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Supply Chain Intelligence and Operational Performance of Small and Medium Enterprises in Ghana: The Mediating Role of Collaboration

By

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ABSTRACT:

This paper examines the role of supply chain collaboration in the relationship between supply chain intelligence and operational performance. A sample of 400 small and medium enterprises in Ghana were used to address the research objectives. Data was analyzed using descriptive statistics and structural equation modelling. The findings of the study revealed that, supply chain intelligence positively impacts the operational performance of small and medium scale enterprises in Ghana. Additionally, the study found that supply chain collaboration plays a significant role in enhancing the operational performance of SMEs in Ghana. Finally, the analysis of the study concludes that supply chain collaboration further plays a significant mediating role in increasing the impact of supply chain intelligence and operational performance of small and medium scale enterprises in Ghana. The study is significant because, the findings would help expand existing literature on supply chain intelligence, supply chain collaboration and operational performance, thereby having positive implications on theory, policy, and practice.

KEYWORDS:

Supply Chain Intelligence, Operational Performance, Supply Chain Collaboration

Introduction

Businesses are using a variety of techniques to stay competitive (Aslam et al, 2021). SMEs operate in the global market space hence need to survive the competition; it is imperative to improve on their supply chain (SC). This implies being effective and efficient than their competitors (Christopher, 2016). Additionally, SMEsmust understand the concepts and practices of supply chain management (SCM) for the purpose of achieving competitiveness and increasing profit(Qayyum & Ashraf, 2015).Operational performance signifies the level of enhancement in organizational performance with regards to cost reduction and upgrade of competence throughout the whole supply chain (Das, 2018). The delivery and production of quality products which are dimensions of operational performance has become one of the major ambitious components that make organizations remain competitive (Yu et al., 2018). Even though SMEs contribute immensely to Ghana's economy, their operational performance is a challenge that needs urgent attention. Supply chain intelligence is the key issue to improve operational performance. Supply Chain Intelligence (SCI) is a relatively new initiative that provides the capability to improve business performance by utilizing sophisticated analytical tools and embracing collaborative decision making (Swain et al., 2019). SCI takes a broader, multidimensional view of supply chains in which by using patterns and rules, meaningful information about data can be discovered.Collaboration in the supply chain is a dynamic process that promotes ongoing development (Peng et al., 2022). Supply chain partners may exchange best practices, pinpoint areas for improvement, and improve processes by working together(Baah et al., 2022). Collaboration improves operational performance through continuous improvement directed at lowering costs, boosting productivity, upgrading quality, and strengthening sustainability throughout the supply chain (Zaridis et al., 2021). Collaboration makes it possible to share information and learn from one another, which spurs innovation and the adoption of new techniques for improved operational performance (Hofman et al., 2020).

Despite several benefits of SMEs to Ghana's economy, the performance of firms in the domestic supply chain among SMEs has been facing myriads of challenges mainly due to the lack of adoption of robust technologies in supply chain management resulting in slow growth of performance in the industry (Donkoh et al, 2018). Businesses may gather, examine, and exchange pertinent information and knowledge along the supply chain thanks to supply chain intelligence (Jiang, 2019). As a result of the openness and visibility that this shared information fosters, supply chain practitioners take decision based on knowledge and expertise (Benzidia et al., 2021). Partners may better coordinate their efforts by aligning their activities and plans when they have access to accurate and up-to-date information. Information about demand trends, inventory levels, manufacturing capabilities, and logistical processes is provided through supply chain intelligence (Ali et al., 2022). Supply chain intelligence is an important phenomenon that firms and organizations require to succeed in this turbulent business environment. In Ghana, SMEs seem not to adequately implement supply chain intelligence (Jiang, 2019), which may add value and improve their operational performance and enhance productivity.Indeed, little attention have been paid to these practices by professionals and academics(Moenga 2016). The significance of supply chain intelligence and its implementation in Ghana's SME sector have not been adequately realized. The consequences have been devastating on the performance of most SMEs in the country (Otchere et al., 2020). SCI addresses pressing social issues and provides operational benefits as well as positive impacts on society. Evidence suggests that the impact of Supply chain intelligence on the operational performance of firms is ambiguous (Marshall et al., 2017). The few existing studies find performance benefits from SCI difficult to realize (Marshall et al., 2017). However, other studies found that these practices led to improved access to knowledge and information-sharing capabilities and better collaborations (Wu &Pagell, 2017). Zhu et al. (2016), covers major social practices relating to employees and community but did

not relate their studies to OP as well as SC collaboration. Esfahbodi et al. (2020) found that in assessing the nexus between environmental and cost performance, variables such as operational performance or supply chain collaboration were excluded from the model. In the same way, Mani et al. (2020), identified suppliers, manufacturers, and customers' development as only social constructs in supply chain, neither SC collaboration nor OP was covered. This therefore identifies a considerable gap in literature in relations to supply chain intelligence and OP that this study seeks to address.

The existing gap in the knowledge shows that, an integrated model examining the complexitiesamong supply chain intelligence, SC collaboration and OP is still missing. Therefore, a study on SCI and OP with SCC as a mediator in SMEs in Ghana remains unexplored. Companies' collaborative relationships with other supply chain members affect the performance of their operations (Hong et al., 2019), but few research have investigated the interplay between SCC and operational performance. Furthermore, some SCC enablers are thought to boost innovation efficiency (Huang et al., 2020). However, rigorous investigation of interrelationships between driving factors of SCC and operational performance is still required, to assist SMEs in identifying the main parts of SCC that affect operational performance. This study relies on the resource-based viewtheory to bridge the gap by examining the mediating effect of supply chain collaboration on the relationship betweenSCI and operational performance of SMEs in Ghana. The paper is guided by three research questions - what is the influence of supply chain intelligence on the operational performance of SMEs in Ghana?What is the effect of supply chain intelligence on supply chain collaboration of SMEs in Ghana?What is the mediating effect of supply chain collaboration in the SCI and OP link?

Supply Chain Intelligence

The term supply chain intelligence describes the tactical application of technology, analytics, and knowledge that guides distribution network choices (Swain & Cao, 2019). It entails gathering, evaluating, and analysing data from several sources. Gathering and analysing information are essential to supply chain intelligence because it enables data-driven decision making (Toorajipour et al., 2021). It entails gathering information from several sources, including users, suppliers, and manufacturing and logistical facilities. Businesses may acquire useful insights into demand trends, stock levels, production schedules, transport costs, and other crucial supply chain variables by utilizing sophisticated analytic approaches. These insights aid in increasing supply chain coordination, supply planning, inventory management, and decision-making to advance supply chain performance (Riahi et al., 2021). Real-time network visibility across the whole distribution chain is a key component of supply chain intelligence. Organisations may control and track the flow of items, sales volumes, and manufacturing processes in real-time with the use of technological solutions like the Internet of Things (IoT), sensors, and cloud services (Baryannis et al., 2019). Due to transparency, supply-chain collaborators are better equipped to coordinate and make proactive decisions as well as solve problems quickly. Additionally, real-time visibility improves an organization's ability to respond to interruptions, allowing for speedy risk mitigation and adaptation (Modgil et al., 2022). Using predictive maintenance, supply chain intelligence enables proactive decision-making by foreseeing future occurrences. Businesses can spot trends, tendencies, and possible problems in the distribution network by looking at historical information. Demand forecasting, strategic supplier prediction, inventory optimization, and scenario simulation to assess the impact of different scenarios on the supply chain are all capabilities of predictive analytics models (Helo& Hao, 2022). Adapting proactively, allocating resources better, and reducing risks before they influence the supply chain are all made possible by this for enterprises (Belhadi et al., 2021). Partnership and connectivity amongst supply chain participants are encouraged by supply chain intelligence. To improve visibility, synchronization, and judgment, the distribution network environment must share information,

perspectives, and expertise. Organisations may promote effective communication, share real-time information, and work together to address supply chain concerns by using collaborating networks and technologies. System and process integration throughout the supply chain provides effective information exchange, transparent data flow, and fosters accountability (Nahr et al., 2021).Furthermore, a culture of improving quality is supported by supply chain intelligence (Dubey et al., 2021). Companies may spot possibilities for enhancement and execute corrective measures by assessing performance information, locating bottlenecks, and tracking important indicators of achievement. Supply chain information makes it easier to assess advancement over time, measure progress to goals, and benchmark against industry norms. Organizations may increase the effectiveness of their supply chains, save costs, and foster innovation by adopting a continuous improvement strategy (Nayal et al., 2022). In summary, supply chain intelligence is a comprehensive method for gaining knowledge and enhancing the effectiveness of the supply chain. It makes use of information, analytics, and technology. Organizations may improve decision-making, get real-time visibility, use predictive analytics, facilitate cooperation, and foster continual development by using supply chain intelligence strategies. In the end, this results in a distribution network that is more reactive, flexible, and effective, giving firms a competitive advantage in the fast-paced business world of today (Dash et al., 2019).

Operational Performance

As organizational effectiveness is vital to economic growth and to investors and stockholders.It is essential to have a clearer appreciation of all the factors that influence financial results. Financial success is essential to the growth and survival of a business since it serves as the functional lifeblood of the organization. According to Sohilauw et al. (2020), an organization's business efficiency and expansion prospects are diminished by bad financial performance or a capital shortage. The quantity of assets a company has under control changes depending on its financial success, which might improve future success. Previous studies see company success as a multifaceted entity with many different factors to consider, including business sustainability, operational effectiveness, the reputation of the firm, and generating economic goals (Feng et al., 2021).Financial performance is sometimes seen as a basic factor in the existence and prosperity of an organization over the foreseeable future.Also, a business standing affects the accomplishment of other economic targets (Kong, et al., 2020). Economic institutions face a serious issue with business performance, and all businesses strive for the highest level of financial effectiveness. The financial performance of organisations is influenced by several factors. These factors might be outside or inside. Revenue growth gauges how well a business generates profits using resources from its main operational strategy. Comparing related businesses across the same trade, sectors, or divisions is another application of this expression (Awaysheh et al., 2020). Financial performance gauges how well a company uses various monies to return money to its financing sources (Kyere&Ausloos, 2021). Effectiveness may be assessed from four angles, according to Alshehhi et al. (2018) - financial, client, internal systems, and creativeness. From a financial perspective, critical success factors are net profit, inventory turnover, leveraged, cash flow, and capital investments (Bunea, 2019).

The demands of the firms outside capital sources, or investors, are intimately related to the financial objectives of profit-oriented organisations. Also, the business financial performance is a representation of aorganisation's financial position that is examined using budgetary control methods to identify the firm's favourable and unfavourable financial circumstances as they relate to its employee productivity at a certain period. To use resources as efficiently as possible in the context of climate uncertainties, this is essential. The net income (bottom line) of a business is the outcome of several interconnected performances in areas such as operations, finance, marketing, and

manufacturing.In a nutshell, various effectiveness evaluation techniques are used depending on their objectives and the outcomes they are aimed at achieving. Everybody, from supervisors and staff members to shareholders and other interested parties, is worried about financial results. On the contrary, extremely depending on the objective and nature of the activity, financial performance metrics vary. Market-based assessments and accounting-based parameters are the two main categories. Market-based metrics attempt to predict future occurrences and are mostly affected by factors beyond the management of the company's control. A new organisation's main objective is to generate income from its assets. The three main financial metrics for measuring a company's value are revenue generation, profitability on resources optimization, and investor value creation (Daniels, 2019). Over the company's existence, this main objective may run across several obstacles. Management's initial goal is to assist the business in surviving in the face of competitors.

Anwar (2017) indicates that though effectiveness and longevity are strongly related, an organisation's economic health would suffer if its assets were not used effectively, causing financial challenges. The term "financial results" refers to a variety of methods for evaluating a company's efficiency. The effectiveness of the organisation may be assessed by looking at how it makes use of its assets to generate revenue. According to Abraham et al. (2017), some well-known indicators of economic empowerment include earnings prior to taxes and interest, return on investment, net worth, and operationally revenue based on equity. Productivity, which may be derived through the return on capital or resources, is frequently used to judge a publicly traded organisational value. An organization's rules and procedures are measured in terms of its financial success. It is employed to evaluate a company's long-term financial condition and to examine how it compares to other companies in the same sector as well as to other sectors or fields generally.The firm's productivity also demonstrates the important accomplishments made by individuals or teams within a business in accordance with their obligations and scope of power to carry out certain legal objectives. Financial performance therefore evaluates a company's ability to use resource management to boost its strategic advantage in a variety of ways (Feng et al., 2021). Moreover, economic results are crucial for determining businesses economic strength or weakness and forecasting future growth using financial improvement opportunities (Van- Wyk& Wesson, 2021). The terminology for financial performance used in this investigation is provided by Okafor et al. (2021). It claims that a business has the potential to use assets from its primary business line efficiently and generate revenue measured by its financial success.

Supply Chain Collaboration

Collaboration in the supply chain is the tactical synchronization and engagement of different parties involved in the network of the distribution chain, such as vendors, manufacturers, wholesalers, retailers, and buyers (Sudusinghe&Seuring, 2022). To accomplish shared objectives and improve the efficiency of the whole supply chain, it entails sharing knowledge, funds, and skills. The foundation of supply chain collaboration is common objectives and purposes amongst supply chain participants. Orientation and a collaborative effort of the desired results, such as cost savings, enhanced customer service, greater operating excellence, or sustainability, are necessary. Trust and a common commitment to work together to accomplish these shared goals form the foundation of cooperative arrangements (Duong &Chong, 2020).To accomplish shared objectives and improve the efficiency of the whole supply chain, entails sharing knowledge, funds, and skills. The foundation of supply chain collaboration is common objectives and purposes amongst supply chain participants. It is essential for supply chain partners to communicate openly and frequently to collaborate. Regular gatherings, group planning meetings, and forums for cooperative problem-solving are all included in this regard.

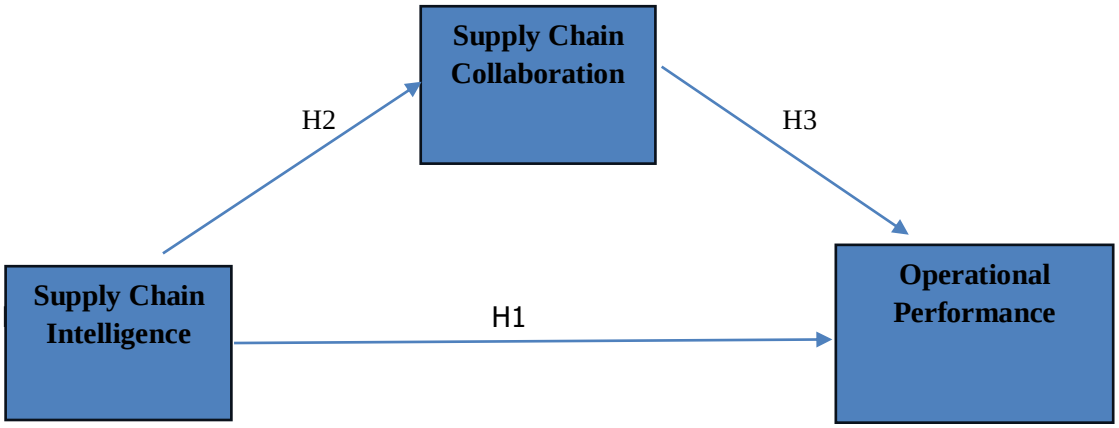
Changes, difficulties, or advantages within the supply chain are made known to all stakeholders through effective communication (Baah et al., 2022). In addition, coordination of tasks and procedures throughout the supply chain is another aspect of collaboration that ensures that responses are timed to meet customer needs and enhance overall performance (Rejeb et al., 2021). Partnership between supply chain partners demands forging enduring bonds and encouraging trust. Trust is imperative for exchanging sensitive data, working together to solve challenges, and reaching mutually advantageous choices. Transparency, dependability, and the will to keep promises are the cornerstones of successful effective collaboration. Trust makes it possible for people to work together more successfully, lessens conflict, and encourages people to cooperate to solve problems and take advantage of possibilities (Ma et al., 2020).

Collaboration in the supply chain is a dynamic process that promotes ongoing development (Peng et al., 2022). Supply chain partners may exchange best practices, pinpoint areas for improvement, and improve processes together by working collaborately. Initiatives for continuous improvement may be directed at lowering costs, boosting productivity, upgrading quality, or strengthening sustainability throughout the supply chain (Zaridis et al., 2021). Collaboration makes it possible to share information and learn from one another.This spurs innovation and the adoption of new techniques for improved supply chain performance. To sum up, supply chain cooperation is a tactical strategy that prioritizes common objectives, information exchange, communication, relationship development, and ongoing improvement among supply chain participants. Organisations may create a supply chain that is more effective, responsive, and robust by encouraging cooperation, which improves customer satisfaction, save costs, and offer a competitive edge in the market (Hofman et al., 2020).

Theory Underpinning the Study – Resource Based View

The Resource-Based View (RBV) emphasizes that an organization's corporate resources and skills are their competitive advantage (Sharma et al., 2022). Cooperation in the supply chain implies using these resources to improve effectiveness as highlighted by RBV when it comes to the implications of distribution network intelligence on operation performance (Nandi et al., 2020). The RBV posits that, businesses may gain a competitive edge by using special internal resources and competencies. These resources might include access to knowledge, supply chain knowledge, technical infrastructure, and database predictive analysis in the environment of supply chain intelligence. These internal resources may help companies successfully acquire, process, and use supply chain intelligence (Nagariya et al., 2023). Businesses may benefit from the pooled knowledge of their collaborators in the supply chain and influence judgments that result in better performance and profitability by sharing supply chain knowledge (Chatterjee et al., 2023). According to the RBV, firms may improve operational efficiency by collaborating with their supply chain and using their own resources and competencies (Arda et al., 2023). Businesses may strengthen the functioning of the supply chain by harnessing supply chain information through cooperation (Kamboj & Rana, 2023).Additionally, businesses have the tendency of improving their competitiveness, achieve superior operational efficiency, and adapt to the changing challenges of the supply chain landscape by using supply chain intelligence efficiently (Dubey et al., 2021).

Research Model and Conceptual Framework



Supply Chain Intelligence and Operational Performance

Real-time insight into the supply chain's many components, such as inventory levels, demand trends, manufacturing capacity, and logistical activities, is made possible through supply chain intelligence (Dubey et al., 2020). Businesses can see bottlenecks, foresee interruptions, and take proactive measures to resolve problems due to improved visibility. Consequently, effectiveness increases while lead times are cut down and administrative efficiency is improved (Modgil et al., 2022). The adoption of supply chain intelligence significantly improves operational performance (Dubey et al., 2020). It helps efficient risk management, simplifies logistical operations, increases visibility, simplifies forecast accuracy, maximizes inventory control, and allows effective supply chain operations. Businesses may boost productivity, save costs, enhance customer service, and gain a competitive edge in the market by using supply chain analytics successfully (Yang et al., 2021). Thus, a significant impact of Supply Chain Intelligence on Operational Performance. Based on this information, the paper hypothesizes that:

H_1. *Supply Chain Intelligence has a positive and significant effect on Operational Performance*

Supply Chain Intelligence and Collaboration

Businesses may gather, examine, and exchange pertinent information and knowledge along the supply chain thanks to supply chain intelligence. As a result of the openness and visibility that this shared information fosters, supply chain participants make decisions with more knowledge and efficiency (Benzidia et al., 2021). Partners better coordinate their efforts by aligning their activities and plans when they have access to accurate and up-to-date information. Information about demand trends, inventory levels, manufacturing capabilities, and logistical processes is provided through supply chain intelligence (Ali et al., 2022). Supply chain partners work together on order processing, capacity planning, and logistics optimization with the use of this information. Regarding shared intelligence, tasks are coordinated, lead times cut down, and inefficiencies or interruptions prevented (Jiang, 2019). Customer satisfaction and supply chain performance are both enhanced through collaborative planning and collaboration. In essence, supply chain cooperation benefits from supply chain intelligence. It provides improved information sharing, enhances coordination and planning, makes it easier to solve problems together, fosters connections and trust, and allows for assessment of effectiveness (Singh et al., 2019). Businesses may improve their collaborative efforts, boost supply chain performance, and provide advantages for all supply chain participants by making use of supply

chain intelligence (Belhadi et al., 2021). Thus, a significant impact of Supply Chain Intelligence on Supply Chain Collaboration. Based on this premise, the study hypothesizes that:

H_2. *Supply Chain Intelligence has a positive and significant effect on Supply Chain Collaboration*

The role of Supply Chain Collaboration in the relationship between Supply Chain Intelligence and Operational Performance

Partnership in the supply chain makes it easier for a business to use supply chain intelligence effectively (Lee et al., 2022). The insights gathered from supply chain information may be jointly analyzed and interpreted when supply chain partners work together. The efficient use of intelligence during decision-making is ensured by this coordinated partnership, resulting in better-informed and more coordinated actions (Abdallah & Al-Ghwayeen, 2020). Collaboration helps firms to fully utilize the intelligence's potential for enhancing operational performance by mediating the use of supply chain intelligence. In essence, supply chain collaboration serves as a bridge between operational performance and supply chain information (Mostaghel et al., 2019). It improves the use of intelligence, makes coordinated action and alignment possible, encourages learning and information sharing, and makes effective risk reduction possible. Collaboration facilitates these processes, strengthening the connection between organizational effectiveness and supply chain knowledge (Nu'man et al., 2020). This enhances the overall effectiveness in terms of operational performance, reactivity, and customer experience. Thus:

H_3. *Supply Chain Collaboration mediates the relationship between Supply Chain Intelligence and Operational Performance*

Research Method

This study focused on SMEs in Ghana with emphasis on firms in Accra. The study used aa cross-explanatory research design to enhance the variability and generalizability of data (Farmer et al., 2011). The quantitative approach was used to test models and hypothesis for conclusions and generalization (Saunders and Thornhill, 2007). Probability sampling was employed for purposes of this study to allow for estimation of the accuracy of the sample that is randomly selected from the population. A total of 494 firms made up the sample size. A total of 424 questionnaires were completed and returned, representing a response rate of 85%. Moreover, due to missing data, 24 out of the 424 questionnaires were discarded. The various constructs used to measure the variables were rigorously identified from existing research. All constructs were adopted and modified to work better with the study.

Descriptive Statistics

The paper is centred on the measures of central tendency. The results are shown in the table 1 below. The mean values of the items exhibit a range between 3.61 and 4.34, which denotes the average score, or rating attributed to each item. In general, items that exhibit higher means tend to correspond with higher scores or ratings, whereas those with lower means tend to correspond with lower scores. The range of standard deviation values observed is between 0.515 and 1.184. The presence of a higher standard deviation in a set of scores or ratings suggests a greater degree of variability, thereby indicating a wider range of responses. On the contrary, objects exhibiting lower standard deviations manifest reduced variability, indicating a greater degree of uniformity in the evaluations.

Table 1: Descriptive Statistics

Items	N	Minimum	Maximum	Mean	Std. Deviation
SCI1	400	2	5	3.87	0.958
SCI2	400	2	5	3.93	0.997
SCI3	400	2	5	3.81	1.107
SCI4	400	1	5	3.14	0.958
SCI5	400	2	5	3.94	0.776
SCI6	400	2	5	4.19	0.984
SCI7	400	1	5	3.93	1.184
SCI8	400	2	5	3.74	1.063
SCI9	400	2	5	4.13	0.955
SCI10	400	2	5	3.86	0.959
SCI11	400	2	5	3.67	0.699
SCI12	400	1	5	3.61	1.139
OP1	400	2	5	3.81	0.746
OP2	400	2	5	3.61	0.797
OP3	400	3	5	3.87	0.616
OP4	400	3	5	4.00	0.515
OP5	400	2	5	3.68	0.863
SCC1	400	3	5	4.06	0.570
SCC2	400	3	5	4.34	0.595
SCC3	400	2	5	4.13	0.713
SCC4	400	1	5	3.81	0.902
SCC5	400	3	5	3.94	0.574

Reliability and Validity

Confirmatory factor analysis was conducted to examine the fitness of the data to the model. Although, the CFA index values has provided evidence that the model has good fitness, a further test to confirm reliability and validity of the latent variables is necessary. To ensure the validity and reliability of the construct variables, a measurement model was implemented. Convergent validity and discriminant validity are two types of reliability and validity that must be assessed when performing structural equation modelling (SEM) (Kline, 2005; Henseler et al., 2015).

Convergent Validity

Several high-correlating error factors were removed during the CFA. After removing those items loading below 0.5 (Kline, 2005), the model showed good fitness with acceptable index values as shown in table 2. Next, the study examined the convergent validity consisting of average variance extracted (AVE), construct reliability (CR), and Cronbach alpha (CA) of the latent variables. The recommended thresholds are that AVE should be greater than or equal to 0.50; CR should be greater than 0.70 (Hair et al., 2022) and CA should be greater or equal to 0.70 (Nunnally, 1978). The results in table 2 shows a satisfactory AVE, CR, and CA values. Therefore, it can be concluded that convergent validity has been achieved.When two independent variables in a regression model have a high correlation with one another, multicollinearity is present. According to Correll, et al. (2018), a variance inflation factor (VIF) of 4 indicates that multicollinearity might be present which requires further analysis. The VIF statistic for the independent and the moderator variables is presented in

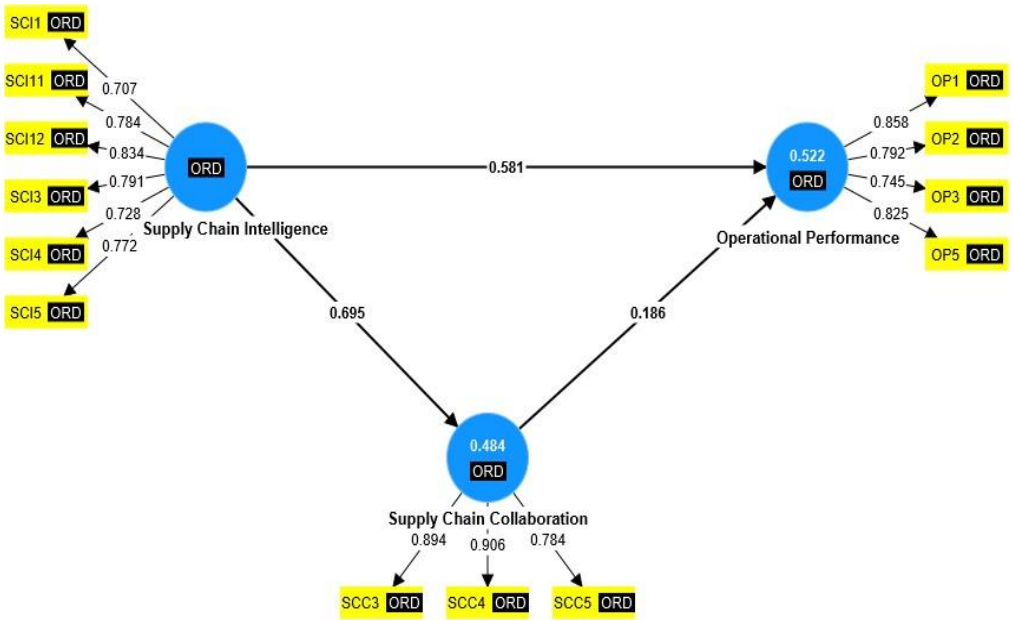
table 2. The results show that the VIF values are less than 4, indicating the absence of multicollinearity.

Table 2: Reliability and Validity

Constructs	Items	Loadings	CA	CR	AVE	VIF
Operational Performance	OP1	0.858	0.819	0.881	0.650	2.371
	OP2	0.792				1.636
	OP3	0.745				1.432
	OP5	0.825				2.264
Supply Chain Collaboration	SCC3	0.894	0.827	0.897	0.745	3.885
	SCC4	0.906				3.784
	SCC5	0.784				1.361
Supply Chain Intelligence	SCI1	0.707	0.863	0.897	0.594	2.101
	SCI11	0.784				2.435
	SCI12	0.834				2.398
	SCI3	0.791				2.357
	SCI4	0.728				2.066
	SCI5	0.772				2.132

The study analyzed the psychometric properties of the reflective model first, which includes the factor loadings, indicator and construct reliability, convergent and discriminant validity before assessing the structural model. The indicator loadings were analyzed to illustrate how each indicator effectively describes the main construct within the study's context. Hair, Hult, Ringle, Sarstedt, Danks, and Ray (2021) recommended a minimum desired threshold of 0.708 for an indicator factor loading. Therefore, for an item loading to be considered an acceptable measure of the quality of its latent construct, it must be higher than the 0.708. The final model is presented in Figure 1.

Figure 1: Measurement Model Assessment



Internal consistency reliability was assessed after the factor loadings. The reliability was assessed using the composite reliability and Cronbach alpha. To ensure that there is no issue with construct

reliability, composite reliability must be greater or equal to 0.70. Similarly, Cronbach alpha values must be greater than 0.70 to ensure that the constructs are valid. The findings presented in the table below shows that, Cronbach alpha and composite reliability are greater than 0.70. The Cronbach alpha values range from 0.819 to 0.863, composite reliability values range from 0.881 to 0.897. The results presented in table 1 shows that construct validity has been achieved. The convergent validity was examined after the reliability test. Convergent validity is the extent to which a measure correlates positively with alternative measures of the same construct (Hair et al., 2016). Hair *et al.* (2022) proposed a minimum extracted average variance (AVE) of 0.5 to demonstrate convergent validity. An AVE value of "0.50" or greater indicates that the definition represents more than half the variance of its indicators. The result presented in Table 1 shows that all the AVE values are greater than 0.50, indicating no problem with convergent validity (that means convergent validity has been established). The AVE values presented in Table 1 ranged from 0.594 to 0.745.

Discriminant Validity

Discriminant validity tests confirm that two theoretically unrelated conceptions have no practical relationship (Henseler et al., 2015). Henseler as al. (2015) and Hair et al. (2017) both mention the Fornell-Larckercriterion as a typical way to evaluate discriminant validity. Hair et al. (2017) state that a model has high discriminant validity if the square root of the AVE for each construct variable is larger than the correlation between two theoretical constructs. Table 2 displays the Fornell-Larcker criterion statistics. The square root of AVE is larger than the correlation between the model's construct variables, which is represented by the bold diagonal values in table 2. Therefore, the Fornell-Larcker criteria provides evidence for the construct's discriminant validity.

Table 3: Fornell-Larcker criterion

Constructs	1.000	2.000	3.000
Operational Performance	**0.806**		
Supply Chain Collaboration	0.590	**0.863**	
Supply Chain Intelligence	0.710	0.695	**0.771**

Table 4: Assessment of Path Coefficients and Significance Level

Hypotheses	Beta	STDEV	T statistics	P values
Supply Chain Intelligence -> Operational Performance	0.581	0.036	16.279	0.000
Supply Chain Intelligence -> Supply Chain Collaboration	0.695	0.026	26.398	0.000
Supply Chain Intelligence -> Supply Chain Collaboration -> Operational Performance	0.129	0.036	3.546	0.000

The study tested three specific objectives. The first objective examined the effect of supply chain intelligence on operational performance. The study's findings proved that supply chain intelligence positively and significantly affects operational performance with $\beta = 0.581$, T=16.279, P=0.000. The second objective examined the effect of supply chain intelligence on supply chain collaboration. The result revealed a positive and significant relationship between supply chain intelligence and supply chain collaboration with $\beta = 0.695$, T=26.398, P=0.000. A mediation analysis was conducted to assess the mediating effect of supply chain collaboration on the relationship between supply chain intelligence and operational performance. For a mediation analysis, the direct and indirect relationship between the variables is tested to check for the significance among the variables. The direct effect

shows that supply chain intelligence positively and significantly affects operational performance with β = 0.581, T=16.279, P=0.000. Similarly, the results revealed a positive and significant effect after the mediator (supply chain resilience) was included in supplier relationship management and operational performance with β = 0.129, T=3.546, P=0.000. The study's findings conclude that supply chain collaboration partially mediates the relationship between supply chain intelligence and operational performance.

Coefficient of determination and predictive power

Based on Henseler's (2018) analysis, R^2 values between 0.75 and 0.50 are deemed statistically significant, while values below 0.25 are not considered significant. Chin et al. (2020) emphasized the crucial significance of understanding the importance of R^2. Table 4 presents the R^2 coefficients related to operational performance and SC collaboration. Based on the results, SC intelligence explain 52.2% and 48.4% of variation observed in operational performance and SC collaboration. Enis and Geisser (1974) developed the Q^2 measure to evaluate the predictive ability of the PLS path model. According to Hair et al. (2019), it may be more effective to implement an internal, data-focused structural model in certain scenarios, particularly before the end of the second quarter. Operational performance and SC collaboration with Q^2 values of 0.503 and 0.483 is displayed in table 4. The results proof the model's capability to make precise predictions.

Table 5: R-square and Q^2 Predict

Endogenous Constructs	R-square	Q^2predict
Operational Performance	0.522	0.503
Supply Chain Collaboration	0.484	0.483

Model Fit Indices

Shi and Maydeu-Olivares (2020) conducted a study that used multiple goodness-of-fit measures to evaluate the capacity of the structural equation model (SEM) to explain the data. Table 6 presents the results of the model fit indices. The Chi-square value of 559.771, SRMR value of 0.069, and NFI value of 0.859 indicate a strong alignment between the model and data within the acceptable range of error margins. Although the threshold of 0.9 is established, both the extraction index and the abnormality index do not meet this criterion. An ideal scenario is one where the squared residual has a common root and is significantly far from 0.

Table: 6 Model Fit Indices

	Saturated model	Estimated model
SRMR	0.069	0.071
d_ULS	4.570	4.792
d_G	3.195	3.273
Chi-square	559.811	559.771
NFI	0.859	0.854

Structural Model

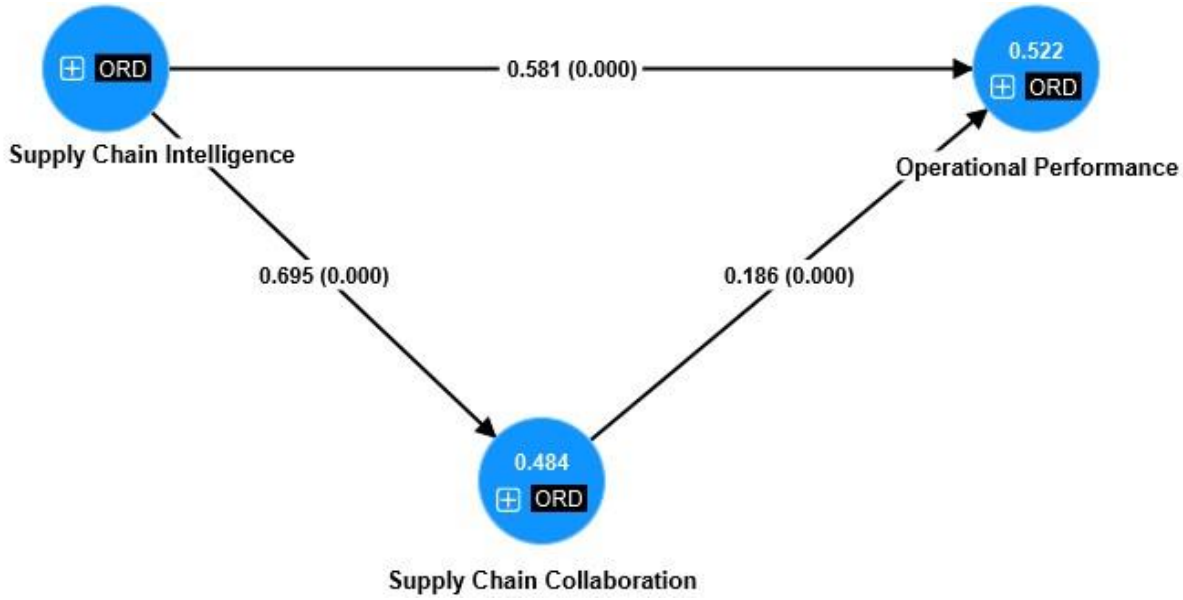
After confirming reliability and validity of the latent variables, the next is to present the structural model. The structural model consists of direct and indirect test to generate evidence in support of the hypotheses. The PLS SEM was used to perform the structural equation modelling. The result is

shown in figure 2 and table 7 below. The result in table 7 shows that SC intelligence has a positive and significant influence on operational performance (β = .186, p < 0.05). This provides support for H1. Again, SC intelligence has significant positive effect on SC collaboration (β = .581, p < 0.05). This provides support for H2. The results also show that SC collaboration directly and significantly drive operational performance (β = .695, p < 0.05). An analysis of the mediated effect shows that SC collaboration positively and indirectly mediated the link between SC intelligence and operational performance (β = .129, p < 0.05) providing for H3. Since the direct and indirect effect are both significant, it can be concluded that the type of mediation is complementary partial or positive confounding or a consistent model (Zhao et al., 2010).

Table 7: Structural Model

Hypotheses	Beta	STDEV	T statistics	P values
Supply Chain Collaboration -> Operational Performance	0.186	0.051	3.643	0.000
Supply Chain Intelligence -> Operational Performance	0.581	0.036	16.279	0.000
Supply Chain Intelligence -> Supply Chain Collaboration	0.695	0.026	26.398	0.000
Supply Chain Intelligence -> Supply Chain Collaboration -> Operational Performance	0.129	0.036	3.546	0.000

Figure 2: Structural Model Evaluation



Discussion of Results

Objective one of the paper sets to examine how SC intelligence affect operational performance. The findings demonstrated that SC intelligence has a positive and significant effect on operational performance. The findings support the hypothesis of the study. This implies that SC intelligence is responsible for an increase in operational performance of SMEs, hence a unit increase in SC intelligence contribute to increases in operational performance. The findings suggest that employing SC intelligence practices may considerably assist SMEs improve upon their performance. They may boost efficiency, cut costs, and improve overall performance by receiving insights into their SC activities. This emphasizes the significance of investing in technology and data analytics to successfully harness supply chain knowledge for best outcomes. The finding is in line with Belhadi et

al., (2021). According to Yang et al. (2021), enhanced visibility and forecasting facilitated by SC intelligence enable organizations to optimize inventory levels, decrease stockouts, and improve on-time delivery. Maina (2021) posits that SC intelligence systems enable managers to make informed decisions quickly, resulting in cost-effective transportation routing and enhanced production schedules. By lowering costs and optimizing resource allocation, this decision-making skill improves operational performance. Furthermore, Modgil et al. (2022) indicated that sophisticated SC intelligence promotes effective cooperation with suppliers and consumers, resulting in smoother coordination, fewer mistakes, and better order fulfilment, eventually leading to increased customer satisfaction. Lohmer et al. (2020) discovered that cost reductions from transportation route optimization and inventory cost reduction directly lead to enhanced profitability and cost efficiency, highlighting the favorable influence of SC information on operational performance. Additionally, Juan et al. (2022) observed that, the agility and reactivity provided by SC intelligence allow organizations to swiftly respond to market swings and supply interruptions, further establishing the link between SC intelligence and improved operational performance.

The second objective set to evaluate nexus between SC intelligence and SC collaboration. The findings showed that SC collaboration is positively and significantly influenced by SC intelligence. This supports the hypothesis in the study, implying that SC intelligence is positively related to SC collaboration. The findings suggest that a unit increase in SC intelligence may contribute to increases in SC collaboration. This implies that, SMEs with greater levels of SC intelligence are more inclined to collaborate within their SC. This means that a thorough grasp of the SC, including its procedures, linkages, and dynamics, might improve SMEs' collaboration. It also emphasizes the need for investing in SC intelligence as a strategic approach to encouraging effective cooperation and increasing overall SC performance in SMEs. The results confirm seminal works ofMostaghel et al. (2019), Asamoah et al. (2021), Jimenez-Jimenez et al. (2019) and Lu et al. (2017) who found that SC intelligence enhances SC collaboration. As stated by Rejeb et al. (2021), SC intelligence systems improve information exchange and communication across SC partners, allowing for better cooperation in planning and decision-making processes. Similarly, Khan et al. (2022) discovered that SC intelligence technologies allow for real-time data exchange, which aids in the development of trust among partners and the alignment of their aims and objectives. Furthermore, Olan et al. (2022) indicated that SC intelligence improves coordination of operations such as demand forecasting and inventory management, resulting in coordinated efforts and increased cooperation throughout the SC. Belhadi et al. (2021) study demonstrated that advanced analytics and data-driven insights produced from SC intelligence systems improve cooperation by allowing partners to detect and manage supply chain issues collaboratively.

Objective three set to determine the SC intelligence and operational performance and the role of SC collaboration. The findings revealed that the indirect role of SC intelligence on operational performance through the mediating role of SC collaboration is positive and statistically significant. This means that SC collaboration partially contributes to enhancing the link between SC intelligence and operational performance. The findings imply that SC collaboration is an enablerfor SC intelligence to improve operational performance among the SMEs. This indicates that the extent of cooperation within a SC has significant effects on how SC knowledge converts into operational efficiency. In other words, when SC partners collaborate well, the information they hold may be better exploited to increase overall performance. Several studies have shown that SC collaboration considerably mediates the relationship between SC intelligence and operational performance. For instance, according to Onofrei et al. (2020), SC intelligence improves collaboration by facilitating efficient communication, information exchange, and coordination among supply chain partners, and

this collaborative behaviour immediately translates into enhanced operational performance. Furthermore, Dey et al. (2023) discovered that SC cooperation mediates the link between SC intelligence and cost efficiency, implying that the collaborative application of intelligence-driven insights leads to cost savings and improved operational performance. Similarly, Annosi et al., (2021) posit that SC intelligence promotes trust among partners, paving the path for collaborative activities that improve operational performance measures such as lead times and on-time deliveries. Yu et al. (2017) emphasized that when disruptions occur, SC collaboration backed by intelligence systems allows rapid and coordinated actions, minimizing the detrimental effect of disruptions on operational performance.

Conclusion

The study found that supply chain intelligence significantly affects SMEs' operational performance. It was discovered also that supply chain intelligence significantly contributes to supply chain collaboration of SMEs. Similarly, the study revealed that supply chain collaboration significantly improves the operational performance of SMEs. The study concludes that adopting supply chain collaboration plays a vital role in improving operational performance among the SMEs.Supply chain collaboration was found to play a significant role in mediating the relationship between supply chain intelligence and the operational performance of SMEs. Managers of SMEs should make concerted effort to nurture dimensions such as an excellent work environment that supports the promotion of SCC systems with key partners to ensure efficient and effective functioning of their firms. SMEs should see themselves as partners to develop structures and mechanisms that can be used by organizations to stay competitive and enhance their operational performance. Also, SMEs need to build social networking systems to ensure frequent communication. Social networking is an indispensable tool in any relationship management and would help mitigate the problem of unreliable supply and untimely delivery of products by SMEs. It is imperative for managers to give priority to the creation of collaborative plans and diversification strategies in the supply chain. This entails information sharing, technology adoption, establishment of stockpile reserves, and implementation of adaptable production methods. In addition, allocating resources to modern technologies for immediate monitoring and communication can improve the ability to respond to possible disruptions, enabling proactive decision-making. Frequently evaluating and revising these techniques will enhance the collaboration and adaptability of the supply chain, leading to improved management of supply chain intelligence and overall operational performance.

Contribution to Theory

The results provide significant theoretical contributions to RBV theory as well as Transaction Cost Economics (TCE). From an RBV standpoint, the findings underline the strategic importance of SC information as a valuable and possibly scarce resource, emphasizing its role in improving operational performance and promoting supply chain cooperation. This is consistent with RBV's theory that a firm's competitive advantage is based on unique and valuable resources, implying that SC intelligence might be a source of long-term competitive advantage. Furthermore, the mediating impact of SC collaboration in connecting SC information to operational performance highlights the relevance of resource complementarity and strategic resource combinations, as emphasized by the RBV framework. Since there is a positive link between SC intelligence and cooperation, corporations may choose collaborative governance frameworks to harness their intelligence capabilities, possibly lowering transaction costs by promoting trust and eliminating information asymmetry. Furthermore, the mediation impact of collaboration highlights how governance decisions like collaboration may serve as ways to reduce transaction costs and improve operational performance.

Contribution to Practice

The results have a significant impact on organisations involved in SC management. First, recognizing SC intelligence's critical role means that businesses should invest in technology and data analytics to improve SC visibility, forecasting accuracy, and decision-making skills. This entails using sophisticated systems for analysing inventory, demand, and supplier performance, which may aid in proactively detecting bottlenecks and inefficiencies. The paper emphasizes the necessity of building a culture of data-driven decision-making and ensuring that essential stakeholders are properly educated in the use of SC intelligence tools. Second, the results emphasize the strategic importance of SC coordination. Firms should aggressively pursue partnership possibilities with suppliers, distributors, and other partners. This might include exchanging information, planning production and inventory management together, or even forging strategic partnerships. Collaboration may result in reciprocal advantages such as cost savings, risk reduction, and enhanced overall supply chain efficiency. Realizing that SC collaboration mediates the link between SC integration and operational performance drives organisations to approach SCmanagement holistically. It suggests that just investing in SC intelligence technologies is insufficient; enterprises must actively use this information to foster cooperation.

Limitations and Future Research Directions

The paper’s reliance on descriptive and explanatory research designs which may not capture the full complexity of the relationships between SC intelligence, collaboration, and operational performance might be a limitation. Furthermore, due to possible contextual changes, the study's emphasis on SMEs in Ghana restricts the generalizability of results to other areas or sectors. Future research could use longitudinal designs to investigate causal relationships over time, consider qualitative methods to gain deeper insights into the mechanisms underlying SC intelligence and collaboration, and broaden the scope to include a more diverse sample of SMEs from various countries and industries, allowing for a more comprehensive understanding of these relationships in a broader global context.

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