developing Sub-Saharan African country, while remaining largely consistent with their conceptualization of SCI, SCP, and Information Sharing, although some modifications were made to suit the context of this study.

It has been established that African economies are among the fastest-growing economies in the world (Dadzie et al., 2015). Ghana is one such rapidly developing Sub-Saharan Africa country, attaining lower middle income status in 2011. Economic restructuring policies put in place decades ago are bearing fruit, with the country developing from a primarily agricultural-based economy to one driven by manufacturing and services (Chironga et al., 2011). Ghana's GNI has increased commensurately in recent years relative to other African countries and now stands at US$1,760 (World Bank, 2015). However significant challenges still persist. Ghana ranks low (100 out of 160 countries) in the World Bank global survey of logistics performance, although it's logistics performance index rating of 2.89 was marginally higher than that of the Sub-Saharan Africa region (2.46) but slightly lower than the average rating of lower middle income countries (2.59) (Arvis et al., 2014). The latest World Bank annual survey of ease of doing business also indicates that the country ranks 70 out of 189 countries (World Bank, 2015). The replication study focused on firms belonging to the supply chain of one giant international corporation based in Ghana. The company in question is a manufacturing firm that has multiple plants in the country as well as an expansive distribution network that stretches across the whole country. Thus the responding firms in the present study were from both manufacturing and service sectors. The use of both manufacturing and service firms, with all the firms being part of the same supply chain presents a new context, in addition to the different geographic context of this study, thereby strengthening the effect of the replication in terms of extending the model beyond its original contextual boundary (Tsang and Kwan, 1999).

While the results of the measurement model were consistent with those of the original study, those of the structural model were not exactly the same as in the original study. Our study observed a mediating effect of the Information Sharing construct on the relationship between SCI and SCP. Overall, the results offer both practical and theoretical implications which are discussed later. The replication is relevant to the information systems discipline since information systems has been found to play key role in the integration of supply chains and information sharing (Zeier et al. 2008) and building a cumulative study (Asamoah et al., 2015; Tsang and Kwan, 1999).

The rest of the paper is organized as follows. The theoretical model and results of the original study are presented next, followed by the research model of the current study. The research methodology, data analysis and discussion follow next. Finally, we present the conclusions and implications of the study.

Research Model and Hypotheses

This study largely adopted the Koçoğlu et al. (2011) model which investigated the relationships between three constructs – SCI, SCP, and Information Sharing. Most studies on SCI and information sharing have explored the latter as a dimension of SCI (e.g., Kannan and Choon Tan, 2010; Lau et al., 2010; Liu et al., 2013). Koçoğlu et al. (2011) stands apart in the literature by clearly delineating the two concepts as separate constructs to be explored independently (Chatzoudes and Chatzoglou, 2015). However no follow up studies have been reported for this novel approach to viewing SCI and information sharing. The present study continues with this approach, and views SCI and information sharing as separate factors that interact to influence SCP.

The original study conceptualized SCI, SCP, and Information Sharing as second-order reflective constructs. SCI was conceptualized with three sub-constructs (Integration with Suppliers, Integration with Customers, and Intra-Organizational Integration). The Information Sharing construct had four sub-constructs – Information Sharing with Customers, Information Sharing with Suppliers, Inter-functional Information Sharing, and Intra-Organizational Information Sharing, whilst SCP was conceptualized with four sub-constructs (Expenses of Costs, Utilization of Assets, Supply Chain Reliability, and Responsiveness and Flexibility). The original study observed a direct positive impact of SCI on SCP and Information Sharing, as well as a direct positive impact of Information Sharing on SCP. The research

model and results of the structural model in the original Koçoğlu et al. (2011) study are presented in Figure 1.
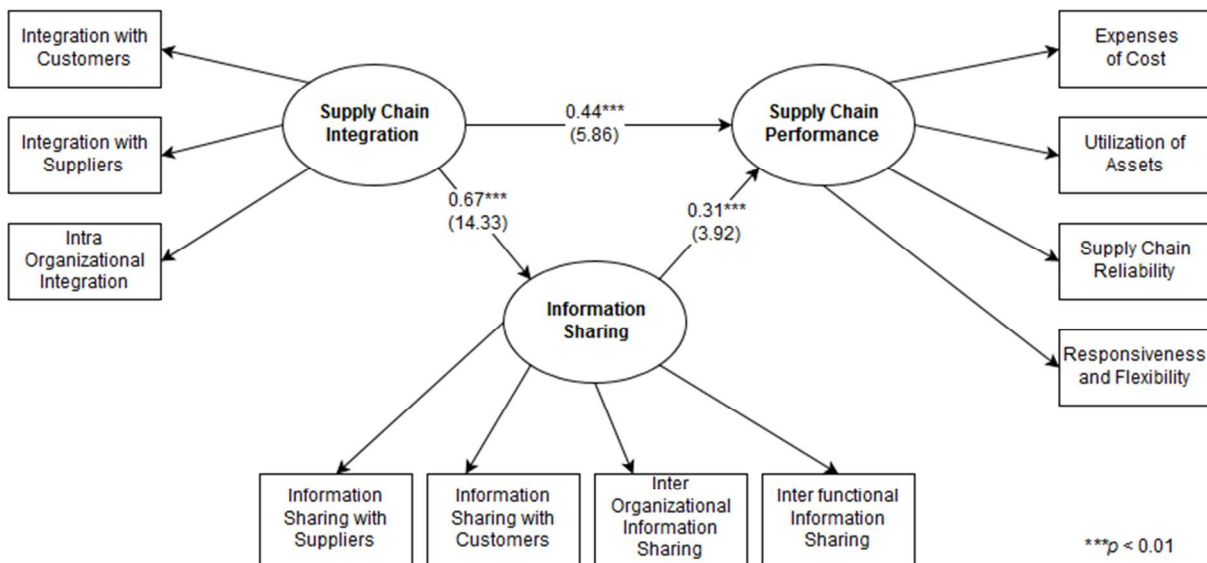
Figure 1: Research Model and structural model results of the original study

In the current study, the conceptualization and operationalization of the SCI and Information Sharing constructs remained unchanged from the original study as they were deemed to be separate factors and accurately measured their respective concepts within the Ghanaian environment as well. The conceptualization of SCP in this study was however was modified to fit the context of this study. Close inspection of the SCP construct, its sub-constructs and items revealed they were more directed at measuring SCP for manufacturing firms, which was the case in the original study. In our study however, both manufacturing and service firms were considered, meaning that the original items were not suitable for our study. We thus adopted SCP as conceptualized and operationalized in the study of Won Lee et al. (2007). The study of Won Lee et al. (2007) explored the effect of supplier linkages, customer linkages, and internal linkages on SCP, and considered both manufacturing and service firms, thus fits well with the context of the present study. In Won Lee et al. (2007), SCP was conceptualized as a second-order construct with Cost Containment and Reliability as its dimensions. The two sub-constructs are key indicators for measuring SCP and have widely been employed in prior relevant studies (e.g., Beamon, 1999; Li et al., 2006). We contend that adopting these sub-constructs enhances the validity and generalizability of the SCP construct and the research model within the new context, and allow us to measure SCP of both manufacturing and service firms in Ghana.

The modified research model and hypotheses used for this study are presented in Figure 2 below. The hypotheses driving the study are developed and discussed in detail in Koçoğlu et al. (2011). Detailed discussions of the development of the SCI and Information Sharing constructs and their dimensions can be found in Koçoğlu et al. (2011) while the SCP construct and its dimensions are discussed in Won Lee et al. (2007).
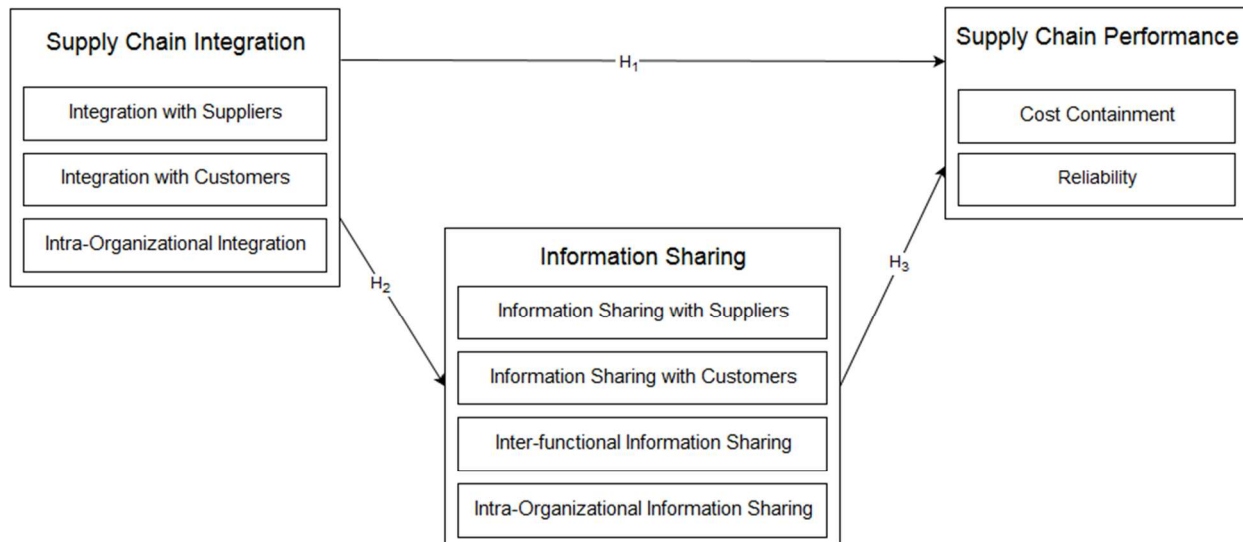
Figure 2   Research Model and hypotheses

Hypothesis 1: SCI positively influences SCP

Hypothesis 2: SCI positively influences Information Sharing

Hypothesis 3: Information Sharing positively influences SCP

Research Methodology

Scholars lament on paucity of replication studies in information systems and management disciplines and call for more of such studies (Berthon et al., 2002; Dennis and Valacich, 2014; Tsang and Kwan, 1999). Various mechanisms have been employed to classify replication research. Berthon et al. (2002) identified three kinds of replication studies – pure replication, extensions, and pure generation studies. The present study falls into the extension category which has been defined as "a duplication of a target study in which one or more key parameters are altered" (Berthon et al., 2002, p.419). Dennis and Valacich (2014) in their categorization of replication studies identified exact, methodological, and conceptual replications. The present study can be described as a conceptual replication as it tests the same research questions and hypotheses, with the context and measures being different from the focal study.

While the original study was based on an empirical investigation of 158 manufacturing firms in Turkey, the replication utilized firms that form the supply chain of one giant international corporation based in Ghana. The responding firms operate in manufacturing and service sectors. Using firms in a single supply chain presents a new context in addition to the different geographic context thereby strengthening the effect of the replication in terms of extending the model beyond its original contextual boundary. Interactions with managers of the company revealed over 250 firms that formed part of the company's supply chain across the country. However, the study focused on the company's direct suppliers, wholesalers, and major distributors, which totaled a hundred and fifty three.

The questionnaires were targeted towards managers who performed the supply chain management function within the organizations. All 153 firms were targeted for data collection and contacted to participate in the research. However, 25 firms declined participation in the study. Questionnaires were administered to the remaining 128 firms, with one questionnaire administered to each firm. All 128 responses were returned, but 12 questionnaires had considerable missing data (more than 10% of total responses missing), whilst an additional 6 were unusable. Thus a total of 110 usable questionnaires were obtained, constituting a fairly high response rate of 71.89%. The responses received were analyzed using

Partial Least Squares Structural Equation Modelling (PLS-SEM) procedures that use advanced multiple regression techniques to estimate the strength and significance of the hypothesized relationships.

Data analysis and Discussion

Demographic Data

The demographic data indicate that majority of the responding firms (about 52.7%) were in the Construction industry, with Retail constituting 15.5% of firms, and Manufacturing contributing 6.4%. This was followed by automobile and heavy equipment with 2.7%. However 10% of respondents indicated that they belonged to other industries, and a further 16.4% of responses were missing.

Industry Classification	Frequency	Percent	Cumulative Percent
Manufacturing	7	6.4	6.4
Financial Services	2	1.8	8.2
Oil and Gas	2	1.8	10.0
Construction	47	42.7	52.7
Retail	17	15.5	68.2
Transportation	2	1.8	70.0
Computers and Electronics	1	0.9	70.9
Automobile and Heavy Equipment	3	2.7	73.6
Other	11	10	83.6
Missing	18	16.4	100.0
Total	110	100	
Firm's Annual Revenue (in Ghana Cedis)	**Frequency**	**Percent**	**Cumulative Percent**
less than 50,000	27	24.5	24.5
50,000 to 500,000	49	44.5	69.1
500,000 to 1 million	7	6.4	75.5
1 million to 5 million	2	1.8	77.3
More than 15 million	5	4.5	81.8
Missing	20	18.2	100.0
Total	110	100.0	
Number of Employees	**Frequency**	**Percent**	**Cumulative Percent**
Less than 60	44	40.0	40.0
60 to 99	28	25.5	65.5
100 to 499	14	12.7	78.2
500 to 2,000	4	3.6	81.8
Missing	20	18.2	100.0
Total	110	100.0	

Table 1. Demographic data of responding firms

Majority of respondents (44.5%) indicated a revenue range of GH¢50,000 to GH¢500,000, followed by annual revenues less than GH¢50,000 (about 24.5% of responses received). There were 14 firms reporting revenue greater than GH¢500,000, and 18% missing responses. Finally, 40% of firms reported an employee size of less than 60, with 25.5% of firms indicating an employee size range of 60 to 99. In all,

about 16.3% of the participating firms had more than 100 employees. There were however a sizable number of missing responses for this demographic data as seen in Table 1 above.

Measurement Model Validity

We assessed the validity of the measurement model in order to explore the hypothesized relationships between SCI, Information Sharing and SCP. Item loadings were examined to ensure that they were sufficiently high (0.7 or higher) and that all items loaded higher on their own constructs than on other constructs (Hair et al., 2010). Five items (Int_Org8, Int_Cus6, IS_IO5, SCP_Rel5, and IS_Sup3) failed to meet this criteria and were eliminated from further analysis.

Further, the attributes of the constructs were tested by measuring the psychometric properties of the constructs. Convergent validity was investigated by assessing the average variance extracted (AVE), composite reliability and Cronbach Alpha for acceptable quality. The AVE of all the constructs were higher than 0.5 as required (Barclay et al., 1995). Composite Reliabilities values were very high (greater than 0.9), exceeding the recommended 0.7 threshold (Chin, 1998). Finally, Cronbach Alpha values also exceeded the 0.7 threshold (Hair et al., 2010). This confirms adequate convergent validity for the research model. The summary of the psychometric properties of the constructs are presented in Table 2.

Constructs	AVE	Composite Reliability	R Square	Cronbach Alpha
Cost containment	0.6877	0.9167	0.8927	0.8865
Integration with Customers	0.6824	0.9148	0.4898	0.8833
Intra Organizational Integration	0.6542	0.9296	0.8422	0.9112
Information Sharing with Customers	0.6845	0.9151	0.6911	0.8835
Inter-functional Information Sharing	0.6317	0.9230	0.7636	0.9030
Intra-Organizational Information Sharing	0.7224	0.9122	0.7349	0.8714
Information Sharing with Suppliers	0.7749	0.9117	0.6982	0.8547
Reliability	0.7521	0.9237	0.8714	0.8894
Integration with Suppliers	0.6392	0.9139	0.8620	0.8867

Table 2. Psychometric properties of the research constructs

Discriminant validity was investigated by comparing the square root of the AVE of each construct to the correlation of that construct with other constructs. Discriminant validity is achieved when the AVE for each construct is greater than 0.50 and the square root of the AVE for a construct is greater than the correlation of that construct with other constructs (Fornell and Larcker, 1981). Appendix 1 compares the square root of the AVE of each construct (bolded) against the correlation of constructs with each other. All bolded numbers are greater than the correlations, depicting adequate discriminant validity.

Structural Model Validity

After confirming adequate measurement model validity, we proceeded to explore the structural model validity by examining the relationship between SCI, Information Sharing, and SCP. The results of the hypotheses test are presented next.

Results of direct effects

The PLS analysis of the direct impact of SCI on SCP did not show a statistically significant relationship (β = -0.032; t = 0.296), thus Hypothesis 1 was not supported. That is higher levels of SCI did not necessarily result in higher SCP. This result fails to agree with the original study by Koçoğlu et al. (2011) who observed positive significant impact of SCI on SCP. The direct effect of SCI on Information Sharing on the

other hand was statistically significant (β = 0.716; t = 13.768; p < 0.01), and the direct effect of Information Sharing on SCP was similarly significant (β = 0.766; t = 7.070; p < 0.01), as reported in Table 3. Thus Hypotheses 2 and 3 supported the results of the original study. A comparison of the results of the present study and the original study is presented in Table 3.

Hs	Hypothesized paths	Koçoğlu et al. (2011)		Our results	
		Path Coefficient (Critical Ratio)	Hypothesis Support	Path Coefficient (Critical Ratio)	Hypothesis Support
H1	SCI → SCP	0.44 (5.86) ***	Supported	-0.032 (0.296)	Not supported
H2	SCI → Information Sharing	0.67 (14.33) ***	Supported	0.716 (13.768) ***	Supported
H3	Information Sharing → SCP	0.31 (3.92) ***	Supported	0.766 (7.070) ***	Supported

*** *p* < 0.01

Table 3   Results of hypotheses effects

The results indicate a not significant direct relationship between SCI and SCP, but the effect of SCI on Information Sharing, and the effect of Information Sharing on SCP were both significant. This raises the possibility of an indirect (mediating) effect of SCI on SCP through the Information Sharing construct. This possible mediating role of Information Sharing is explored next.

Test for mediating effect of Information Sharing

We tested the possible mediating effect of Information Sharing using the mediation test procedure described by Baron and Kenny (1986). There is a mediating effect if (i) the independent variable (SCI) predicts the dependent variable (SCP), (ii) The proposed mediator (Information Sharing) is predicted by the independent variable (SCI) and predicts the dependent variable (SCP), and (iii) the direct effect of the predictor (SCI) on the dependent variable (SCP) is either no longer significant (for full mediation) or is reduced in strength (for partial mediation) when the mediator (Information Sharing) is added (Baron and Kenny, 1986). The results of the tests are presented in Table 4.

Relationship	Mediating Factor	Path Coefficient	t- value	R-Square
SC Integration → SC Performance	No factor	0.516	7.054***	0.266
SC Integration → SC Performance	Information Sharing	-0.032	0.285	0.553
SC Integration → Information Sharing	-	0.716	14.234***	-
Information Sharing→ SC Performance	-	0.766	7.106***	-

*** *p* < 0.01

Table 4. Results of test for Mediating Effect

The results from the mediation test presented in Table 4 shows that the direct effect of SCI in the absence of the mediating factor was positive and significant at p < 0.01. With the introduction of the mediating factor however, the direct effect between SCI and SCP becomes not significant with a negative path coefficient. Further, both the direct impact of SCI on Information Sharing (β = 0.716; t = 14.234) and Information Sharing on SCP (β = 0.766; t = 7.106) are positive and significant. Also, the R^2 of SCP jumps from 0.266 to 0.533 with the introduction of the Information Sharing construct. The behavior of the Information Sharing construct confirms a significant full mediating effect of Information Sharing on the relationship between SCI and SCP (Baron and Kenny, 1986).

The findings of the study firstly confirms the widely held view that SCI enhances SCP. Beyond this however, the study sheds some new light on the nature of this positive effect. Most previous studies that have observed a positive impact SCI on SCP had conceptualized information sharing as a dimension of SCI (e.g., Kannan and Choon Tan, 2010; Lau et al., 2010; Liu et al., 2013). The findings of this study however points to the fact that it may have been the information sharing component embedded in the SCI construct that is driving SCP. The study suggests that SCI enhances SCP by enhancing the information flows within and across the supply chain. This confirms the important role information management plays in enabling effective supply chain management and enhancing SCP. A breakdown in vital information sharing with customers and suppliers, as well as inter-organizational or intra-functional information sharing may thus scupper potential SCP gains, regardless of the level of SCI achieved. The positive full mediation of Information Sharing on the relationship between SCI and SCP also suggests that one way firms in a supply chain can improve their SCP is to enhance their level of information sharing within and across the supply chain.

Conclusion

The study conceptually replicated the study of Koçoğlu et al. (2011) to explore the effect of SCI on SCP, as well as the role of Information Sharing in the relationship between SCI and SCP. While the results of the measurement model were consistent with those of the original study, those of the structural model were not exactly the same as in the original study. The positive direct impact of SCI on Information Sharing and of Information Sharing on SCP was confirmed in our study, however the direct effect of SCI on SCP observed in the original study was not confirmed in our study. Instead, a mediating effect of Information Sharing on the relationship between SCI and SCP was observed. Overall, the results offer both practical and theoretical implications. First we have demonstrated the relevance of the theoretical model in a different context. The results of the measurement model were sound and consistent with those of the original study. Further, the SCI, Information Sharing and SCP constructs that originate from a developed nation are relevant in the sub-Saharan African environment as well.

The interplay between SCI, SCP, and Information Sharing in a supply chain as observed in this study provides further interesting insights that are relevant to both academics and business practitioners alike. First, the study confirmed that SCI positively impacts on SCP, but it does this by enabling higher information sharing within and across the supply chain. We suggest that supply chain information sharing may have an unnoticed capability driving SCP in previous studies that have explored the effect of SCI on SCP. The mediating role of information sharing in enhancing SCP needs further exploration and theorizing by information systems and supply chain management scholars. The ultimately positive effect of SCI on SCP observed in the study further bolsters the line of reasoning put forward by previous studies and confirms results of previous studies. For business practitioners, the findings of this study provides insight for effective SCI decisions. We encourage business managers to invest in initiatives that would increase the level of SCI as this would result in higher SCP for firms. Also, the positive mediating effect of Information Sharing on the relationship between SCI and SCP means that the dimensions of the Information Sharing construct (that is Information sharing with customers, Information sharing with suppliers, Inter-functional information sharing, and Intra-organizational information sharing) represent important concerns that business practitioners must pay attention to and ensure are functioning smoothly in order to keep enjoying positive results from their SCI initiatives.

The differing results of this study with the original study do not contradict the original study, and may have arisen due to a number of factors including different conceptualization of the SCP construct, the focus on both manufacturing and service firms in this study as against only manufacturing ones in the original study, and the focus on firms belonging to one supply chain in the present study. Additionally, unique contextual forces operating within the Ghanaian and Sub-Saharan environment may have influenced the results (Asamoah et al., 2015). This raises the need to explore the role that the Ghanaian and Sub-Saharan African environment may have played in arriving at the results. Thus, the differences in results between the original study and the current study offer opportunities for more studies to enhance the understanding of the original model in terms of theoretical conceptualization as well as generalizability in different contexts to generate new knowledge.

There were a few limitations with regard to the conduct of this study. First, the survey was centered only on firms that are part of the supply chain of a giant firm in Ghana. Whilst this not a limitation on its own,

it means the findings of this study are not easily generalizable to other firms in other supply chains. Further, we depended fully on responses received for data, and could not independently verify them. This study focused on the impact of SCI on SCP and the role of Information Sharing among firms of a supply chain in Ghana. The study generated interesting results that are both different to the original study, and provide new knowledge. Further research is however needed to corroborate the results of this study and to create better understanding of the relationship between SCI, Information Sharing, and SCP.

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