Examining the Effects of Information Systems Usage and Managerial Commitment on Supply Chain Performance: The Mediating Role of Supply Chain Integration

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Abstract
The aim of the study is to investigate the effect of Information Systems Usage on Supply Chain. Information systems involve creating specific environment for the fulfilment of organizational strategy. However, information system affords an organization an enormous benefit that materializes in the long-run. Unfortunately, realization of information system is also accompanied with risk which mostly deters management from taking the initiative hence missing out on the intended benefits of implementing information system usage in organizations. Without overemphasizing the crucial role played by information system in the supply chain performance, this study seeks to focus on investigating the effect of Explorative Information Systems Usage and Exploitative Information Systems Usage on Supply Chain Performance. Even though Information Systems is an increasingly important element of academic research and discussions, there seems to be no consensus in the extant literature on the impact of information systems (IS) usage on the supply chain. Most importantly the study investigates moderating functions of supply chain integration (SCI) and managerial commitment (MC). Survey instruments were collected from manufacturing companies in Ghana. Simple random sampling was used to select 100 companies of which 1,300 respondents were identified, and questionnaires were administered. The study showed that Managerial Commitment, Explorative Information Systems Usage, and Exploitative Information Systems Usage impact significantly and positively on Supply Chain Performance. Additionally, the findings concluded that Supply Chain Integration, specifically operational integration significantly and positively mediates the relationship between the usage of Information Systems and Performance of Supply Chain. In this regard, these results imply that operational integration between partners can help influence the performance of supply chains.

Keywords
explorative information systems usage, exploitative information systems usage, supply chain performance, managerial commitment, supply chain integration, information integration, operational integration, and relational integration

Introduction
The recent coronavirus pandemic, COVID-19, is spreading and disrupting global business functions in ways that are difficult to evaluate and model. Increasingly, researchers are getting concerned about achieving comprehensive value capture (both qualitative and quantitative) within the supply chain performance (AlMulhim, 2021; Zhang et al., 2021). For example the qualitative metrics like customer satisfaction and product quality, and the quantitative metrics like flexibility, supply chain response time, order-to-delivery lead time, resource utilization, and delivery performance have all become key areas of research (Sharma, Luthra, et al., 2020; Sharma, Shishodia, et al., 2020). Information Systems Usage (ISU) in supply chain has turned out to be a crucial digital transformation instrument for firms’ operations in meeting the ever-changing consumer needs (De Camargo Fiorini & Jabbour, 2017), which translates into performance. Information systems can be used, especially as a catalyst in facilitating the entire process of supply chains.
ISU and exploitative ISU and assessing their subsequent influence using derivatives of ISU and ambidexterity herein explorative and exploitative ISU, which seek to explain the innovative means through which organizations can utilize information systems for strategic outcomes, and it is imperative to increase managerial commitment (Kull et al., 2019). Managerial commitment levels may influence the rate at which firms invest in ISU for strategic outcomes, and it plays a critical function in the creation of specific business environments and strategies (Kull et al., 2019). With IS becoming a chief component in the integration of supply chains, this study seeks to examine how SCI will mediate the connection between ISU and SCP.

Supply Chain Integration (SCI), however, is referred to as a series of actions which are related to rigid organization and coordination of the flow of products within supply chain framework, this includes value creation, logistics, course of operations, and optimization processes; considering the principles of information flow (De Camargo Fiorini & Jabbour, 2017). Specifically, SCI in this study refers to information integration, operational integration, and relational integration (Barbosa et al., 2018; Kembro et al., 2017). Meanwhile supply chain performance is defined as the gross performance of a firm in managing the supply chain process (Wu et al., 2014). To achieve supply chain performance (SCP), it is imperative to increase managerial commitment (Kull et al., 2019). Managerial commitment levels may influence the rate at which firms invest in ISU for strategic outcomes, and it plays a critical function in the creation of specific business environments and strategies (Kull et al., 2019). With IS becoming a chief component in the integration of supply chains, this study seeks to examine how SCI will mediate the connection between ISU and SCP.

Although there have been several studies on ISU (Wu et al., 2014) and ambidexterity actions (explorative and exploitative activities; Ardito et al., 2020; Kristal et al., 2010) as separate independent factors and their effects on supply chain performance, there is no known study on the derivatives of these factors acting together to influence supply chain performance. This has left scholars to contemplate the role innovative initiatives play in the success of supply chain performance as far as information system usage is concerned (Nasiri et al., 2020). Thus, there are no known effects on SCP of explorative and exploitative ISU, which seek to explain the innovative means through which organizations can utilize information systems to maximum performance within the supply value chain considering the barriers in implementing information sharing process (Benitez et al., 2018; Kembro et al., 2017). This article therefore seeks to find solution to this scholarly dilemma by using derivatives of ISU and ambidexterity herein explorative ISU and exploitative ISU and assessing their subsequent influence on the entire supply chain performance.

In this regard, the research will seek to contribute to literature firstly, by presenting SCI as a resource capable of delivering competitive advantage as explained by both the Resource Based View and Relational View theories. Second, the study identifies an apparent theoretical gap in prior research concerning the need for unifying theories that explain the combination of resources and networks. For example, organizational resources, capabilities, and strategic assets that a company benefits from, may not be sufficient in a supply chain relationship because, due to the network relationships that exist in a supply chain partnership, firms can increase performance and profits (Jayaram & Tan, 2010; Levy, 1996). Third, it extends the ISU concept by testing its applicability in a developing world context. This presents an alternative for investigating the value of supply networks. Lastly, the study clarifies that internal ISU capabilities enhances SCP.

Theoretical Foundations

The Resource-Based View (RBV) and the Relational View (RV) are key theories used in the explanation of how firms consume and create value as they pursue their strategic and operational objectives (Golicic & Smith, 2013). While RBV provides effective analysis on the firm level, the RV provides more insight into a network environment (Huo et al., 2016). The RBV theory highlights those resources that, due to relationships and inter-firm collaborations, could be used to deliver unique capabilities (Sheu, 2004). All capabilities and competencies developed and owned by a firm or group of firms could be deemed a resource (Golicic & Smith, 2013); and where firms integrate their operations and processes for the attainment of individual and group goals as in the case of supply chains, the effective harmonization of the integration effort makes the ISU a valuable resource capable of delivering a competitive advantage.

Kagan et al. (1990) posit that RBV provides an effective means of understanding ISU within firms through the harnessing of organizational resources, capabilities, and strategic assets. SCI is a key resource that enables firms to establish relationships. Firms develop strategic relationships founded on openness, mutual trust, and shared risk to enhance sustained commitments (Cagliano et al., 2006). Managing a supply chain is practically impossible without strategic partnerships founded on shared benefits and risks (Jayaram & Tan, 2010; Prajogo & Olhager, 2012). Jayaram and Tan (2010) argue that through strategic integration firms get valuable resources and advisory services in handling turbulent situations.

The Relational View (RV) theory explains the significance of relational assets to supply relation chains. Wu et al. (2006) revealed that rents yield two benefits when managed appropriately—internal and relational rents. The relational rents relate to supernormal profits that are generated by firms and individuals due to the relationship they establish with
their collaborative partners. It is thus fair to say that RV extends RBV to include IS and supply chain resources in meeting group goals (Levy, 1996).

**Hypotheses Development**

**Explorative Information Systems Usage and Supply Chain Performance**

Explorative ISU for the purpose of this article is referred to the sharing of information among stakeholders to generate an alternative business process to create new opportunity or new product or new market in order to enhance supply chain activities in the long-term. This concept involves business processes such as planning, developing, and executing business activities (Lumineau & Oliveira, 2020). In this context, explorative ISU should have a positive relationship with performance, however, appropriately integrating it with supply chain system performance should be enhanced (De Camargo Fiorini & Jabbour, 2017). Schildt and Keil (2005) posit that trends in sales performance could be enhanced when information systems are used. A similar research by Hemmatfar et al. (2010) reveal that the use of information systems helps firms to better integrate functions internally and with external partners. More innovation emerges, enabling the firms to venture into new markets to take up new opportunities that creates new business value (Lu & Ramamurthy, 2011). Explorative ISU has been shown to facilitate the development of competitiveness of firms in supply chains due to the timesaving attributes, cost-reduction, reduction in returned orders, and meeting varied customer demands (Rai & Tang, 2014). Through exploration, supply chain partners are more able to accommodate complexities in varying information systems’ data processing requirements and are much better placed to plan collaboratively with partners. For this reason, the first hypothesis of the study is presented as:

**H1: Explorative information system usage positively influence supply chain performance**

**Exploitative Information Systems Usage and Supply Chain Performance**

Exploitative ISU is defined as the operational use of IS resources to support the goals of firms and their supply chains. By leveraging on existing IS, firms expand their IS capabilities in serving supply chain partners (AlMulhim, 2021; Frank et al., 2019). Information system is entrenched in organizational process through technology and sharing of technology (Frank et al., 2019). This allows repetitive or routine usage of information system within an organization, this situation offers internal speedy and flexibility to serve, and process operations faster (Kembro et al., 2017). Units can rely on one other to execute actions, collaborate on platforms, develop joint architecture that helps each other, and engage in application adoption standards that facilitate easy processing of data across individual unit systems (Nasiri et al., 2020). Luo and Ling (2013) posits that the operational use of information systems usually leads to clearly defined benefits like process efficiency, process consistency, and a net reduction of cost, thus enhancing efficiency. This enhances the speedy delivery of goods, and or services to partners (Dehning et al., 2007).

In a related research, Benitez et al. (2018) asserted that information technology influences exploitative capability of a firm, a situation which improves the operational competence thereby enhancing organizational performance. In this vein, the following hypothesis can be suggested:

**H2: Exploitative information system usage will impact supply chain performance positively**

**Managerial commitment (MC)** deals with the willingness of managers to implement and monitor decisions believed to yield maximum benefits for the organization and its supply chain partners. MC implies managers create compatible philosophies with those of partners for the attainment of shared goals, and provide personal leadership for meeting specific goals that have been set on both firm and group levels (Chopra & Sodhi, 2004; Li & Wang, 2007; Zhou & Benton, 2007). There is evidence in management literature that confirms the importance of managerial support for project success, and this management role is deemed the utmost factor to achieve competitive edge over rivals (Devece et al., 2017). Managers commit resources, show ownership, provide vision, embody values, and culture that promote value delivery across the supply chain and, finally, set the rules of the game.

According to Kim et al. (2010), management plays enormous role in enhancing the performance of supply chain performance. This is because management has the tendency of allocating resources and providing guidance to staff, the directions of the organization. This, however, has the potential to win trust from partners and other actors. Similarly, Gunasekaran et al. (2017) posit that management behavior has the propensity of assimilating technology in organizational processes. Thus, through the actions of managers, there is the acceptance of technology in the organization which then leads to operationalization of this technology i.e. information system, in turn, influences supply chain performance. Subsequently, Gunasekaran et al. (2017) argued that management commitment plays indirect but positive role on SCP. With this, it is however, safe to suggest that:

**H3: Managerial commitment has a positive effect on supply chain performance**

**Mediating Effect of SCI**

Informational integration relates to the sharing of data and information among actors within the supply chain operations (Olugbenga & Rafiat, 2015); as the skill to obtain and share
information reduces the rate of returned orders (Gorla et al., 2010). A study by Venkatraman et al. (1993) on the benefits of SCI concludes that firms which have higher information integration are better in forecasting and planning operations more collaboratively as compared to firms relatively low level. Li and Huang’s (2013) study reveal that the higher the information integration in supply chain functions, the greater the information exchange between supply chain participants and the greater the potential to enhance a firms’ inventory flow performance relative to firms that give little attention to information integration.

**Operational Integration**—Supply chain partners integrate activities and operations through information and data sharing. It ensures that firms in a supply chain operate as a virtual firm (Yang & Su, 2009) with no physical boundaries. An interesting study on operational integration revealed that firms that encourage high operational integration are better able to encourage joint planning (Luo et al., 2015). Operational integration enhances the sharing of data and market information, and helps in the diagnosis of issues on time (Luo & Ling, 2013). Information systems allows firms to integrate their operations on both intra and inter departments’ levels, blurring functional areas, and ensuring a coordinated and collaborated supply chain with aligned processes, information flows, and visions (Boyer & Hult, 2005). This in turn improves supply chain performance due to the inefficiencies that arise.

**Relational integration** constitutes a cohesive inter-relation between firm and related stakeholders in line with its core activities (Qrunfleh & Tarafdar, 2014). This also considers how firms are better able to relate with customers and their suppliers while undertaking supply chain functions. Beamone (1999) indicated that although the key aim of supply chain partners is to meet high-performance outcomes, there is the need for firms to pay attention to relational issues in building complementary organizational structures in aiding partners achieve agreed goals. Yu et al. (2001) posited that firms with high relational integration are better able to give satisfactory performance resulting from personal working relationships. This implies that relational integration in supply chains comes with more benefits to firms, and it is in the interest of firms to consider how to use information systems to tap into relational assets. In view of the above, it therefore hypothesized that:

**H4:** Explorative information systems usage has a positive relationship with information integration

**H5:** Explorative information systems usage is positively linked to operational integration

**H6:** Explorative information systems usage will positively relate to relational integration

Operational integration concerns the capabilities that enable the alignment of supply chain resources at both the inter and intra firm level, and these resource usages are necessary for attaining supply chain goals (Dyer & Singh, 1998; Liu et al., 2013).

Information system use and the accompanying exchanges enhance the attainment of operational integration, and shared operational assets help supply chain partners to improve their individual performances (Zhou & Benton, 2007); however, according to Leuschner et al. (2013), there is no significant association with the variables, operational integration, and supply chain. Operational integration allows for the use of collaborative assets, joint planning, shortened lead times, and the avoidance of information distortions among supply chain partners (Liu et al., 2013). It also helps firms advance their competitiveness and sustain performance (Vanpoucke et al., 2017). To this end, it is hypothesized that:

**H7:** Operational integration is positively linked to supply chain

**The Mediation Effect of Operational Integration**

Some extant literatures have found differing influence of ISU on the performance of firms. Li et al. (2009) indicated that ISU have an indirect effect on performance, and that the relationship is plausible through SCI. This hints of a mediation role of SCI in the relationship between ISU and SCP. The relationship between SCI and firm performance has been well established as well as the mediated relationship with SCI on dimensional lines, with different results (Chang et al., 2016; Leuschner et al., 2013).

Operational integration, as a dimension of SCI, also encompasses the use of IS to address supply chain challenges as and when they arise, with ISU helping partners achieve goals when applied at the appropriate level of integration (Leuschner et al., 2013). ISU leading to operational integration provides partners with the ability to synchronize their operations to ensure that there is easy flow of information and materials to help check information asymmetry that often characterizes supply chain operations (Rai & Tang, 2014; Figure 1). For this reason:

**H8:** Operational integration mediates the path between explorative ISU and SCP

**Design Methodology**

**Developing/Designing Instrument**

In measuring the items for the embedded constructs, cues were taken from prior studies. This was to help in improving the validity of the study as far as content is concerned (Straub et al., 2004). A total of seven constructs, with each comprising
of multiple items, were used for the questionnaire. Some items, however, were adopted to fit the context of the study. We pre-tested the instruments in interviews with 20 supply chain practitioners who had 7 to 10 years of work experience in the supply chain industry in Ghana. The purpose was to evaluate the understanding of participants of the survey questions and the face validity of the measures of the variables. Expert opinions were solicited and inculcated into the designing of the questionnaire to get a comprehensive picture. An initial survey with 75 respondents was to test the validity of the instrument. Preliminary results through EFA indicated a positive validity of the instrument.

**Measures**

We present all the measures for the constructs in the Appendix. In measuring Information Integration, six items were implemented from Rajaguru and Matanda (2013) and Narasimhan and Kim (2002). These items asked about the extent to which the respondents’ information systems have built in functions to facilitate collaboration in supply chain partners. We measured operational integration by asking about the extent to which they shared databases or information systems that are used for joint forecasting among supply chain partners. The three items were adopted from Basnet (2013) and Rajaguru and Matanda (2013). Relational integration is measured using four items asking the informant to specify the degree to which their supply chain partners work together to help achieve shared goals. These items were adapted from Kahn and Mentzer (1998) and Gimenez and Ventura (2003, 2005). We adapted four times from Rajaguru and Matanda (2013) and Boyer (1996) to measure managerial commitment in the day-to-day running of the firm. Exploitative Information System (IS) usage was adapted from Luo and Ling (2013), which sort sought to measure the extent to which, for example,
the management of warehouse stock are enhanced using information system solutions. It was measured with two items. Explorative Information System (IS) usage was measured with five items. The items were adapted from Boynton et al. (1994). One of the questions here, for example, measured the extent to which "new business opportunities are enabled using information systems solutions." Lastly, the dependent variable, supply chain performance, was measured with three items adopted from Graham et al. (1994), Chan and Qi (2003), and Parker and Axtell (2001). The items measured were done using English language and were scaled using a five-point Likert. These points ranged from strongly disagree signifying (1) to strongly agree representing (5).

**Data Sampling and Collection**

A survey instrument was adopted to test the research hypotheses and the model. The population sample of this study was a list of registered companies in the Association of Ghana Industries (AGI) online database. The total number of registered members (companies) was 600 at the time of the study. This database is Ghana’s most credible source for an authentic list of companies in the manufacturing sector. We used simple random sampling to select 100 companies for the study. Unsurprisingly, all the selected companies happened to be operating in the Accra-Tema metropolis of Ghana –The researchers sent letters (with follow up visits and phones calls) explaining the research. Each firm elected at least 12 individuals within their supply chain and IT department. These individuals were in managerial positions. Out of the 1,500 targeted professionals, 1,300 participants expressed willingness to participate in the survey after sending introductory letters and following them up with phone calls. The instruments were delivered to the informants through trained interviewers who collected the questionnaires immediately after completion (Steenkamp et al., 2010). This was done in two parts. First, questionnaires for the independent variables and moderators were handed over to the respondents and marked with their initials for safe keeping. Sent and upon collection marked with the initials of the respondent for safe keeping. A second questionnaire on the dependent variable was also sent after 2 weeks upon collecting the independent/moderator questionnaires, and those that were returned got marked. The second set of questionnaires were linked with the individual responses collected from the first set of the survey for appropriate data entry. All ethical protocols were observed during the data collection process; for example, the confidentiality and anonymity of the respondents were maintained. This was explained to the interviewees prior to the survey through the introductory letters. We also promised sharing the research results with the interviewee, which perhaps contributed to the 28% (421/1,500) response rate for the study. Unfortunately, only 400 questionnaires were usable leaving an effective response rate of 26.67%.

**Common Method Bias**

The data collection strategy followed prior research for reducing measurement error, especially when the study adopted the cross-sectional design approach. This is because the collection of data on the variables were taken from the same targeted respondents (Podsakoff et al., 2003). Our approach to lessen biases focused on both item and construct levels. First, to reduce the chances of socially desirable responses, informants were offered confidentiality, and were assured that there were no wrong or correct answers, and were given a “don’t know” option when completing the questionnaire. Second, though the same respondents were involved in answering the questionnaires, the period for answering both predictor and criterion variables questionnaires were separated. The time lag helped to avoid biases in retrieving prior responses on the earlier questionnaire, and provided a new memory for answering the new questionnaire when presented to respondents (Steenkamp et al., 2010; Podsakoff et al., 2012). Also, a few items were reverse coded in the questionnaire. Items were carefully constructed to avoid ambiguity, and were kept simple to help improve scale items. Harman’s single factor test was deployed to control for any biases that might have arisen after separation of the measures for the predictor and criterion variables. The initial factor gave a result of 24.49%, which signifies that the common method bias will not be a problem as far as this study is concerned.

The procedures adopted in avoiding measurement biases were based on our research setting, design, and location. It is quite easy to approach the organizations in person, and physical distances between the studies firms did not pose much problem. Personal visits, therefore, was applied in process of collecting the data.

**Results and Analysis**

To analyze the data, partial least square structural equation modeling (PLS-SEM) on SmartPLS Version 3 was used. This type of analysis allows for the test of contributory relationships amid latent variables of the conceptual framework. As suggested by Hair et al. (2014), two approaches exist when using the structural equation modeling (SEM); these are SEM based on the covariance, which considers data that shows multivariate normality as a re-condition for further analysis and variance-based PLS-SEM. The variance-based does not need the use of multivariate normality. Initial data screening and analysis revealed that data exhibited non-normal attributes; therefore, the choice for using PLS-SEM was justified. As suggested by Chin (1998), we followed the two-step method to assess SEM. First, reliability and validity were tested for the model. Secondly, the significance of the structural path within the latent constructs was tested as per the model.
Measurement Model Assessment

Reliability, convergent validity, and discriminant validity were deployed to evaluate the model. Reliability, specifically with Cronbach’s alpha, was assessed. Additionally, reliability was determined holistically with composite reliability. As shown in Table 1, Cronbach’s alpha and composite reliability results for all the variables were higher than the .7 threshold which was recommended by Henseler et al. (2016) except for supply chain performance and Exploitative Information System (IS) Usage that recorded Cronbach alpha values of .54 and .58 respectively. According to Cronbach alpha, levels of .58 to .97 (satisfactory) and .45 to .98 (acceptable) have been used in Van Griethuijsen et al. (2015) indicating the internal consistency values are acceptable. To evaluate convergent validity, the Average Variance Extracted (AVE) was used. To assure convergent validity, AVE should be greater than .5 (Hair et al. 2014). All values for the constructs, as indicated in Table 1, fell above the minimum threshold of .5 for AVE, indicating a good convergent validity.

According to Chin (1998), in order to achieve discriminant validity, three conditions must be satisfied: (1) the loadings of individual constructs must be greater than the cross loadings; (2) the square root of the average variance derived from each construct must be higher than the highest correlation amid latent variables involving the focal construct (Fornell & Larcker, 1981); and (3) the hetero-trait-monotrait ratio of correlations (HTMT) values must be lower than .85. As indicated in Table 2, the individual loadings are higher than that of the cross-loadings. The outcome in Table 2 shows that the square root of the AVE shown in the diagonal for each construct was greater that the correlations among the latent variables providing compelling evidence of discriminant validity. Lastly, results of HTMT .85 condition depicted in Table 3 provide a strong argument of discriminant validity. In sum, the psychometric properties of the measures are seen to be adequate for the study; hence, further analysis could be conducted.

Multicollinearity within the variables in this study were assessed. The tolerance results higher than 0.10 and VIF outcome lower than 10 (Hair et al., 1998) were all indication that multicollinearity conditions were not violated.

### Table 1. Factor Loadings and Reliability Statistics.

|       | INFINT | MC    | OPTINT | RATIV | REINT | SCP   | TATIV | α    | CR   | AVE   |
|-------|--------|-------|--------|-------|-------|-------|-------|------|------|-------|
| INFINT1 | 0.809  | 0.231 | 0.277  | 0.281 | 0.242 | 0.209 | 0.297 | .84  | .86  | .88   |
| INFINT2 | 0.809  | 0.273 | 0.345  | 0.304 | 0.150 | 0.300 | 0.397 |      |      |       |
| INFINT3 | 0.591  | 0.252 | 0.183  | 0.218 | 0.291 | 0.205 | 0.261 |      |      |       |
| INFINT4 | 0.811  | 0.266 | 0.230  | 0.289 | 0.206 | 0.246 | 0.278 |      |      |       |
| INFINT5 | 0.750  | 0.343 | 0.311  | 0.260 | 0.181 | 0.214 | 0.236 |      |      |       |
| INFINT6 | 0.685  | 0.263 | 0.325  | 0.235 | 0.181 | 0.191 | 0.332 |      |      |       |
| MC1    | 0.348  | 0.679 | 0.214  | 0.293 | 0.120 | 0.205 | 0.183 | .78  | .79  | .86   |
| MC2    | 0.324  | 0.855 | 0.243  | 0.193 | 0.183 | 0.233 | 0.215 |      |      |       |
| MC3    | 0.218  | 0.807 | 0.212  | 0.201 | 0.175 | 0.219 | 0.168 |      |      |       |
| MC4    | 0.209  | 0.744 | 0.143  | 0.205 | 0.227 | 0.131 | 0.090 |      |      |       |
| OPTINT1 | 0.327  | 0.209 | 0.840  | 0.171 | 0.174 | 0.230 | 0.055 | .77  | .78  | .87   |
| OPTINT2 | 0.269  | 0.219 | 0.830  | 0.217 | 0.129 | 0.278 | 0.052 |      |      |       |
| OPTINT3 | 0.335  | 0.238 | 0.811  | 0.199 | 0.220 | 0.299 | 0.241 |      |      |       |
| RATIV1  | 0.270  | 0.187 | 0.159  | 0.759 | 0.214 | 0.222 | 0.319 | .85  | .86  | .89   |
| RATIV2  | 0.287  | 0.233 | 0.193  | 0.779 | 0.131 | 0.336 | 0.265 |      |      |       |
| RATIV3  | 0.305  | 0.242 | 0.174  | 0.835 | 0.107 | 0.328 | 0.270 |      |      |       |
| RATIV4  | 0.289  | 0.272 | 0.207  | 0.814 | 0.107 | 0.345 | 0.272 |      |      |       |
| RATIV5  | 0.248  | 0.172 | 0.201  | 0.732 | 0.144 | 0.262 | 0.335 |      |      |       |
| REINT1  | 0.162  | 0.114 | 0.125  | 0.117 | 0.791 | 0.094 | 0.039 | .77  | .77  | .85   |
| REINT2  | 0.055  | 0.050 | 0.182  | 0.120 | 0.728 | 0.063 | 0.072 |      |      |       |
| REINT3  | 0.237  | 0.260 | 0.228  | 0.209 | 0.792 | 0.082 | 0.187 |      |      |       |
| REINT4  | 0.350  | 0.234 | 0.131  | 0.081 | 0.750 | 0.086 | 0.188 |      |      |       |
| SCP1    | 0.169  | 0.221 | 0.289  | 0.368 | -0.015 | 0.791 | 0.280 | .54  | .56  | .76   |
| SCP2    | 0.283  | 0.174 | 0.185  | 0.278 | 0.114 | 0.726 | 0.323 |      |      |       |
| SCP3    | 0.238  | 0.170 | 0.233  | 0.167 | 0.166 | 0.635 | 0.266 |      |      |       |
| TATIV1  | 0.343  | 0.173 | 0.050  | 0.305 | 0.158 | 0.336 | 0.840 | .58  | .58  | .83   |
| TATIV1  | 0.341  | 0.200 | 0.201  | 0.308 | 0.109 | 0.335 | 0.840 |      |      |       |

Note. INFINT = information integration; MC = managerial commitment; OPTINT = operational integration; RATIV = explorative information system (IS) usage; REINT = relational integration; SCP = supply chain performance; TATIV = exploitative information system (IS) usage. Shaded areas represent groups of factor loading for the labels (variables) in the respective columns.
To illustrate the explanatory prowess of the structural model, the determination factor $R^2$ was used to ascertain the predictability of the endogenous constructs. The outcome of the structural model is shown in Table 2 and Figure 2.

With Hypothesis one (H1), Explorative ISU had significantly positive influence on Supply Chain Performance ($\beta = .209, \ p = .000$). Exploitative ISU also had significantly positive impact on Supply Chain Performance ($\beta = .269, \ p = .000$), supporting H2. Managerial Commitment has significantly positive effect on Supply Chain Security ($\beta = .089, \ p = .028$) supporting H3. This result suggests that, as Managerial Commitment increases, it is expected that a Supply Chain Performance will also increase. As expected, the finding revealed that Explorative ISU has significant and positive impact on Information Integration ($\beta = .356, \ p = .000$) supporting H4. H4 had the most significant effect on Information Integration. Likewise, Explorative ISU had significantly positive influence on Operational Integration ($\beta = .238, \ p = .000$), supporting H5 assertion. As expected, Explorative ISU has significant and positive influence on Relational Integration ($\beta = .191, \ p = .000$). Additionally, findings revealed that Explorative ISU has significantly positive impact on Relational Integration ($\beta = .191, \ p = .000$). In general, 28.5% of the variation in Supply Chain Integration is explained by the constructs in the model. The total suitability of the model was evaluated through the use of SRMR composite factor model. Value of the model is .073, which is quite lower than .08 threshold suggested by Hu and Bentler (1999). This shows that indeed the proposed model is a good fit. Table 4 shows hypotheses testing of specific indirect effects. Operational Integration mediates positively and significantly the link between Explorative ISU and Supply Chain Performance (Table 5).

Discussion of Results

The study had eight proposed hypotheses tested. Using the partial least square structural equation model (PLS-SEM), the finding supported all the relationships hypothesized. This offers empirical prove that all the constructs, namely Explorative ISU, Exploitative ISU, Managerial Commitment, Information Integration, Operational Integration, and Relational Integration are indeed significant in predicting Supply Chain Performance.

Finding from the analysis confirmed a positive effect of Explorative ISU on Supply Chain Performance ($t = 3.92, \ p < .001$) with a path coefficient of .209. This gives credence to the fact that Explorative ISU inherent in an organization will improve the performance of Supply Chain. The outcomes proves the relevance of the strategic usage of information systems in supply chain. It confirms results in similar study by Prajogo and Olhager (2012) who emphasize the importance of ISU in supply chains and how they improve SCP either directly or indirectly.
In the same vein, the statement that Exploitative ISU positively affects Supply Chain Performance is upheld ($t = 5.06$, $p < .001$) with a path coefficient of .269. The implication of this is that the operational use of IS to enhance SCP is achievable. Daily use of IS to process orders, manage inventory, and fulfill orders are all enhanced with ISU; thus, more importance should be placed on IS to attain supply chain goals.
Relatedly, H3 proposition that managerial commitment will have positive impact on performance of supply chain had statistical significance ($t=1.91, p < .05$) and a path coefficient of .089. This presupposes that managers serve as a critical resource for supply chain success. They create trust and release resources for the effective operation of the supply chain. The results aligns with those of Chopra and Sodhi (2004) and Zhou and Benton (2007) who affirm that MC helps firms create compatible philosophies with those of partners for the attainment of shared goals, and provide personal leadership for meeting specific goals that have been set on both firm and group levels.

It is further revealed that Explorative ISU significantly and positively affect Information Integration ($t=8.56, p < .05$) as depicted by H4 and a path coefficient of .356. The result suggests that value from information systems takes time to materialize. The strategic use of IS helps develop complementary IS capabilities across supply chains and enables coordinated decision-making and information sharing; and presents information integration as a strategic initiative that should be pursued with a long-term focus and with associated benefits being realized in the long term. Since explorative ISU allows new resources to be sort and creates synergies to handle future complex information processing needs, the results confirm the importance of information integration in attaining collaborative planning and information sharing needs of firms. The results align with those of Rai and Tang (2014) and Lee et al. (2015).

In relation to operational integration, the fifth hypothesis stated that “Explorative ISU is positively related to operational integration” and was statistically supported ($t=6.65, p < .01$) and had a positive path coefficient of .324. The results signify the role ISU plays in integrating inter and intra firm operations (Rai & Tang, 2014); and although the approaches to adopt to get the optimum integration benefits are inconsistent in literature, ISU’s importance as an enabler of operation integration is affirmed by this result.

Moreover, our findings on the Relational Integration support our argument that Explorative ISU will positively affect Relational Integration as indicated in the sixth hypothesis ($t=4.16, p < .001$) with path coefficient of .191. The argument for the development and sustaining of relational assets is strengthened by this result. Trust and commitment to value networks are enhanced when ISU capabilities are deployed and supported. Through ISU, long-term relationships could be established that provide a strategic impact to channel partners; and the associated relational rents developed through such investments could be the long-run impact performance of the channel.

Further, the result supported the claim that Operational Integration will positively influence Supply Chain ($t=4.21, p < .001$) and again noticed a coefficient of .218. It asserts that aligning inter and intra firm business operations enhance the overall performance in meeting the needs of partners. An effective operational integration creates a better response to orders, optimized order-to-fulfilment requirements, improved cycle times, and generation of transaction efficiencies.

Finally, the mediating hypothesis, which states that Operational Integration mediates the positive and significant relationship between Explorative ISU and Supply Chain Performance, was upheld ($t=3.21, p < .001$) with a path coefficient of .052. This infers that strategic assets enhance performance and that ISU generates the needed synergies for operational integration that impact performance of supply chains. ISU, when in sync with business operations, deliver capabilities that provide operational speed and cost efficiencies that lead to attainment of benefits for partners. The results also signify that explorative ISU alone might not be enough without blurring the physical boundaries that characterizes supply chain operations; and that a mediation effect that provides an aligned inter and intra firm operations might be required to attain the desired performance.

There appears to be a practical gap that warrants the significance of this research area in the future. This research considered the practical application of both ISU and SCI, and their influence on SCP, thus providing an alternate perspective for analysis. ISU provides a means for firms to realize their digital transformation investments and should be seen as an important research domain for supply chain-information investments and research.

### Theoretical and Managerial Implications

The theory on Resource based view is rather firm and specific in nature. However, the added-on support from the Relational View theory provides support for harnessing resources across networks. Furthermore, previous
theoretical need embraces contemporary research in resource based view and relational view theories to provide a stronger theoretical base for supply chain function.

The study found that the impact of explorative and explorative ISU on SCP were positive and significant. This indicates that supply chain partners in the sample frame might have adopted the information systems usage approach in handling their supply chain goals. Investments into each usage strategy should be aligned with supply chain goals, and a misfit could be detrimental to the unearthing of new opportunities, as well as sustaining existing ones. Supply chain partners could strive in developing information systems policies and strategies that ensure the assimilation of information resources in an aggressive fashion to take advantage of the benefits of explorative usage of information resources.

Managers should motivate system users to enable the use of these technological tools in undertaking supply chain functions. Systems procurement and usage have been the prelude of big players in the supply chain, leaving little benefits to other partner users. Managers should take note of this practice and develop countermeasures where it affects their individual firms without compromising the supply chain goals.

For greater performance, it is recommended that managers balance explorative and exploitative ISU strategies for higher and sustained SCP. Again, since explorative usage relies on flexibility and innovation, a culture to foster innovation in the use of information resources when promoted within supply chains could enhance the performance of the chain. Managers need to instill confidence in information system personnel to refine and configure legacy systems to enable the benefits of exploitative usage of information resources to be realized. Training programs to ensure that information systems personnel have the needed skills to interact and communicate knowledge of existing systems to system users should always be encouraged.

It was evident that operational integration could be derived from information services that supply chain partners deploy to enhance their performances. Through information systems, partners can develop joint initiatives, work together effectively and also have the required data for decision-making. Physical integration tactics should be coupled with those of information systems to improve performances of supply chain functions.

**Limitations and Future Research**

Research on supply chain information systems such as this study have mostly relied on focal firms as data sources, ignoring the basic principle that a supply chain includes at least a customer-manufacturer-supplier bond. This places a limitation on our work. We have relied on focal firms although we ensured some level of systems interoperability between respondent firms.

**Appendix**

**Explorative Information System (IS) Usage**

- Trends in sales performance are understood using Information System solutions.
- Information System solutions help us to integrate our manufacturing functions.
- New business opportunities are enabled using Information Systems solutions.
- Supply chain partners use Information System solutions to improve competitiveness.
- Information System solutions allows us to collaborate with our business partners.

**Exploitative Information System (IS) Usage**

- Our firm uses Information System solutions for order processing.
- Information System solutions help in exchange of shipment information.
- Management of warehouse stocks are enhanced using Information System solutions.
- Our firm’s business procedures are compatible with supply chain partners’ skills.
- Customer databases help my firm to better understand our customer needs.
- Our supply chain partners use Information System solutions to increase the productivity of employees.
- Our supply chain partners use Information System solutions to increase the productivity of employees.

**Managerial Commitment**

- Managers from our firm and those of our supply chain partners have compatible philosophies in business dealings.
- Our firm’s management provides personal leadership for meeting our supply chain goals.
- Top management commits resources towards Information Systems adoption and usage.
- Top management encourages just-in-time production and delivery of goods and services to clients.
- Employee involvement in the use of Information Systems to support daily operations is encouraged by management.
- The expectations of our Supply Chain partners are understood and addressed by management.

**Supply Chain (SC) Integration**

**Information integration**

- Our information systems have built-in functions to facilitate collaboration with supply chain partners.
• Our firm can forecast and plan collaboratively with supply chain partners through integrated information systems.
• Supply Chain partners exchange information through the internet and its related technologies.
• Supply Chain partners use Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), or other technologies to exchange information.
• Supply Chain partners share a central database that allows them to exchange information.
• Our integrated information systems allow our firm to project and plan future demand with supply chain partners.
• Supply Chain partners use telephone, mobile phones, and their related technologies to exchange information.

Operational integration
• Information System solutions are used for joint planning among Supply Chain partners.
• Shared databases are used to help Supply Chain partners to anticipate and resolve issues.
• Our firms’ procedures are compatible with our supply chain partners’ business procedures.
• Information System solutions are used for joint forecasting among Supply Chain partners.
• Information System solutions are used to communicate Supply Chain responsibilities.
• Supply Chain partners collaborate to resolve supply chain problems.
• Supply Chain partners synchronize their activities using Information System solutions.
• Supply Chain partners consult each other before making decisions affecting one another.

Relational integration
• Supply Chain partners work together to synchronize their visions.
• Supply Chain partners work together to establish complementary organizational structures.
• Supply Chain partners coordinate their activities to help them achieve agreed goals.
• Supply Chain partners work together to define Supply Chain goals and objectives.
• Supply Chain partners work together to achieve each other’s goals.
• The personal working relationships our firm maintains with Supply Chain partners are satisfactory.
• Our firm is satisfied with the products and services received from Supply Chain partners.

Supply chain performance
• The use of Information System solutions has helped reduce the number of returned orders.

• Using Information System solutions enhances our firm’s ability to respond to our customers’ demand variations.
• Using Information System solutions has enhanced our inventory flow performance.
• Delivery performance is enhanced using Information System solutions.
• Using Information Systems solutions enhances our firm’s flexibility in meeting customer needs.
• Quality of our products has been enhanced using Information System solutions.
• Using Information System solutions has reduced the time customers spend to do business with us.
• Our operating costs are reduced with the use of Information System solutions.

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References
AlMulhim, A. F. (2021). Smart supply chain and firm performance: The role of digital technologies. Business Process Management Journal, 27(5), 1353–1372.
Ardito, L., Petruzzielli, A. M., Dezi, L., & Castellano, S. (2020). The influence of inbound open innovation on ambidexterity performance: Does it pay to source knowledge from supply chain stakeholders? Journal of Business Research, 119, 321–329.
Barbosa, M. W., de la Calle, A., Ladeira, M. B., & de Oliveira, M. P. V. (2018). Managing supply chain resources with Big Data Analytics: A systematic review. International Journal of Logistics Research and Applications, 21(3), 177–200. https://doi.org/10.1080/13675567.2017.1369501
Basnet, C. (2013). The measurement of internal supply chain integration. Management Research Review, 36(2), 153–172. https://doi.org/10.1108/01409171311292252
Beamon, B. M. (1999). Measuring supply chain performance in SMES. International Journal of Operations & Production Management, 19(3), 275–292. https://doi.org/10.1111/9789812836069_0029
Benitez, J., Llorens, J., & Braojos, J. (2018). How information technology influences opportunity exploration and exploitation firm’s capabilities. Information & Management, 55(4), 508–523.
Boyker, K. K. (1996). An assessment of managerial commitment to lean production. International Journal of Operations and Production Management, 16(9), 48–59. https://doi.org/10.1108/01443579610125589
Boyer, K. K., & Hult, G. T. M. (2005). Extending the supply chain: integrating operations and marketing in the online grocery industry. *Journal of Operations Management, 23*(6), 642–661.

Boynton, A. C., Zmud, R. W., & Jacobs, G. C. (1994). The influence of IT management practice on IT use in large organizations. *MIS Quarterly, 18*(3), 299–316. https://doi.org/10.2307/249620

Cagliano, R., Caniato, F., & Spina, G. (2006). The linkage between supply chain integration and manufacturing improvement programmes. *International Journal of Operations and Production Management, 26*(3), 282–299. https://doi.org/10.1108/01434570610646201

Castillo, V. E., Mollenkopf, D. A., Bell, J. E., & Bozdogan, H. (2014). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research, 67*(10), 2085–2095. https://doi.org/10.1016/j.jbusres.2014.02.002

Chang, W., Ellinger, A. E., Kim, K. K., & Franke, G. R. (2016). The influence of IT management practice on IT use in large organizations. *MIS Quarterly, 18*(3), 299–316. https://doi.org/10.2307/249620

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (Vol. 295, pp. 295–336). Lawrence Erlbaum. https://doi.org/10.1016/j.aap.2008.12.010

Chopra, S., & Sodhi, M. M. S. (2004). Managing risk to avoid supply-chain breakdown. *MIT Sloan Management Review, 46*(1), 53–61.

De Camargo Fiorini, P., & Jabbour, C. J. C. (2017). Information systems and sustainable supply chain management towards a more sustainable society: Where we are and where we are going. *International Journal of Information Management, 37*(4), 241–249. https://doi.org/10.1016/j.ijinfomgt.2016.12.004

Dehning, B., Richardson, V. J., & Zmud, R. W. (2007). The financial performance effects of IT-based supply chain management systems in manufacturing firms. *Journal of Operations Management, 25*(4), 806–824. https://doi.org/10.1017/CBO9781107015324.004

Devecce, C., Palacios-Marqués, D., Galindo-Martí, M. Á., & Llopis-Albert, C. (2017). Information systems strategy and its relationship with innovation differentiation and organizational performance. *Information Systems Management, 34*(3), 250–264. https://doi.org/10.1080/10580530.2017.1330002

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage author. *Academy of Management Review, 23*(4), 660–679. https://doi.org/10.2307/259056

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.2307/3151312

Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics, 210*, 15–26.

Gimenez, C., & Ventura, E. (2003). Supply chain management as a competitive advantage in the Spanish grocery sector. *International Journal of Logistics Management, 14*(1), 77–88.

Gimenez, C., & Ventura, E. (2005). Logistics-production, logistics-marketing and external integration: Their impact on performance. *International Journal of Operations and Production Management, 25*(1), 20–38. https://doi.org/10.1108/0143570510572222

Golicic, S. L., & Smith, C. D. (2013). A meta-analysis of environmentally sustainable supply chain management practices and firm performance. *Journal of Supply Chain Management, 49*(2), 78–95. https://doi.org/10.1111/jscm.12006

Gorla, N., Somers, T. M., & Wong, B. (2010). Organizational impact of system quality, information quality, and service quality. *Journal of Strategic Information Systems, 19*(3), 207–228. https://doi.org/10.1016/j.jsis.2010.05.001

Graham, T. S., Daugherty, P. J., & Dudley, W. N. (1994). The long-term strategic impact of purchasing partnerships. *Journal of Supply Chain Management, 30*(4), 13–18.

Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Child, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research, 70*, 308–317.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (1998). *Multivariate data analysis*. Prentice hall. https://doi.org/10.2307/1266874

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review, 26*(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128

Hemmatfar, M., Salehi, M., & Bayat, M. (2010). Competitive advantages and strategic information systems. *International Journal of Business and Management, 5*(7), 158–169. https://doi.org/10.5539/ijbm.v5n7p158

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: Updated guidelines. *Industrial Management & Data Systems, 116*(1), 2–20.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Huo, B., Ye, Y., Zhao, X., & Shou, Y. (2016). The impact of human capital on supply chain integration and competitive performance. *International Journal of Production Economics, 178*, 132–143. https://doi.org/10.1016/j.ijpec.2016.05.009

Jallow, A. K., Demian, P., Anumba, C. J., & Baldwin, A. N. (2017). An enterprise architecture framework for electronic requirements information management. *International Journal of Information Management, 37*(5), 455–472. https://doi.org/10.1016/j.ijinfomgt.2017.04.005

Javornik, A., & Mandelli, A. (2012). Behavioral perspectives of customer engagement: An exploratory study of customer engagement with three Swiss FMCG brands. *Journal of Database Marketing and Customer Strategy Management, 19*(4), 300–310. https://doi.org/10.1057/dbm.2012.29

Jayaram, J., & Tan, K. C. (2010). Supply chain integration with third-party logistics providers. *International Journal of Logistics Management, 21*(1), 1–18. https://doi.org/10.1108/01443571010115360
Sharma, R., Shishodia, A., Kamble, S., Gunasekaran, A., & Belhadi, A. (2020). Agriculture supply chain risks and COVID-19: Mitigation strategies and implications for the practitioners. *International Journal of Logistics Research and Applications*, 1–27. https://doi.org/10.1080/13675567.2020.1830049

Sheu, J. B. (2004). A hybrid fuzzy-based approach for identifying global logistics strategies. *Transportation Research Part E, 40*(1), 39–61. https://doi.org/10.1016/j.tre.2003.08.002

Steenkamp, J. B. E., De Jong, M. G., & Baumgartner, H. (2010). Socially desirable response tendencies in survey research. *Journal of Marketing Research, 47*(2), 199–214.

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivistic research. *Communications of the Association for Information Systems, 13*, 380–427.

Van Griethuijsen, R. A. L. F., Van Eijck, M. W., Haste, H., Den Brok, P. J., Skinner, N. C., Mansour, N., Gencer, A. S., & BouJaoude, S. (2015). Global patterns in students’ views of science and interest in science. *Research in Science Education, 45*(4), 581–603. https://doi.org/10.1007/s11165-014-9438-6

Vanpoucke, E., Vereecke, A., & Muylle, S. (2017). Leveraging the impact of supply chain integration through information technology. *International Journal of Operations and Production Management, 37*(4), 510–530. https://doi.org/10.1108/IJOPM-07-2015-0441

Venkatraman, N., Henderson, J. C., & Oldach, S. (1993). Continuous strategic alignment: Exploiting information technology capabilities for competitive success. *European Management Journal, 11*(2), 139–149. https://doi.org/10.1016/0263-2373(93)90037-I

Wei, S., Ke, W., Liu, H., & Wei, K. K. (2019). Supply chain information integration and firm performance: Are explorative and exploitative IT capabilities complementary or substitutive? *Decision Sciences, 51*(3), 464–499. https://doi.org/10.1111/dsci.12364

Wu, F., Yeniyurt, S., Kim, D., & Cavusgil, S. T. (2006). The impact of information technology on supply chain capabilities and firm performance: A resource-based view. *Industrial Marketing Management, 35*(4), 493–504. https://doi.org/10.1016/j.indmarman.2005.05.003

Wu, L., Chuang, C. H., & Hsu, C. H. (2014). Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. *International Journal of Production Economics, 148*, 122–132.

Yang, Y., & Su, C. (2009). The relationship between benefits of ERP systems implementation and its impacts on firm performance of SCM. *Journal of Enterprise Information Management, 22*(6), 722–752.

Yu, Z., Yan, H., & Cheng, T. C. E. (2001). Benefits of information sharing with supply chain partnerships. *Industrial Management and Data Systems, 101*(3), 114–119. https://doi.org/10.1108/02635570110386625

Zhang, J., Yalcin, M. G., & Hales, D. N. (2021). Elements of paradoxes in supply chain management literature: A systematic literature review. *International Journal of Production Economics, 232*, 107928.

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