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DOES SUPPLY CHAIN COMPLEXITY DRIVE SUPPLY CHAIN INTEGRATION?

By

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DECLARATION

'I hereby declare that this submission is my own work towards the Master of Science Logistics and Supply Chain Management degree and that, to the best of my knowledge, it contains no material previously published by another researcher which has been accepted for the award of any other degree of the University except where due acknowledgement has been made in the text.'

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ABSTRACT

Due to the competitive advantage of enterprises' performance, the sustainable supply chain environment is drawing more and more attention from supply chain (SC) management. One of the major dangers in reaching the organizational objective is believed to be growing supply chain complexity (SCC), which can have a negative effect on cost, on-time delivery, profitability, operational effectiveness and customer satisfaction. Supply chains are incredibly complicated due to increased globalization, fluctuating client demands, expanded product lines, uncertainty over supplier performance and several other associated variables. The literature is conflicting, despite

prior studies suggesting that supply chain complexity is a key factor in determining performance results. Consequently, a more detailed analysis is needed. The study aimed at examining the relationship between supply chain complexity and supply chain integration. The study adopts a quantitative research design. A structured questionnaire was developed which was used in the collection of data from 80 respondents. The data was analyzed using both descriptive and inferential analysis. From the analysis, it was realized that there is a positive and statistically significant relationship between supply chain complexity and supplier integration. The study further shows that there is a positive and statistically significant relationship between supply chain complexity internal integration. The model showed a positive and statistically significant relationship between supply chain complexity and customer integration. Based on the study's findings, management was advised to have an in-depth understanding of supply chain complexity and supplier integration to avoid potential delays in receiving goods from their suppliers and to enhance supply chain performance. The findings imply that when the number and diversity of suppliers rise along with the degree of uncertainty and volatility in both downstream and upstream linkages, supply chain managers should pay attention to the integration process to protect operational performance.

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LIST OF ABBREVIATIONS

SCC	Supply Chain Complexity
SCI	Supply Chain integration
SC	Supply Chain
VSCC	Vertical Supply Chain Complexity
HSCC	Horizontal Supply Chain Complexity

SSCC	Spatial Supply Chain Complexity
II	Internal Integration
SI	Supplier Integration
CI	Customer Integration
OIPT	Organizational Information Processing Theory

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DEDICATION

I dedicate this thesis to the glory of the Almighty God. Through His kindness and strength, I was able to complete this work. Also, I dedicate it to my family for their unwavering support and encouragement throughout my studies.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The degree to which an organization's supply chain (SC) comprises many varied pieces that interact in unanticipated ways is known as supply chain complexity (SCC) (Aitken et al., 2016). Supply chains naturally get increasingly complicated as organizations diversify their product offerings, incorporate new technology, and expand their worldwide supply bases (Dong et al., 2020). This complexity is exacerbated by the uncertainty caused by unpredictable supplier lead times, changes by suppliers, rising customer expectations, and so on (Serdarasan, 2013). SCC is now one of the most important concerns in today's supply chains (Bode and Wagner, 2015). Hall et al. (2012) believe that it is important to look into the complexity of supply chains. According to McKinsey & Company, the food and beverage industry's complexity costs producers upwards of 50 billion dollars in gross revenues each year (Adams et al., 2016). As a result, current practicebased findings show that supply chain experts identify SCC with "problems" and seek to mitigate the associated risks.

Since there are several varied meanings, concepts and explanations of SCC in the literature, it is challenging to compare and integrate data. Choi and Krause (2006) describe SCC for the upstream supply chain as the "distinction of the focal firm's suppliers, their actual number, and the extent to which they interrelate," whereas other studies use varying levels of conception such as unpredictability within internal operations and uncertainty between downstream supply chain stakeholders with distinct sub-dimensions in each (Wiengarten et al., 2017). While some subdimensions such as the structural characteristics of SCC are frequently described and investigated, others such as range, variety, diversity and unpredictability are not (Thompson,

1967). Meanwhile, Fernández Campos et al. (2019) rather have a broader definition. The concept has been investigated less consistently and as a result SCC remains a nebulous idea (Bode and Wagner, 2015).

Supply chain complexity refers to the complexity of the products, relationships, and procedures that make up a chain. Due to its complexity, it is difficult to handle SC as expected and yet because of its relevance in the day-to-day business environment, it has become a critical issue in the global business arena. In the same vein, Wagner and Bode (2015) stress that complexity in supply chains has become one of the most significant issues today. Several factors, both inside and outside the chain, influence SC complexity. Complexity drivers refer to these components. The drivers of complexity must be identified to manage or reduce it (Walker et al., 2008). There may be difficulties inside modern SCs due to the numerous important partners, many of whom are typically situated abroad and have different perspectives and methods (Van der Byl et al., 2015). The complexity of each SC firm in planning and selecting the best course of action for activities to implement unavoidably increases as SC complexity rises, as dictated by the variety of SC partners (Sarkis et al., 2011).

The performance of a corporation will rely on the structure in which it operates and interacts, claims Sarkis et al. (2011). Performance may degrade as SC complexity increases, according to Bozarth et al. (2009), since it becomes more challenging to predict the outcomes of relationships when a complex system grows to include more interacting partners. The number of entities and nodes involved in an SC determines its static complexity, which represents the structural characteristics of a diverse SC system. Static complexity refers to a system's physical setup, and the structural characteristics of a system will show how unpredictable it is. Uncertainty is stated to be caused by the dynamic complexity as a consequence of a system change. Due to the

timedependent acts that increase the complexity of a system and cause unforeseen outcomes, it is regarded as having a time-independent complexity (Park and Kremer, 2015). Many writers have looked at how significant static complexity can influence extended and linked SC systems (Scholten, 2018). SC complexity is critical since it has a variety of effects on performance. As friction commonly occurs among SC partners when sustainability initiatives are adopted, recent work has fixated on the influence of complexity on SC sustainability (Mirghafoori et al., 2017).

The notion of supply chain integration (SCI) has sparked a lot of interest in operations and supply chain management studies (Ataseven and Nair, 2017). Flynn et al. (2016) define SCI as crosscompany connections of supply chain operations in its most basic form. It emphasizes the importance of cooperative connections, sharing of knowledge, risks and motivations among partners to provide a customer with the most value possible (Zhu et al., 2018). According to Bruque-Camara et al. (2016), all supply chain stakeholders must firmly commit to SCI. Integration strategies link all areas of the business, from suppliers to consumers, to guarantee that goods are delivered on schedule and to the right location (Gunasekaran and Ngai, 2004). The two main ideas of SCI are information sharing and cooperative decision-making (Jajja et al., 2018). According to Bagchi et al. (2005), honest information sharing is necessary for inter-organizational collaboration with important suppliers and clients. The dispersion of integration in supply chains is diverse and complicated, as noted by Prajogo and Olhager (2012) and Stevens and Johnson (2016), and it can only be accomplished by having a long-term perspective and working with partners.

1.2 Problem Statement

Firms are easily exposed to disruption events in today's changing business climate. It makes efficient supply chain management a difficult undertaking and necessitates the development of supply chain resilience. In this respect, a resilient supply chain allows it to be prepared for

unforeseen occurrences, lessen the impact of a disruption, and increase its ability to bounce back to its original or even superior condition (Jüttner and Maklan, 2011). At the same time, as product variety and customization levels rise, and supply chain partners become more globally distributed, the dynamic environment is mirrored in the complexity level of business operations (Bozarth et al., 2009). The supply chain's complexity, along with management and control challenges, makes it harder to resist or respond to unforeseen events (Datta et al., 2007), implying a negative impact on supply network resilience. For this reason, supply chain complexity is regarded by both practitioners and academics as one of the most important issues in modern supply networks and a significant barrier to productivity (Bozarth et al., 2009; Bode and Wagner, 2015). Although the negative impact of supply chain complexity on financial and operational performance has been frequently studied (Aitken et al., 2016; Brandon-Jones et al., 2015), the impact of supply chain complexity on supply chain integration appears under-explored. In other words, little study has been done on the connection between supply chain integration and supply chain complexity. The impact of supply chain complexity on supply chain integration is examined in this study. This study explores whether supply chain complexity influences supply chain integration to bridge this knowledge gap.

1.3 Research Objectives

The study seeks to empirically analyze the relationship between supply chain complexity and supply chain integration. Specifically, the study seeks:

1) To examine the influence of supply chain complexity on supplier integration.
2) To assess the influence of supply chain complexity on internal integration.
3) To examine the influence of supply chain complexity on customer integration.

1.4 Research Questions

The study seeks to answer the following research questions:

1. What influence does supply chain complexity have on supplier integration?
2. Does supply chain complexity influence internal integration?
3. How does supply chain complexity influence customer integration?

1.5 Significance of the Study

Supply chain complexity (SCC) and supply chain integration (SCI) have both been discussed in the literature. To establish supply chain complexity in manufacturing enterprises, the research aims at evaluating supply chain complexity and its effects on supply chain integration, namely supplier, internal and customer integration. This research adds to the body of knowledge in two ways. First, by considering a developing country where technological advances and deployment are low, the study broadens the contextual view of the impact of supply chain complexity on supply chain integration.

Second, the study makes a relevant contribution by exploring whether and how supply chain complexity drives supply chain integration in firm performance. The study argues that though managing supply chain complexity may drive supply chain integration, it may not automatically lead to firm performance; therefore, researchers need to identify firm-specific mechanisms that translate such strategic resources into superior performance outcomes. It is helpful for managers to implement suitable actions to derive the possible performance advantages of supply network complexity drivers because such knowledge clarifies the performance implications of supply chain complexity. Along this line, the study integrates studies that separately analyzed the relationships between supply chain complexity and supply chain integration.

The study will be interesting to policymakers since it expands their understanding of Ghana's industrial sector. This study will assist various manufacturing industries in developing better guidelines for regulating supply chain complexity and supply chain integration in light of recent reforms in the manufacturing sector. Furthermore, this study will be valuable to students, researchers, academics, consultants, and other practitioners for learning, discussion, consulting, and future research in this field.

1.6 Overview of Methodology

This thesis employed a quantitative research approach with 80 respondents to examine and analyze field data to determine if supply chain complexity promotes or hinders supply chain integration in some Ghanaian manufacturing enterprises. The manufacturing sector was chosen as the empirical context where manufacturing firms in Greater Accra and Ashanti regions constitute the study population. The study adopted a cross-sectional survey design The data collection tool for the study was questionnaires. The data was analyzed using descriptive statistical methods such as frequencies and percentages and inferential statistical tools such as regression and correlation with the aid of SPSS statistical software.

1.7 Scope of the Study

The study's conceptual scope is limited to supply chain complexity and supply chain integration (supplier, internal, and customer integration). It focuses on firms in Ghana's manufacturing industry in parts of the Greater Accra and Ashanti regions.

1.8 Limitations of the Study

The study looked at how supply chain complexity affects, fosters, or inhibits supply chain integration in some Ghanaian manufacturing firms. The research was restricted to some Ghanaian industrial companies centered in parts of Greater Accra and Ashanti regions. It was challenging to obtain data from the chosen respondents. This is because some individuals were unwilling to provide certain personal information. A number of the questions may have been filled out erroneously or incompletely. More importantly, given the limited sample size, the generalizability of the findings may be affected.

1.9 Organization of the Study

There are five significant chapters in this research. In chapter one, the analysis is introduced. It focused on the context issue, research aims, research issues, relevance, research methods, and scope of the study. The theories and articles on supply chain complexity and supply chain integration by many authors and academics were examined in chapter two to aid in the analysis of the data gained from the survey. In the third chapter, the researcher discussed the method and data sources used to complete the study. The fourth chapter dealt with evaluating the data and discussing the conclusions of the study. In chapter five, the findings were summarised and compared to previous literature suggestions. It then draws inferences and makes suggestions based on the facts. There were also suggestions for further investigations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents works related to this research and particularly the following have been discussed: the conceptual review, including supply chain complexity and its drivers (internal, external and interfacial); supply chain integration (supplier integration, internal integration and customer integration) followed by the theoretical review, notably organizational information processing theory; the empirical review, which comprises the relationship between the constructs, and the last section comprises the conceptual framework and hypothesis development.

2.2 Conceptual Review

This section reviews how various authors define the key variables and how they relate to the study. This section looks at the various literature concerning the area of study, identifies key concepts, and determines key concepts adopted for the study.

2.2.1 Supply Chain Complexity (SCC)

Many globally successful companies depend heavily on their supply chain networks. All goods begin at the parent company's planning stage and continue until they reach the client. Before a product reaches the consumer, the product passes through multiple phases at the hands of several network partners, each of whom adds value. Service providers in the industrial and service sectors must collaborate with several SC partners to enhance their product offerings. The importance of SC is growing more than ever because of the globalization of the business sphere. As a result, businesses need to manage their SC networks as efficiently as possible. However, managing an SC network to meet demand is sometimes a difficult undertaking (Manuj et al., 2011). Many

obstacles/problems stand in the way of efficient and successful network administration (Ellinger et al., 2002). These days, SCs have numerous intricate relationships with their suppliers, clients, and other companies, making it challenging to manage the supply chain.

Complexity, in the perspective and/or theories of S. Vachon and R. D. Klassen (2002), has given rise to a variety of definitions and applications in industrial, organizational and information technology studies. Supply chain complexity is characterized by the risks or challenges that arise within multiple SC organizations during product conceptualization, development and dissemination, according to studies by Bozarth et al. (2009). It was described as chaotic systems, concurrent interactions, and amplifications by Wilding R. in 1998. According to Vachon and Klassen (2002), complexity is a three-dimensional notion that encompasses the multiplicity, connectivity, and unpredictability of the system. Additionally, they described SC complexity as a metric for the degree of complexity exhibited by the contributing factors and performing elements that have an impact on it. According to Novak et al., (2001), product architecture and SC complexity are related. In the meantime, Perona et al. (2004) analyzed the impacts of complexity on SC in exploratory work. Their findings imply that a corporation's success is significantly influenced by how it controls system complexity. The complexity driver, by Bode et al. (2015), increases the number of SC interruptions, and the components interact and amplify one another's impacts.

Complexity in an SC can result in more costs, poorer SC performance overall, and lower client satisfaction, all of which can damage a company's reputation. As a result, it is critical to cope with the complexity that arises within SC. SC is complicated by several issues. These elements are referred to as drivers, and they are linked to the complexity of the system. Process design and layout, information flow, and operational procedures are a few examples of internal factors that

may contribute to this complexity. External factors like upstream and downstream partners may also play a role (Bozarth et al., 2009).

According to Serdarasan (2013), there are two types of SC complexity drivers: static and dynamic. Dynamic complexity drivers are connected to the SC's uncertainty or randomness, whereas static complexity drivers are connected to the SC's structure. The causes of particular SC complexity can be determined using a variety of sources, such as questionnaire interviews, past and present databases, archives, and so forth. By figuring out the factors that contribute to SC complexity, the partner firms will be able to control and maintain their SC more effectively. This facilitates achieving better SC outcomes (Koudal et al., 2007; KPMG, 2011). The relationships between manufacturers, production lines, distributors, and retailers complicate the industrial supply network, according to research by Pathik et al. (2007), A logical method for assessing and managing complexity may be created by developing an understanding of how these linkages interact.

At various supply chain stages, complexity takes many forms. Upstream, internal and downstream are the three basic supply chain levels that are differentiated in the current literature (Bozarth et al., 2009). While some researchers have concentrated on only one level, such as internal complexity or upstream complexity (Dong et al., 2020), others have studied all three levels (e.g. Wiengarten et al., 2017). The focus company's upstream complexity rises when it has several suppliers from various geographic locations, sizes of firms, organizational cultures, and technical capabilities (Chae et al., 2019). Similar to how extended supplier lead times are unpredictable and add to upstream complications (Brandon-Jones et al., 2015). When there are many different kinds of parts, processes, and products, or when the manufacturing schedule varies often, internal complexity is high (Eckstein et al., 2015). When a company strives to meet a range of changing

customer expectations and requirements, its downstream complexity, which is connected with the size and diversity of clients, increases (Caridi et al., 2010). A second factor contributing to the dynamic downstream complexity is shorter product lifecycles (Chen, 2018).

While SCC is typically associated with subpar performance outcomes, that isn't always the case, according to a recent study, for instance one by Sharma Pathak et al. (2019). SCC may have an impact on the company's operational success by limiting its capacity to succeed at its competitive strategy, including any combination of product quality, cost, speed and versatility (Ward et al., 1998), which could affect operational effectiveness (Vachon and Klassen, 2002). Another crucial strategic performance criterion is innovation results, a performance element that is frequently taken into account separately from the typical competitive concerns previously mentioned. Several research particularly looked at the complex relationship between SCC aspects and the creativity of the target business (Sharma Pathak et al., 2019).

2.2.1.1 Component of Supply Chain Complexity

According to Bozarth et al. (2009), detail complexity or structural complexity is unlike dynamic complexity, which is defined as "the uncertainty of a system's response to a given set of inputs"; structural complexity is defined as "the unique code of components or elements that make up a system". According to Serdarasan (2013), structured complexity "describes the architecture of the supply chain, the amount and variety of its parts, and the extent of interactions between them". Dynamic complexity "implies the uncertainty in the supply chain and integrates time and randomness". Similarly, the study on systems complexity emphasizes the distinction between these two types of complexity (Senge, 2006). The distinctiveness of characterization approaches (items, procedures, clients, suppliers, and so forth) in an SC environment as well as their interdependencies and linkages determines structural complexity. The quantity, variety and

interrelatedness among components of the system also determine structural complexity. The system's dynamical motion causes dynamic complexity, which includes problems with time and unpredictability (Huaccho Huatuco et al., 2010). As a result, dynamic complexity is produced in an SC environment by the complexity of SC processes (Sivadasan et al., 2002) as well as the pattern of increase of SC elements or their interactions (Collinson et al., 2012). The literature has highlighted the possible negative impacts of complexity on delivery performance. However, a rising number of experts say that embracing some complexity might improve a company's competitiveness.

The complexity that might harm the SC function, on the other hand, could be essential to the firm's or strategic unit's strategy. Aitken et al. (2016) and Bozarth et al. (2018) suggest a distinction between strategic (or beneficial) and dysfunctional (or destructive) complexity, i.e. the level of unpredictableness required or not for a business unit to execute its strategy. Elimination and infrastructural facilities (or absorption) relate to the physiological process of lowering the use of unpredictability in the SC function or rather to the attempt to limit the negative impacts of complexity on SC performance (Serdarasan, 2013). This is because curbing approach complexity may be impractical or harmful to the institution. For non-strategic complexity, reduction methods should be used, but tolerance tactics can be used to mitigate the performance implications of strategic complexity. Nonetheless, while these two fundamental methods give a sound theoretical foundation on which to base the complexity management conversation, managers want more comprehensive and richer approaches to managing complexity in their SCs (Aitken et al., 2016; Bozarth et al., 2018). They require theories or insights to help them choose the right practices for the various complexity kinds and aspects that the SC stages must deal with. To help managers

understand how each sort of procedure may help the SC manage complexity, these notions or observations also need to be made clearer.

Managers need more elaborate and comprehensive contexts to handle the complication of their SCs. They want the knowledge that will help them choose techniques that are appropriate for the various complex kinds and circumstances. These observations need to be more illuminating, assisting managers in understanding how various types of practices could improve the SC. The five categories of complexity management techniques include lateral relations, self-contained activities, idle resource creation, information management investments, and environmental management techniques. Flynn and Flynn (2004) empirically tested this theoretical framework in a manufacturing environment. Aitken et al. (2016) used it to classify the few activities that they saw in an example test case. According to a survey, one-third of project management approaches may be classed as accommodation and two-thirds as reduction. Bozarth et al. (2018) investigated the function of project leaders in the construction sector using an ambidexterity lens method (exploration vs. exploitation).

2.2.1.2 Horizontal Supply Chain Complexity (HSCC)

According to organizational theory, horizontal complexity is connected to an organization's knowledge and skill competence (Daft, 2006). For instance, a company with more units, departments or business divisions than others has a higher level of horizontal complexity. The volume of local suppliers in a focal firm's supply base has been connected to the horizontal complexity of a production flow (Choi and Krause, 2006). Horizontal complexity is anticipated to be the driving force behind both of the disruptive processes mentioned above. First off, since no supplier can be entirely trusted, there will very likely be more disruptions as there are more genuine suppliers (Chaturvedi and Martnez-de-Albéniz, 2011). But as Choi and Krause (2006) notes, the

sourcing strategy used influences how severe these supply chain interruptions are (single-, dual- or multi-sourcing). The widespread deployment of dual/multi-sourcing systems will boost longitudinal complexity and the frequency of interruptions, but it will also minimize the severity of those disruptions when they do occur. Second, having a broader supplier base entails more administrative and coordination work, which may make it harder for a buying organization to foresee issues (Kasarda, 1974). The more uncomplicated suppliers a focused business has, the more interfaces there are to manage, monitor, and coordinate (Choi and Krause, 2006). Boundaryspanning personnel (such as those in supply chain management, buying, and logistics) are substantially less likely to have a sufficiently broad viewpoint to lessen the chance of interruptions as task complexity rises (Vachon and Klassen, 2002). Work complexity has been shown to decrease the choice quality and impair judgment efficiency (Wally and Baum, 1994).

2.2.1.3 Vertical Supply Chain Complexity (VSCC)

Companies that have higher degrees of hierarchy are much more complicated than those that have lesser levels. This is identified as vertical complexity (or hierarchy complexity) in organizational theory (Tolbert and Hall, 2009). The number of tiers in a supply chain, which has been associated with supply chain complexity, corresponds with this level of complexity (Blackhurst et al., 2005). First, the likelihood of vertical supply chain reactions (i.e. downstream interruptions from integrated supply chain tiers) is negatively associated with chain complexity (Choi et al., 2001). For instance, in January 2005, defective diesel injection pumps seriously disrupted Audi, BMW, and Daimler's supply chains. The inexpensive half-inch connector used in these petrol pumps had a Teflon coating issue that was ignored by the manufacturer, Robert Bosch. Federal-Mogul, a Bosch supplier in the US, produced the socket using Teflon that had been tainted by DuPont, a US chemical business. The contaminated Teflon shut down production lines at auto OEMs farther

along in the supply chain, causing a costly massive recall of thousands of vehicles and harming Bosch and the OEMs' brands (Wagner and Bode, 2006). This illustration shows how quickly other layers may change when one layer changes. Related to the domino effect, minor failures might compound unexpectedly to cause significant disruptions farther down the distribution chain (Chopra and Sodhi, 2014).

The likelihood of these economic effects increases with the number of layers. As a result, vertical complexity raises the possibility that issues that arise upstream may disrupt a company's supply chain (events that spread throughout the supply chain). Second, as the vertical supply chain becomes more complicated, the upstream supply chain becomes more unreliable (Milgate, 2000). Choi and Hong (2002) postulated that many focal firms lack transparency and knowledge of "what lies further than top-tier suppliers" (such as the identities of the second and third-tier suppliers). Usually, greater supply chain layers evolve gradually over time without supervision. Therefore, it could be difficult to observe and identify early warning signs. As an example, Simchi-Levi et al. (2014) mentioned Evonik Industries, a German second-tier automotive supplier, whose 2012 explosion at one of its production facilities severely disrupted several automakers.

2.2.1.4 Spatial Supply Chain Complexity (SSCC)

The multiplicity of an organization and/or its supplier base is referred to as spatial complexity, and it can cause supply chains to lose their structure (Choi and Hong, 2002). Global sourcing is usually linked with high degrees of geographic complexities in the upstream supply chain. Prior research has shown that regional complexity influences supply network complexity and the incidence of supply chain issues (Lorentz et al., 2011). A geographically scattered supply chain first and foremost entails a physically protracted flow of commodities with longer routes and unknown lead times, which increases the risk of disruption (Simchi-Levi et al., 2014). Longer routes, for instance,

usually have more logistical touchpoints and depend more on crucial infrastructure (like ports and airports), which are susceptible to risk factors including cargo theft, physical handling and climate issues (e.g. contamination with fresh or sea water, condensation, fire or natural disasters). The agent-based simulation research by Nair and Vidal (2011) found that longer average routes among supply chain nodes reduce the resilience of a supply network. Second, data and monitoring expenses grow as the proximity between providers rises, similar to horizontal complexity (Stock et al., 2000).

Due to trade restrictions, customs hurdles, currency rate volatility and institutional variations, global sourcing is often linked with more unpredictability and less transparency as compared to sourcing from local or local products (Wagner and Bode, 2006). Due to anticipated period and language problems as well as the limitations of face-to-face interactions, coordination of operations, consistency management and resource sharing become expensive when a customer and a vendor are separated by a substantial geographic distance (Madhavan et al., 2004). Even though modern technology has significantly reduced the costs of information exchange and monitoring, it is still challenging to constantly monitor vendors in terms of unprocessed forms like their financial position or even their specific environmental exposure dangers if the geographical location is great. It may be more difficult to swiftly recognize, analyze and use countermeasures over greater geographic distances.

2.2.2. Supply Chain Integration (SCI)

A supply chain is defined as a network of companies linked by both upstream and downstream links or vertical sequence of linked processes and exchanges that add value to the finished products and services delivered to the final client, and where the system is actively governed by purchasing firms (Singh and Verma, 2018). According to Liao et al. (2017), supply chain operations might

provide the production and communication sectors an advantage if they use supply chain competencies as a guiding principle and a significant source of competitive edge. This study examines customer integration, supplier integration and internal integration as aspects of supply chain integration, which is consistent with studies by Kumar et al. (2017). In operations and supply chain management field, the idea of SCI has garnered a lot of attention (Nair and Ataseven, 2017).

According to Flynn et al. (2016), the most fundamental definition of SCI is cross-company connections of supply chain processes. To give a consumer the most value possible, it focuses on the necessity of strategic collaboration, information distribution, risks and incentives among partners (Zhu et al., 2018). Every supply chain participant must firmly commit to SCI (Bruque et al., 2016). Integration techniques successfully integrate every stage of the process, from suppliers to customers, resulting in on-time and accurate delivery of the products (Ngai and Gunasekaran, 2004).

Information exchange and group decision-making among partners are crucial components of SCI (Jajja et al., 2018). According to Bagchi et al. (2005), big suppliers and customers work together across organizations to share information. According to Prajogo and Olhager (2012), the widespread adoption of supply chain integration is a difficult and varied task that can only be completed by cooperating with partners over an extended period. Integration, according to Flynn et al. (2016), makes the business more dependent on internal and external stakeholders. In a previous study, the relationship between supply chain integration and organization effectiveness was examined. To ensure that their supply chain partners act in the company's best interests, Ralston et al. (2015) claim that supply chain integration pushes firms to divulge and relinquish control over data that was previously exclusive. According to Lu et al. (2018), supply chain integration affects operational performance, and integration affects supplier and customer

collaboration, cost and efficiency. It is possible to pinpoint several SCI characteristics and dimensions. Therefore, multidimensional components were used to quantify SCI in prior studies (Weingarten et al., 2016; Liu et al., 2016). "Supplier integration (SI), internal integration (II), and customer integration (CI)" are the three commonly acknowledged elements (Zhao et al., 2015).

2.2.2.1 Supplier Integration (SI)

Suppliers are seen as the only provider of inputs needed for organizational operations, hence they are essential to the ongoing production of goods and/or services to satisfy customer expectations. To manage changing customer expectations while also reducing cycle and delivery times, large manufacturing businesses nowadays develop solid alliances and connections with their suppliers. To aid in the production and be nearer to the client, suppliers are also getting more engaged in the process of goods and processes. Supplier integration refers to the development of interorganizational strategies, coordinated procedures, information exchange, knowledge and network coupling with suppliers (Chaudhuri et al., 2018). Stank et al. (2001) defined supplier integration as "the degree to which a firm may work with its core supplier members". Some authors refer to supplier integration as downstream integration. Scannell et al. (2000) examined supplier integration with a focus on upstream integration. According to Flynn et al. (2010), supplier integration requires essential skills linked to working with important suppliers. For production plans, on-time deliveriess and service speed, a good standard of supplier integration is desirable, especially in upstream activities (Chen et al., 2018).

Supplier integration, as defined by Duhaylongsod and De Giovanni (2019), is a "state of synergy" that involves tight interaction with suppliers. To maintain close coordination and synchronization between a firm's supply chain and its important clients, share vital information (such as demand forecasts, inventory levels and production schedules) across a shared communication channel (Jia

et al., 2020; Kalyar et al., 2019). Supply chain integration with suppliers is a type of supply chain management that involves close alignment and collaboration (Bienstock and Birasnav, 2019). Among the relevant pieces of information provided across existing exchanged communications and network channels are demand estimates, stock levels and production schedules.

2.2.2.2 Internal Integration (II)

The foundation that keeps the continuity and safety of all supply chain members is internal integration. It serves as both the suppliers' and the customers' focal point. The corporation cannot connect suppliers or consumers without internal integration. The acceptance of the direction of an organization, vision, and ambitions by all departments results in the availability of specified and shared goals, which are crucial for developing an efficient supply chain strategy. When such an agreement exists, each department takes into account two different types of clientele. The company's primary customer is the item or service it wishes to offer, and its secondary customer is the department or employee who relies on the additional output to complete their role and, in turn, achieve the broader organizational objectives. Internal supply chain management is the integration of internal logistics operations inside the confines of a corporation. According to one definition, internal integration is "the degree to which a firm arranges its plans, processes, and processes into linked, cooperative processes to meet the needs of its consumers and successfully engage with suppliers" (Flynn et al., 2010). According to Zhao et al., (2011), internal integration stresses organizational structure, processes, and procedures; as a result, it must be collaborative and coordinated to meet customer expectations.

According to Flynn et al. (2010), internal SCI is critical since it serves as the basis for customer and supplier integration. Frankel and Mollenkopf (2015), however, contend that nothing is known about it at the moment. The ability of a company's departments to communicate and coordinate

procedures is referred to as internal integration. Therefore, internal integration's primary objective is to harmonize and integrate a company's internal practices, strategies and processes (Qi et al., 2017; Chai and Kim, 2016). Chang et al. (2016) synchronized plans, activities and operations through information exchange and group decision-making. Internal integration links functional divisions including buying, production and sales, according to Zhang et al. (2018). This research defines internal integration as upholding cross-functional collaboration and cooperation inside an organization to accomplish organizational strategic goals. The nature of the connections, synchronization and interaction between organizational departments was evaluated using a series of questions.

2.2.2.3 Customer Integration (CI)

Customers are the lifeblood of businesses, regardless of the goods or services they offer, and they provide the vitality that is necessary for the firm to grow and endure in the face of tough competition. What was formerly considered vital may shortly turn out to be supplemental since customer demands and expectations are continually shifting. Organizations should thus closely monitor developments in the external environment, including advancements in the political, economic, social, technical, and legal spheres. To beat rivals and satisfy customers, it should take proactive rather than reactive action. One of the most important aspects of supply chain management is customer relationship management. On customer integration, many academic viewpoints were investigated and defined.

2.3. Theoretical Review

The theoretical review aims to identify existing theories about the research idea and the relationship between them.

2.3.1. Organizational Information Processing Theory

Caridi et al. (2010) demonstrate the need for improved exposure in dynamic supply chains. Their findings reveal that focused firms can struggle to adapt knowledge exchange to supply chain dynamics in some circumstances. They argue businesses are currently unaware of the providers' vendors. CT also attempts to explain how businesses share intelligence and what specific information-sharing techniques are employed in supply chains to meet information management requirements. According to Grover and Saeed (2007), companies will benefit from implementing inter-organizational structures where product or component complexity is high and business fragmentation is low. In a similar vein, Kim et al. (2006) claim that the supply chain's optimal efficiency results from integrating the data processing capacities supplied by electronic information distribution with the information processing need to be generated by the interorganizational environment.

Businesses must be able to coordinate and use data effectively, especially while doing operations with a high level of uncertainty (Galbraith, 1977). According to Galbraith (1998), companies should either limit their information needs by "mechanistic" operating techniques or expand their information processing capability. Businesses coordinate interdependent operations in mechanistic models through division of labor and centralization. Conflicts are assigned to administrators who have "exception scenario" solutions. Organizations that use this strategy seek to organize actions based on rules, hierarchy, priorities, and strategies to deal with specific, exception scenarios. Businesses facing supply constraints because of capability issues, for example, can resolve the problem by shifting it to a manager who oversees boundary-spanning tasks. Administrators may

feel frustrated by many demands to handle difficulties in increasingly uncertain settings because of the frequency of exception occurrences.

Businesses can deal with the rising incidence of exception scenarios by decreasing their information processing requirements or expanding their information processing capability (Peng et al., 2014). However, by using slack technologies and/or generating self-contained activities, an organization can reduce its information management requirements. These acts are inefficient and do not contribute to responsiveness. Alternatively, an organization's information processing ability can be improved by engaging in both lateral partnerships and vertical information structures (Srinivasan and Swink, 2015). External lateral relationships entail operational protocols that enable firms to gain existing and usable knowledge from both buyers and vendors. By enhancing the availability (visibility) of information, such lateral linkages are thought to improve decisionmaking efficiency. Companies can use vertical information systems to manage data in a way that does not overburden hierarchical communication networks during job execution. Vertical information systems enable an organization to manage data effectively and intelligently, allowing it to easily adjust or plan new plans with lower capital expenses.

2.4. Empirical Review

2.4.1. Past Research on Determinants of Supply Chain Integration

Integration, according to Flynn et al. (2016), increases the reliance on stakeholders, both internally and externally. Prior research has covered supply chain integration and how it relates to financial and operational success (Ralston et al., 2015), demonstrating that supply chain integration requires businesses to disclose and relinquish control over information that was earlier regarded as confidential, handing the knowledge to their members of the supply chain in the hopes that they will act in their best interests. According to Lu et al. (2018), the degree of dependency affects cost

and efficiency as well as coordination between suppliers and customers. Supply chain integration influences operational performance. According to Kumar et al. (2017), SCI improves the performance of the supply chain. When a supply chain is confronted with environmental externalities, cooperation and integration have a higher impact on its performance, according to a prior study (Flynn et al., 2010) that examined the relationship between supply chain cooperation and agility. According to Fayezi et al. (2017), internal and outside (customers and suppliers) integration is crucial for building flexibility in an institution's supply chains. Supply chain agility, which enables a business to swiftly recognize and respond to internal and external threats through effective supply chain integration, was also highlighted as a significant skill in this study. An agile company may quickly turn obstacles and change into opportunities. To guarantee a company's long-term success, agility must be used and maintained across the supply chain, despite its importance and need (Fayezi et al., 2013).

In their studies of the changeover of supply chains from lean and functional to agile and customized, Christopher and Towill (2001) and Jia et al. (2020) showed that supply chain agility is a connectivity concept with strong competitive competencies, with market sensitivity, process, and system assimilation, and the existence of cybernetic collaboration as key determinants of relationship integration. The responsiveness or capability of a supply chain is also assessed through strategic sourcing (Fayezi et al., 2017). It affects how quickly a business reacts to an outsidecreated motion, as opposed to the supply chain's capabilities and performance, which are typically influenced by internal causes (Alvarado-Vargas and Kelley, 2019). Companies with an efficient supply chain have become increasingly important to create a network of partners as economies have evolved and trading dependencies have expanded (Fayezi et al., 2017). Agility includes the ability to create win-win relationships with external allies, which is perfectly acceptable in highly

erratic and volatile situations. Companies that analyze external surroundings and changes, forge beneficial partnerships with stakeholders, customers and suppliers, and promptly adjust to these changes have an advantage over rivals in the new environment.

The title of research by Koufteros et al. (2007) that examined the causes and effects of supplier integration in product activities was “black box” and “gray-box” supplier integration in product design: Antecedents, consequences, and the moderating role of firm size. A social network viewpoint was used to develop the research technique, which included 157 firms as a sample. Antecedents, supply base optimization, supplier selection and supplier embedding were found to have a favourable impact on supplier integration.

Forslund and Jonsson’s (2009) study “Obstacles to supply chain integration of the performance management process in buyer-supplier dyads: The purchasers’ perspective” sought to clarify the extent to which operational tool challenges and supplier relationship challenges prevent supply chain integration of the performance management method. A hypothetical-deductive study’s findings were based on a poll of 257 procurement managers in nine Swedish industrial sectors. The mean, standard deviation and reliability coefficients were calculated using scale testing. The integration of the performance management approach was found to be delayed by issues with supplier relationships (lack of trust, contradictory goals and priorities, and a lack of concurrent communication structure).

Zhang and Huo’s (2012) study, “The Impact of Dependence and Trust on Supplier Chain Integration,” looked at how dependability and trust in the supply chain impact how the supply chain is integrated and how well it performs financially. Data from 617 Chinese businesses in industries including publishing and printing, chemicals and electrical, catering services, jewelry, pharmaceutical and health, and arts and crafts were analyzed using structural equation modeling.

The structural equation modeling method as well as reliability and validity were applied. It was discovered that customer/supplier trust has a major impact on supply chain integration.

2.4.2. Past Research on Outcomes/Consequences of Supply Chain Complexity

Complexity in the supply chain is frequently linked to poor operational effectiveness (Turner et al., 2018). Complex systems, which are made up of many different parts, create a disordered situation for the focal company and raise its operational load when it comes to managing several players (De Leeuw et al., 2013). Firms become more sensitive to several operational hazards such as supply chain disruptions when this impact is coupled with high uncertainty and unpredictability that occur with complexity (Birkie and Trucco, 2020; Bode and Wagner, 2015). Increased transaction expenses (such as those connected to manufacturing, stocks, shipping, and communication), lower efficiency, protracted and unpredictable lead times, difficulties meeting deadlines, and variable product quality are some negative outcomes (Dittfeld et al., 2018). These impacts might be the result of internal complexity as well as external complexity (both upstream and downstream) (Serdarasan, 2013).

Upstream complexity has the most negative impact on operational performance. The expenses of maintaining a big supply base increase in lockstep with the number of linkages and interfaces that must be handled (Giannoccaro et al., 2018; Lu and Shang, 2017). This is partly due to the focal firm's higher information processing needs, which result in higher overheads (Bode and Wagner, 2015; Lu and Shang, 2017). Additionally, the target company's burden of coping with numerous organizational cultures, cultures and institutional frameworks is increased by suppliers who are varied in terms of region or industry (Dong et al., 2020). As a result, as transaction costs rise, the focal firm's degree of control over the supply base decreases, leaving it less prepared to deal with possible supplier dishonesty (Giannoccaro et al., 2018). The dissemination of quality criteria and

collection of consistent feedback from several vendors are other examples of loss of control. Bode and Wagner (2015) contends that upstream complexity increases the likelihood of disruptions and necessitates managerial action to prevent or regulate them. Based on the sheer number of suppliers, a more sophisticated primary supplier is more likely to be linked to more regular and poorly handled interruptions in any situation. Vigorous complexity, in conjunction with detail complexity, has a detrimental impact on operational performance. For example, because the focal business adjusts its production tactics regularly and keeps additional safety stock, supplier lead times are volatile, resulting in increased operating costs (Lu and Shang, 2017).

Numerous clients with wide variations in demand, according to Bozarth et al. (2009), impair operational efficiency, which results in lower production volumes and more setups. With more and more diversified clients, transaction costs may rise, lowering the company's ability to effectively manage its customer base. For instance, geographic dispersion is anticipated to enhance client variety, which might raise stock levels and cash-to-cash order processing (Lorentz et al., 2012). The bullwhip effect brought on by a change in the distribution method can also have a substantial influence on local company operations due to the diverse client base that includes wholesalers, dealers, third-party logistics providers, and end users. Logistics and the number of goods or service customization delivered to the ultimate client may be affected by such disruptions.

Hu et al. (2008) claim that the productivity and quality of the car manufacturing sector are significantly harmed by the wide range of build-combinations. Low-volume manufacturing with a wider range of products and parts results in capacity limitations as well as higher planning and implementation expenses (Caniato and Größler, 2015; Wiengarten et al., 2017). Furthermore, increased inventory costs and lower efficiency are usually associated with the proliferation of

products. According to Wiengarten et al. (2017), complex internal processes harm operational performance, are challenging for quality control and continuous improvement, and also have an impact on delivery timeliness. Furthermore, given the volatile climate in which many businesses operate, more unpredictable production plans impede supply-demand matching, eventually harming operational performance.

Chen (2018) asserts that the demand uncertainty that emerges from the challenges associated with forecasting request volume and composition has a major detrimental effect on financial performance. As downstream complexity rises, the focus business may find it more difficult to maintain high customer satisfaction and develop collaborative partnerships based on relationshipspecific assets, resulting in a loss of market share and, eventually, a negative impact on financial performance.

2.4.3. Gaps in Past Studies

In their research, Aitken et al. (2016) looked at supplier integration by looking into information integration to handle supply chain complexity. They overlooked, however, other techniques like logistics, which may also help build competitive capacities. To explore this subject further, we define supplier integration in this study as a company's ability to both increase supply chain resilience and absorb the effects of supply chain complexity.

Without even using the word "complexity", some research looked into SCC sub-dimensions (e.g. demand volatility and long supplier lead time). Furthermore, while various sub-dimensions of SCC are frequently used as dependent variables (e.g. number of suppliers, demand uncertainty), it is difficult to find such research using an automated database search because the keywords are not specified in the abstract or title (Rosenbusch et al., 2013). We were able to lower the danger of publication bias, or the propensity for journals to publish papers with strongly supported

hypotheses, by incorporating research in which SCC parameters are control variables (Rosenbusch et al., 2013).

Melek et al. (2021) found that an increasing number of SCC studies rely on advanced data analysis in their work "Order from chaos: A contextual of supply chain complexity and company performance." However, there hasn't been a corresponding growth, in theory, to go along with these improvements. They discovered that the majority of research either has no relationship to any particular theory or adapts broad ideas like TCE or generic social network reasoning. Their findings support SCC as a general construct with important sub-constructs. By concentrating on certain boundaries or elements of SCC and how they relate to specific elements of performance, future SCC research might help advance theory. For instance, a business could have a very complex supply chain but a basic customer base or vice versa. The primary subdimensions of complexity may differ depending on the supplier and customer bases of a business. We might be able to better understand SCC if there were theoretical frameworks that distinguished between these components and made their interrelationships clearer. The researchers advise more research on the many SCC dimensions and levels to better understand its causes, effects, processes, and contingencies. Similarly to this, complexity is widely used in empirical studies as a dependent variable since it is assumed to explain performance discrepancies (Brandon-Jones et al., 2015). Their meta-analysis demonstrates that to conduct more pertinent studies and formulate sound hypotheses, academics should distinguish between various kinds of SCC rather than utilizing it as a baseline control variable.

2.5 Hypothesis Formulation

2.5.1 Supply Chain Complexity and Supply Chain Integration

Businesses must be able to collaborate efficiently and utilize data, especially while conducting operations under conditions of significant uncertainty (Galbraith, 1977). Galbraith (1998) suggested that businesses either reduce their information requirements through "mechanistic" operating methods or increase their information processing capacity. Companies will profit from developing inter-organizational structures where a product or component complexity is high and company fragmentation is minimal, claim Grover and Saeed (2007). Similarly to this, Kim et al. (2006) assert that the inter-organizational environment's demand for information processing is integrated with the data processing capabilities provided by electronic information dissemination to provide the supply chain's smooth operation. Vertical information systems can be used by businesses to handle data without placing an undue demand on hierarchical communication networks while tasks are being carried out. An organization can handle data more effectively and intelligently with the help of vertical information systems, which enables it to simply adapt or plan new plans with less capital outlay.

The firm's capacity to integrate, create, and respond to change to handle dynamically changing situations' is characterized as dynamic capabilities (Teece et al., 1997). Suppliers are viewed as the firm's external resources in this research, to maintain competitiveness and adapt to changing circumstances through mergers and reconfiguration. When a supply chain's complexity is great, it becomes more difficult to manage all of the associated actors, there is less capacity available to interact with members of the supply chain, and planning buffer inventories for interruptions becomes more challenging. As a result, a company's ability to resist and adapt to change would be harmed. Supplier integration as a competitive skill could be able to tolerate supply chain

complexity and have a beneficial effect on resilience in this situation. To begin with, integrating suppliers makes cooperative planning, efficient communication, and real-time information exchange easier (Wieland and Wallenburg, 2013).

Supplier integration enables improved inventory management, which increases the availability of raw materials and leads to greater preparedness for unforeseen events when a company operates in a complicated supply chain (Droge et al., 2004). Furthermore, a long-term connection with suppliers strengthens and broadens mutual trust and shared accountability, both of which are essential for reducing delivery complications (Jacobs and Subramanian, 2012). Suppliers are more ready to assist product flows to decrease lead times and mistakes caused by delivering complexity because of pooled risks and strategies (Li et al., 2016). It allows for a speedier reaction to market developments (supply chain agility). As a result, the projected negative direct link between supply chain complexity and supply chain resilience, as well as the direct association between supply chain complexity and supply chain agility, should weaken as the amount of supplier integration increases. Overall, by integrating suppliers to establish a competitive capability, the negative consequences of supply chain complexity may be somewhat mitigated, while supply chain robustness and agility are improved. Therefore, I propose that:

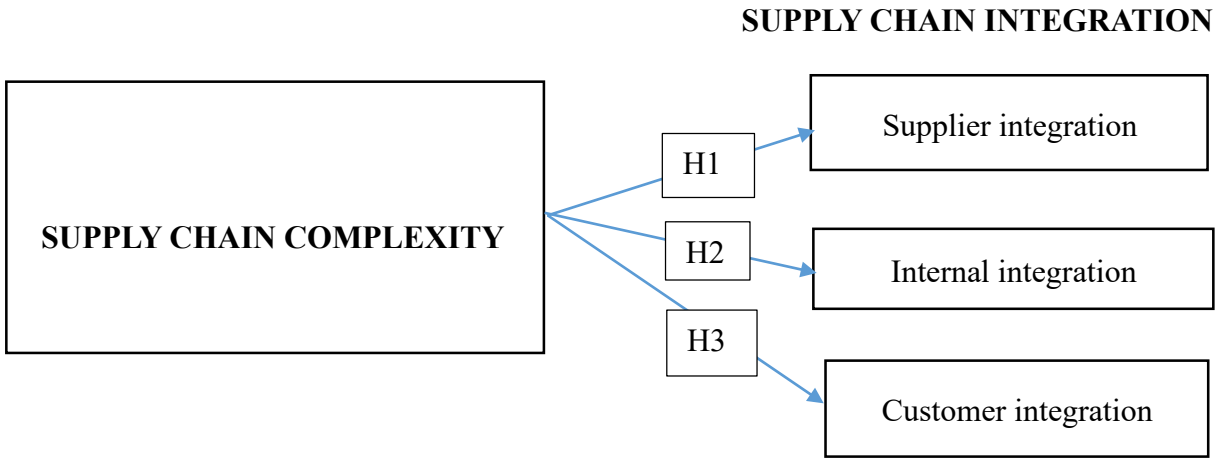
H1: *Supply chain complexity is positively related to supplier integration*

H2: *Supply chain complexity is positively related to internal integration*

H3: *Supply chain complexity is positively related to customer integration*

2.6 Conceptual Framework

A conceptual framework is a research instrument that helps with a greater understanding of the study issue. According to Atkinson (2006), a conceptual framework explores the conceptual and theoretical difficulties that surround and produces a distinct and unmistakable foundation on which present variables are constructed and identified. The goal of this research is to see if supply chain complexity promotes or discourages supply chain integration. Supply chain complexity is an research independent variable while supply chain integration is a dependent variable, as shown in Figure 1 below.



Source: Field Study (2022)

Figure 1: Conceptual Framework

METHODOLOGY

3.1 Introduction

The methods used in the study are described in this chapter. The chapter discusses key methodological concerns such as research approach and design, population, sample and sampling, data type and instrument, measures, data collecting, data analysis, reliability, validity, and ethical considerations.

3.2 Research Approach and Design

There are several methods for doing research, which implies there are various data possibilities and also data gathering and analysis approaches. In general, the research approach refers to whether a study focuses on generating theory based on existing evidence (inductive approach) or evaluating theory using appropriate data (deductive approach) (Saunders et al., 2007; Cohen et al., 2007). The purpose of this study is to test a theory/model concerning the nature of the link involving supply chain complexity and supply chain integration using a deductive method. The deductive approach employs quantitative data and statistical methodologies to make inferences based on a sample of data (Saunders et al., 2007).

The approach for collecting and analyzing data is referred to as the research design (Bryman, 2012). Cross-sectional (survey) design, longitudinal (survey) design and experiment are all common research designs connected with the deductive research technique (Bryman, 2012; Saunders et al., 2017). A cross-sectional survey approach was used in this investigation. This method entails gathering data on numerous variables from a huge number of instances all at once (Bryman, 2012). The use of a cross-sectional survey in this study is consistent with previous research on supply chain complexity (Bozarth et al., 2009; Serdarasan, 2013; Aitken et al., 2016)

and supply chain integration (Flynn et al., 2010; Singh et al., 2018; Qi et al., 2017). A crosssectional survey design is less appropriate for investigating cause-and-effect linkages than a longitudinal survey design and experiment. It is, nonetheless, suitable for studying the relationship between variables. Furthermore, the use of a cross-sectional survey methodology improves external validity and generalization (Rindfleisch et al., 2008). Due to time and cost restrictions, longitudinal survey design and experimental design were not addressed in the study.

3.3 Population

When a sample is collected from a larger group of participants, it is referred to as the population (Osoro et al., 2015). Pernecky (2016) asserts that a population is a larger grouping of all individuals from which a sample is taken. Cooper and Schindler (2010) define the unit of analysis as the person participant or the item on which the measurement is made. The study's population is made up of small- and medium-sized enterprises (SMEs) manufacturing sectors operating in the Ashanti and Greater Accra regions of Ghana and have existed for at least four years. Criteria for determining what firm size are numerous (Dabebneh and Tukan, 2007). In this study, SMEs refer to autonomous business entities that engage between five and one hundred full-time employees (Ghana Statistical Service 2015; Dabebneh and Tukan, 2007).

A business survey conducted by the Ghana Statistical Service (2021) indicated that GDP from manufacturing in Ghana increased to 4674.98 million Ghana cedis in the third quarter of 2021 from 4612.31 million in the second quarter of 2021. The Greater Accra and Ashanti regions are an excellent and essential empirical structure for the research of supply chain complexity and integration among manufacturing firms for at least two reasons. To begin with, these regions are the manufacturing hub of Ghana, with important logistics and transport infrastructure connecting

the rest of the regions as well as Ghana's surrounding countries. Also, both regions are notable administrative areas that contain the majority of Ghana's business firms and have a higher proportion of small, medium, and new businesses (Ghana Statistical Service 2016:2015).

3.4 Sample Size and Sampling Approach

Ary et al. (2018) define sampling as selecting a portion of a population to serve as a representative sample of the overall population. Saving money and time is the aim of sampling. There is not one method that works for all situations when choosing an appropriate sample size. While it is often believed that the larger the sample, the better, 'large' samples might lead to statistically significant effects for insignificant effects (Hair et al., 2014). Two criteria determined the selection of the appropriate sample size in this investigation. The first is the theoretical model's complexity in proportion to the statistical analysis necessary to estimate it, and the second is the generalization issue.

It is claimed that sample size requirements vary with model complexity, with complicated models (i.e. models with many connections between variables, independent variables, or variables that need to be estimated) necessitating a 'larger' sample size (Hair et al., 2014). The model for this study is quite simple, with only one dependent variable (supply chain complexity) and one independent variable (i.e. supply chain integration). The study used linear regression analysis to analyze this model. According to Hair et al. (2014), a sample size of fifty to one hundred is usually sufficient to identify a significant difference explained when using regression analysis with a power of .80 and an alpha of .05. According to Hair et al. (2014), using regression analysis with a ratio of fifteen to twenty instances per independent variable is often adequate. According to this recommendation, a sample size of at least one hundred people is required for this research. If the sample reflects the population, a sample size of at least one hundred is often acceptable for the

application of inferential statistics and can enable generalization (Hair et al., 2014). As was previously mentioned, the purpose of this research was to gather a representative group of at least 100 people. Two hundred companies were chosen for the study after concerns of non-response and unsatisfactory replies (e.g. missing data) were taken into account.

Due to problems in collecting a comprehensive and valid sample frame in Ghana, this study was unable to apply probability sampling procedures (Agyapong et al., 2019). The Association of Ghana Industries, Yellow Pages Ghana, Ghana Business Directory, and the Registrar General's Department's Directory all have databases with information on firms in the nation. To acquire information on enterprises that fall within the study's demographic, researchers used the internet databases of the Association of Ghana Industries and Yellow Pages Ghana. In this study, a twosampling non-probability technique was used. Quota sampling and purposive sampling were used in the first and second stages, respectively. Quota sampling was found acceptable since it provides for the collection of a sample with proportionate characteristics to the population (Bryman, 2012). As a result, many practitioners consider quota sampling to be as effective as probability sampling (Bryman, 2012). The primary causes of variation in the study's population are firm industry and size. Manufacturing companies made up the majority of the study's population. Because all of the companies in the study's population work in the manufacturing sector (Ghana Statistical Service, 2016), the study's goal was to collect the majority of the data from them. A purposive sample approach was used to choose the companies within each category after determining the percentage of enterprises to draw from these important sub-groups within the population. The researcher needed to give the study's instrument exclusively to firms of interest face-to-face; therefore, they used purposeful sampling (Chowdhury and Quaddus, 2016).

3. 6 Data Type and Instrument

Quantitative primary data was obtained via a structured/self-completion questionnaire following the study's research objective and design. The use of a primary source of data is consistent with prior supply chain complexity research (Bozarth et al., 2009; Serdarasan, 2013; Aitken et al., 2016) and supply chain integration research (Flynn et al., 2010; Qi et al., 2017). Furthermore, because of the nature of the research environment (small manufacturing enterprises in a developing economy), secondary sources of data to quantify the variables are difficult to come by. The questionnaire included items that tapped into the study's constructs (i.e. supply chain complexity and supply chain integration information) as well as demographic information about the respondents (gender, age, education level, position, and experience) and the firms (i.e. industry type, age and size). The measures employed to capture the study's constructs are discussed in the next section.

3.7 Measures

To find suitable measures for the study's constructs, a review of the current literature was done (supply chain complexity and supply chain integration). The study's supervisor generated and evaluated an initial item pool, following which suitable scale variables were created to measure them. Three elements were utilized to quantify supply chain complexity and supply chain integration after a series of evaluations.

Independent variable*:* Supply chain complexity is an independent variable in this study. Complex adaptive systems are what Surana et al. (2005) and Wycisk et al. (2005) refer to as SCC (2008). SC complexity refers to the complexity of the goods, procedures and exchanges that make up a chain. (1) Spatial supply chain complexity, (2) Vertical supply chain complexity, and (3) Horizontal

supply chain complexity are the three components used to quantify supply chain complexity. Each item was graded on a five-point scale ranging from "strongly disagree (=1)" to "strongly agree (=5)." Respondents were asked to rate how well their companies performed on each issue during the last year using this scale.

Dependent variable: Cross-company connections between supply chain operations are the most fundamental definition of supply chain integration (SCI) (Flynn et al., 2016). It emphasizes the significance of cooperative connections, information sharing, risks, and motivations among partners to provide the most advantage to a customer (Zhu et al., 2018). The three components used to measure this variable are supplier integration, internal integration and customer integration. These recommendations were from Flynn et al., 2010 and Qi et al., 2017. Each item was scored on a five-point scale ranging from "strongly disagree = 1" to "strongly agree = 5". Using this scale, the respondents were asked to indicate the extent to which they agree or disagree with the items relating to supply chain integration.

3.8 Data Collection

This study used a face-to-face data-collecting technique, namely delivery-and-collection, in line with previous survey studies that focused on senior managers as key informants and were done in Ghana (Agyapong et al., 2019; Boso et al., 2013). This data-gathering method is not only appropriate for the business environment but also yields a high response rate. In Ghana, mail and internet data collecting strategies are challenging to deploy due to the inadequate postal system and low internet ease of access rate. This study relied on field study personnel because of time constraints and the difficulties of giving surveys utilizing a face-to-face approach and reaching out to a large number of businesses (Adomako et al., 2018). The researcher did a background check

on the trustworthiness of the field study personnel to guarantee that quality data was acquired and that ethical issues were followed. The personnel was told to only collect completed surveys from important informants and not to pursue questionnaires that were not returned within 30 days.

3.9 Data Analysis

Given the study's explanatory nature, a quantitative approach to data analysis was used, which included the use of statistical tools. There were two different kinds of statistical analyses carried out. The first, descriptive analysis, which focused on producing descriptive results on the characteristics of the respondents and firms as well as the study's construct of interest, used statistical tools like frequency (percentages) and means (standard deviations) to generate results (including measures and composite scales for supply chain complexity and supply chain integration). The second, inferential analysis, which employed correlation and regression analyses to generate findings, was focused on determining the link between the study's components of interest. The study used IBM SPSS version 21 for all of its analyses and relied on tables and graphs to illustrate its findings.

3.10 Reliability and Validity

An instrument's reliability is the degree of accuracy assigned to the quantities to be measured (Shaba, 2008). Data analysis, according to Chapman (2018), is the process of examining, reorganizing, adjusting, and converting data to extract useful information. The degree to which evaluations are carried out efficiently is measured by reliability. The standards for reliability are based on the independence of the test instruments. They should offer a particular case free of the same outcome. Two analysts adopting the same procedure would certainly touch base on the same conclusion at the point when the dependability is high. Validity determines if the acquired data is

true and accurate, and it disseminates definite questions. The researcher considered fundamental reliability and validity factors in this investigation. First, the research supervisor, appointed by the university to scrutinize the form and type of inquiries, was given the questionnaire guide. The reasoning behind this was that they were transparent and fair, breaking down on the off chance. Once more, the questionnaire was distributed in advance to give our responders time and space to be ready. Finally, the information gathered was thoroughly coded and analyzed to lower the chances of oversights and failures. The method for data collection, which is the research questionnaire, was tested for its validity and reliability. By validity, the best indicators or questions were chosen to test the definition after a serious inspection of several indicators. This was activated by a pre-test. Also, metrics were tested to see accuracy in evaluating the definition at hand to fulfill the need for reliability. Linguistic ambiguity and ambiguous questions on selected indicators were subsequently eliminated or corrected. Each set of measures was tested for reliability using Cronbach's alpha, and their validity was determined first using exploratory factor analysis and then by evaluating the level of correlation across the scales (Hair et al., 2014).

3.11 Ethical Issues

Lewis et al. (2007) defined ethics as the rules or norms of conduct that direct moral judgments about our conduct and interactions with others. Greener and Martelli (2018) argue that ethical concepts such as non-maleficence, beneficence, autonomy, and fairness must be followed by researchers, especially in primary research. Newman et al. (2014) offered some fundamental norms for data collecting, including informed consent, voluntary participation, right to privacy, plagiarism, anonymity, and privacy concerns. To attain this purpose, many procedures were followed. First, the researcher took precautions to ensure that the respondents' and study organizations' privacy was protected. Second, plagiarism, avoidance of slanting the study results,

and educating interviewees about the research were all treated seriously. The consent of many manufacturing companies involved was required before the research could commence. Third, no monetary or other kinds of encouragement were provided to the responders. Fourth, notwithstanding logical pleas, those who did not finish the questionnaire after two follow-up calls and four weeks were eliminated from the research. Finally, the information gathered was solely utilized to fulfill the study's objectives, and it was stored safely (in separate areas) for future use if the need arose.

3.12 Chapter Summary

The methodology of the study is described in this chapter. In conclusion, the study relies on a cross-sectional survey methodology and a deductive approach to explore the relationship between supply chain complexity and supply chain integration. A sample of data from manufacturing firms in the Greater Accra and Ashanti regions is used to evaluate the link between these factors. The study uses a questionnaire to gather information from senior executives at companies, then hierarchical moderated regression analysis in SPSS is utilized to estimate the suggested theoretical model.

CHAPTER FOUR

RESULTS PRESENTATION AND DISCUSSIONS OF FINDINGS

4.1 Introduction

Following the research methodology utilized and the objectives of the study, the fieldwork results are incorporated, assessed, and discussed throughout this part. The objective of the study is to conduct an empirical analysis of the link between supply chain integration and supply chain complexity. The findings were organized into sections that were well-defined and reflected the goals and questions of the study. The review's main topics for discussion include the respondent's context, knowledge sharing, supply chain complexity, and supply chain integration.

This chapter focused on the examination and discussion of the data from the research that had been conducted. Before data analysis, SPSS version 23 was used to code the data. The data collected might be subjected to various sorts of analysis using this program. Eighty questionnaires were collected for the investigation. The investigation started with a demographic analysis, which looked at factors including years of experience, the product of the company, locations of the organization, and educational background. The data was then examined using both descriptive and inferential methods. For descriptive statistics, mean scores and standard deviations were employed, while linear regression analysis and Pearson's correlation were used for inferential statistics. This chapter offers a summary of the results of the analysis as well as a test of the hypothesis.

4.2 Demographic Information

Table 1 summarizes the respondents' demographic characteristics. A hundred (100) respondents were targeted; however, only eighty (80) out of the total number fully completed and submitted the questionnaire, which brings the response rate to eighty percent (80%).

Table 1: Demographic Information

Variables	Frequency	Percentage (%)
Company's head office		
Middle Belt (Ashanti Region)	12	15.0
Northern Belt (Northern Region)	4	5.0
Southern Belt (Greater Accra)	64	80.0
Total	**80**	**100.0**
Company's years of existence/operation		
1-5 years	31	38.8
11-15 years	11	13.8
16-20 years	5	6.3
6-10 years	15	18.8
Above 20 years	18	22.5
Total	**80**	**100.0**
Company employees on a full-time basis		
21-30	9	11.3
31-40	2	2.5
Above 40	69	86.3
Total	**80**	**100.0**
Dedicated supply chain management department/unit		
No	21	26.3
Yes	59	73.8
Total	**80**	**100.0**
People managing/supervising supply chain functions are generally well-educated		
No	14	17.5
Yes	66	82.5
Total	**80**	**100.0**
Have you been part of the organization for the past three years?		
No	11	13.8
Yes	69	86.3
Total	**80**	**100.0**
Highest level of education		
Bachelor's Degree	48	60.0
Diploma	1	1.3
Higher National Diploma (HND)	8	10.0
Master's Degree	21	26.3

Senior High School	2	2.5
Total	**80**	**100.0**
Position in the company		
CEO	12	15.0
General Manager	3	3.8
Managing Director	5	6.3
Marketing Manager	12	15.0
Operations Manager	14	17.5
Production Manager	6	7.8
Purchasing/Procurement Manager	5	6.3
Sales Manager	5	6.3
Supply Chain/Logistics Manager	11	13.8
Others	7	9.1
Total	**80**	**100.0**
Number of years in position		
1-5 years	66	82.5
16-20 years	1	1.3
6-10 years	13	16.3
Total	**80**	**100.0**
Product of the company		
Furniture and Fittings	6	7.5
Plastic Manufacturing	5	6.3
Automobile	5	6.3
Aluminum Smelting	3	3.8
Paper Manufacturing	3	3.8
Food Processing	35	43.8
Beverage Processing	12	15.0
Metal Processing	2	2.5
Other	9	11.3
Total	**80**	**100.0**

Source: Field study (2022) Majority of the respondents indicated that their company's head office is located in the southern belt (Greater Accra) and this recorded 64 respondents representing 80%. This is followed by respondents from the middle belt (Asante Region) recording 12 respondents representing 15% whilst those from the northern belt (Northern Region) recorded 4 respondents representing 5%. Respondents were again asked to indicate the number of years the company has

been in existence or operation. Thirty-one (31) of the respondents representing 38.8% indicated that their company has been in existence between 1-5 years and this is followed by those above 20 years of recording (18) of the respondents representing 22.5%. Fifteen (15) respondents representing 18.8% mentioned that the company has been in existence for 6-10 years, and this is followed by those companies that have been in operation for 11-15 years recording 11 respondents representing 13.8% and finally, companies that have been in operation between 16-20 years recorded the least respondents of 5 representing 6.3%. The respondents were again asked to indicate the number of employees the company has employed on a full-time basis. The majority of the respondents indicated that the company has employed over 40 employees and this recorded 69 respondents representing 86.3% followed by companies that have employed between 21-30 employees recording 9 respondents representing 11.3% whilst those between 31-40 employees recorded the least respondents of 2 representing 2.5%.

The existence of a specific supply chain management department or unit was also a question that the respondents were asked to answer. Majority of the respondents indicated that the company has a dedicated supply chain management department and this recorded 59 respondents representing 73.8% whilst those who indicated that their company has no dedicated supply chain management unit recorded 21 respondents representing 26.3%. Regarding whether the people managing/supervising the supply chain function are generally well-educated, 66 respondents representing 82.5% responded affirmatively whilst 14 respondents representing 17% indicated that people managing the supply chain function are generally not well-educated. The respondent was again asked to indicate whether they have been with the organization for the past three years. While 11 respondents, or 13.8%, said they had been with the company for less than three years, 69 respondents, or 86.3%, said they had been with the company for the previous three years.

Additionally, respondents were asked to identify their level of education and 48 responses (or 60% of the respondents) reported having bachelor's degrees. This is followed by those with a master's degree recording 21 respondents representing 26.3%. Respondents with higher national diplomas recorded 8 respondents recording 10% and this is followed by those with a senior high school certificate recording 2 respondents representing 2.5%. Those with diploma recorded the least respondent in 1 representing 1.3%. Also, it required the responders to state their present position within the business. The majority of the respondents were operations managers which recorded 14 respondents representing 17.5% and this was followed by CEOs, and marketing managers recording 12 respondents representing 15% respectively. 11 respondents representing 13.8% indicated that they were supply chain/Logistics managers whilst production managers recorded 6 respondents representing 7.8%. Purchasing/procurement managers recorded 5 respondents representing 6.3% and this is followed by managing directors and sales managers recording 5 respondents representing 6.3% respectively. Other positions recorded 7 respondents representing 9.1% whilst general managers recorded the least respondents 3 representing 3.8%.

Regarding the number of years, the respondents have been in the current position, 66 respondents representing 82.5% indicated they have been in their current position between 1-5 years and this is followed by those who have been in their current position between 6-10 years recording 13 respondents representing 16.3%. Those who have been in their current position for 16-20 years recorded the least respondents, 1 representing 1.3%. Furthermore, respondents were asked to identify the sector of the business they work in. The majority of the respondents were from food processing recording 35 respondents representing 43.8% and this is followed by beverage processing recording 12 respondents forming 15%. Furniture and fittings recorded 6 respondents forming 7.5% and this is followed by plastic manufacturing and automobile recording 5

respondents forming 6.3% respectively. Aluminum smelting and paper manufacturing also recorded 3 respondents each forming 3.8% respectively. Metal processing recorded the least respondents of 2 representing 2.5% and other sectors also recorded 9 respondents representing 11.3%.

4.3 Statistical Test

The measurement's internal consistency findings are shown in Table 2. All of the measures were judged to be valid and reliable since they were all within the allowed range of 0.7, according to the research.

Table 2: Internal Consistency of Construct

Construct	Number of Items	Cronbach's Alpha
Supply Chain Complexity	12	0.707
Customer Integration	8	0.825
Supplier Integration	9	0.799
Internal Integration	9	0.872

Source: Field Survey, 2022

4.4 Descriptive Statistics of Study Variables

The descriptive study of each concept is the emphasis of this section. The outcomes are provided in the next section. On a five-point Likert scale, 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree, respondents were asked to score each variable. As a result, it was predicted that the mean values for each item would range from 1.00 to 5.00, with 3.00 serving as the average.

4.4.1 Supply Chain Complexity

This section looks at the respondents' perspectives on the supply chain complexity factors.

4.4.2 Vertical Supply Chain Complexity

Based on the literature review, five (5) elements were chosen, and respondents were asked to rate their level of acceptance on a five-point Likert scale. The vertical supply chain complexity variables are shown in Table 3. The vertical supply chain complexity recorded an overall mean of 3.245. This shows that the vast majority of the respondents agreed with the variables of vertical supply chain complexity. Specifically, it was realized that with vertical supply chain complexity, most respondents agreed that "*Our company is managing several direct suppliers*" (Mean=3.750, SD=0.987). Also, the respondents agreed that "*We can depend on on-time delivery from suppliers in this supply chain*" (Mean=3.575, SD=1.041). The result further indicated that "*Our company uses a global supply base with variable collection per collection*" (Mean=3.375, SD=1.059). The respondents further agreed that "*Our suppliers' lead times are too long compared to our competitor's suppliers*" (Mean=2.912, SD=1.009). Finally, the respondents agreed with the statement that "*Our firm has been relying on a small number of suppliers*" (Mean=2.613, SD=1.419). The study's findings demonstrate that the manufacturing companies under consideration concur that the company has been depending on a limited number of companies, that the lead times of those suppliers are excessive compared to those of our competitors' suppliers, and that the supply chain's vendors can be counted on to deliver goods on schedule for the organization., and that the company is managing several direct suppliers.

Table 3: Descriptive Statistics on Supply Chain Complexity

Statement	Min	Max	Mean	SD
VERTICAL SUPPLY CHAIN COMPLEXITY				
Our firm has been relying on a small number of suppliers.	1	5	2.613	1.419
Our suppliers' lead times are too long compared to our competitor's suppliers.	1	5	2.912	1.009

We can depend on on-time delivery from suppliers in this supply chain.	1	5	3.575	1.041
Our company uses a global supply base with variable collection per collection.	1	5	3.375	1.059
Our company is managing several direct suppliers.	1	5	3.750	0.987
Overall Mean			**3.245**	
HORIZONTAL SUPPLY CHAIN COMPLEXITY				
We face a high variability of customer requests (quantity, number, and types of service/product features, means of delivery, etc.).	1	5	3.862	0.951
The demand for our products is unstable and unpredictable.	1	5	3.125	1.306
The percentage of orders requires a customer-motivated scheduling change.	1	5	3.663	1.006
Each customer has specific requirements.	1	5	3.913	1.021
Our products last less than one season.	1	5	3.025	1.190
Overall Mean			**3.518**	
SPATIAL SUPPLY CHAIN COMPLEXITY				
The variety of products produced in our plant is extensive.	1	5	3.350	1.080
A percentage of products are made based on customer specifications.	1	5	3.900	0.851
We offer our customers direct add-ons and the option of product individualization.	1	5	3.487	1.114
The schedule is difficult to predict in advance as it might change on a daily level.	1	5	3.600	1.038
There are variations in our processing times.	1	5	3.725	0.914
Overall Mean			**3.613**	

Source: Field Survey, 2022

4.4.3 Horizontal Supply Chain Complexity

Based on the literature review, five (5) components were chosen, and respondents were asked to rate their degree of agreement on a five-point Likert scale. The horizontal supply chain complexity variables are shown in Table 3. The horizontal supply chain complexity recorded an overall mean of 3.518. This shows that the vast majority of the respondents agreed with the variables of horizontal supply chain complexity. Specifically, it was realized that, with horizontal supply chain complexity, most respondents agreed that "*Each customer has specific requirements*"

(Mean=3.913, SD=1.021). Also, the respondents agreed that "*We face a high variability of customer requests (quantity, number, and types of service/product features, means of delivery, etc*.)" (Mean=3.862, SD=0.951). The result further indicated that "*The percentage of orders requires a customer-motivated scheduling change*" (Mean=3.663, SD=1.006). The respondents further agreed that "*The demand for our products is unstable and unpredictable*" (Mean=3.125, SD=1.306). Finally, the respondents agreed with the statement that "*Our products last less than one season*" (Mean=3.025, SD=1.190). The study's findings show that the manufacturing firms under consideration agree that every client has unique requirements, a certain proportion of orders necessitates a client-driven change in scheduling, and the organization's product demand is uncertain and unpredictable.

4.4.4 Spatial Supply Chain Complexity

Based on the literature review, five (5) components were chosen, and respondents were asked to rate their degree of agreement on a five-point Likert scale. The spatial supply chain complexity variables are shown in Table 3. The spatial supply chain complexity recorded an overall mean of 3.613. This shows that the vast majority of the respondents agreed with the variables of spatial supply chain complexity. Specifically, it was realized that, with spatial supply chain complexity, most respondents agreed that "*A percentage of products are made based on customer specifications*" (Mean=3.900, SD=0.851). Also, the respondents agreed that "*There are variations in our processing times*" (Mean=3.725, SD=0.914). The result further indicated that "*The schedule is difficult to predict in advance as it might change at a daily level" (*Mean=3.600, SD=1.038). The respondents further agreed that "*We offer our customers direct add-ons and the option of product individualization"* (Mean=3.487, SD=1.114). Finally, the respondents agreed with the statement that "*The variety of products produced in our plant is extensive*" (Mean=3.350,

SD=1.080). According to the study's findings, the manufacturing firms under investigation agree that they offer direct add-ons and the option of product customization to their customers, that it is difficult to predict their schedules ahead of time because they could change daily, and that some of their products are produced to order.

4.4.5 Supply Chain Integration

This section examines how the respondents viewed the variables on supply chain integration.

4.4.6 Supplier Integration

The results in Table 4 show that the variations in the response obtained on supplier integration of manufacturing companies in Accra, Kumasi and the northern metropolis are fewer suggesting that with the use of the 5-point Likert scale, most of the items measuring supplier integration have a mean value exceeding 3.0. The survey discovered that the majority of respondents are in agreement with the question, with a mean value of 4.100 and SD of 0.756, "*The company is working to build a partnership with suppliers*". Similarly, they agreed on the items "*The company is working with suppliers through clear contracts (regarding the quantities, specifications, costs, and delivery*)" (Mean = 4.063, SD=0.832) "*Suppliers are committed to the required specifications*" (Mean =4.063, SD=0.752), "*The company shares information with suppliers through the electronic network"* (Mean =3.989, SD=0.921), "*The company and suppliers discuss significant changes that affect the continuity of their relationship*" (Mean =3.850, SD=0.781) (see Table 4.5).

Table 4: Descriptive Statistics on Supplier Integration

Statement	Min	Max	Mean	SD
Supplier Integration				
The company shares information with suppliers through the electronic network.	1	5	3.989	0.921
The company is working to build a partnership with suppliers.	1	5	4.100	0.756

The company is working with suppliers through clear contracts (regarding the quantities, specifications, costs, and delivery).	1	5	4.063	0.832
Suppliers are committed to the required specifications.	2	5	4.063	0.752
Suppliers contribute to product design.	2	5	3.700	0.999
The company holds regular meetings with suppliers to review business issues.	1	5	3.750	0.921
There are joint activities between the company and suppliers (training programmes, joint celebrations, exchange of experience).	1	5	3.525	1.006
The company and suppliers are connected with an electronic system to control inventory.	1	5	3.700	0.947
The company and suppliers discuss significant changes that affect the continuity of their relationship.	1	5	3.850	0.781
There are common awareness programmes held between the company and suppliers to develop the business.	1	5	3.788	0.837
Overall Mean			**3.853**	

Source: Field Survey, 2022

The study furthermore indicates that the respondents are in agreement with the following items "*There are common awareness programmes held between the company and suppliers to develop the business*"(Mean= 3.788, SD=0.837), "*There are joint activities between the company and suppliers (training programmes, joint celebrations, exchange of experience*)" (Mean=3.525, SD=1.006), "*The company holds regular meetings with suppliers to review business issues*" (Mean=3.750, SD=0.921), "*Suppliers contribute to product design*" (Mean=3.700, SD=0.999) and finally "*The company and suppliers are connected with an electronic system to control inventory*" (Mean =3.700, SD=0.947). The study's findings suggest that the manufacturing firms under investigation communicate with their suppliers electronically, work with them under clear contracts (concerning volumes, standards, charges and delivery), hold regular meetings with them to discuss business matters, and examine substantial variations that could affect the future of their relationship.

4.4.7 Internal Integration

The results in Table 5 show that the variations in the response obtained on internal integration of manufacturing companies are less suggesting that with the use of the 5 points Likert scale most of the items measuring internal integration have a mean value exceeding 3.0. The study found that with a mean value of 4.150 and SD of 0.781, the majority of the respondents are in agreement on the item "*The company involves different departments in the preparation of strategic plans*." Similarly, they agreed on the items "*The company is keen on holding regular meetings with departmental managers to coordinate work*)" (Mean =4.100, SD=0.820), "*The company holds a training programme to increase employees' competencies*" (Mean =3.850, SD=0.956), "*There is an internal network for the exchange of information between employees*" (Mean =3.975, SD=0.914), "*The company uses an MRP system to harmonize forecasting, procurement, production and sales*" (Mean =3.925, SD=0.911).

Table 5: Descriptive Statistics on Internal Integration

Statement	Min	Max	Mean	SD
Internal Integration				
The company is constantly striving to unify its culture with stakeholders (mission and vision).	1	5	3.863	0.896
The company involves different departments in the preparation of strategic plans.	1	5	4.150	0.781
The company uses an MRP system to harmonize forecasting, procurement, production, and sales.	1	5	3.925	0.911
The company departments share in the development of production processes.	1	5	3.925	0.776
There is an internal network for the exchange of information between employees	1	5	3.975	0.914
The company holds a training programme to increase employees' competencies.	1	5	3.850	0.956
The company is keen on holding regular meetings with departmental managers to coordinate work.	1	5	4.100	0.820
The company holds extensive meetings to increase the homogeneity among employees.	1	5	3.775	0.941

The company allows employees to participate in solving problems, internal conflicts, and settlements.	1	5	3.775	1.043
Multiple teams are working interactively.	1	5	3.975	0.826
Overall Mean			**3.931**	

The study furthermore indicates that the respondents agree with the following items "*Multiple teams are working interactively*" (Mean =3.975, SD=0.826), "*The company departments share in the development of production processes*" (Mean =3.925, SD=1.776), "*The company is constantly striving to unify its culture with stakeholders (mission and vision*)" (Mean =3.863, SD=0.896), "*The company allows employees to participate in solving problems and internal conflicts and settlement*" (Mean =3.775, SD=1.043) and finally, they agreed that, "*The company holds extensive meetings to increase the homogeneity among employees*" (Mean =3.755, SD=0.941). The study's findings suggest that the production companies are constantly working to align their culture with their relevant parties (mission and vision), maintain vast meetings to increase employee homogeneity, invite staff members to take part in problem-solving and internal conflict resolution, hold a training programme to boost staff competencies, and include various departments in the creation of strategic plans.

4.4.8 Customer Integration

The results in Table 6 show that the variations in the response obtained on customer integration of manufacturing companies are less; suggesting that with the use of the 5-point Likert scale, most of the items measuring internal integration have a mean value exceeding 3.0. The study found that with a mean value of 4.337 and standard deviation of 0.810, the majority of the respondents are in agreement on the item "*Customer satisfaction is a central goal the company aims to achieve*." Similarly, they agreed on the items "*The company seeks to build a partnership with customers*" (Mean = 4.125, SD=0.919), "*There is a specialized customer service department in the company*"

(Mean =4.013, SD=0.892), "*The company has a fast system to receive orders from customers*" (Mean =4.075, SD=0.759), "*Company customers are encouraged to provide feedback*" (Mean =4.100, SD=0.704) (see Table 6).

Table 6: Descriptive Statistics on Customer Integration

Statement	Min	Max	Mean	SD
Customer Integration				
Customer satisfaction is a central goal the company aims to achieve.	1	5	4.337	0.810
The company seeks to build a partnership with customers.	1	5	4.125	0.919
There is a specialized customer service department in the company.	2	5	4.013	0.892
The company has a fast system to receive orders from customers.	2	5	4.075	0.759
The company reserves full database about its customers.	1	5	4.050	0.855
The company sets up seminars for its customers.	1	5	3.512	0.967
Company customers are encouraged to provide feedback.	1	5	4.100	0.704
The company deals with complaints and observations of customers properly.	2	5	4.075	0.708
The company engages its customers in the preparation of marketing programmes.	1	5	3.613	0.974
The company engages its customers in the design of the company's products.	1	5	3.700	1.084
Overall Mean			**3.960**	

The study furthermore indicates that the respondents agree with the following items: "The company deals with complaints and observations of customers properly" (Mean =4.075, SD=0.708), "*The company reserves the full databases about their customers*" (Mean =4.050, SD=0855), "*The company engages its customers in the design of the company's products*" (Mean =3.700, SD=10.84), "*The company engages its customers in the preparation of marketing programs* (Mean =3.613, SD=0.974) and finally "*The company sets up seminars for its customers*" (Mean =3.512, SD=0.967). The study's findings suggest that the manufacturing organizations

under investigation have specialized customer service departments, handle customer complaints and observations appropriately, and also work to forge long-term relationships with their clients.

4.5 Correlation Analysis

The correlation results are provided in Table 7. The findings show that there is a significant association between supply chain complexity and customer integration (R=0.455; p-value>0.05). The findings further show that there is a substantial association between supply chain complexity and internal integration (R=0.499; p-value>0.05). Furthermore, a substantial association exists between supply chain complexity and supplier integration (R = 0.483; p-value > 0.05).

Table 7: Correlation analysis

Constructs	1	2	3	4
Supply Chain Complexity	1			
Customer Integration	0.455**	1		
Internal Integration	0.449**	0.755**	1	
Supplier Integration	0.483**	0.719**	0.780**	1

Source: Field Survey, 2022

4.6 Regression Analysis

The suggested model was estimated using ordinary least square (OLS) regression analysis. SPSS version 21 was used for the OLS analysis. The results of OLS analysis for examining the connection between supply chain complexity and supplier integration are shown in Table 8. Additionally, the relationship between internal integration and supply chain complexity was looked at. Lastly, the relationship between customer integration and supply chain complexity.

Table 8: Regression analysis

	Supplier Integration Model 1	Internal Integration Model 2	Customer Integration Model 3	p-value	VIF
	Beta (t-value)	Beta (t-value)	Beta (t-value)		
Supply Chain Complexity	0.483(4.873)	0.449(4.433)	0.455(4.508)	0.000	1.000
Model Indices					
R	0.483	0.449	0.455		
R Square	0.233	0.201	0.207		
Adjusted R Square	0.224	0.191	0.196		
R Square Change	0.233	0.201	0.207		
F Change	23.747	19.655	20.318		

Source: Author's construct, 2022

The model's predictive ability for customer integration was high with an R square value of 0.207. Thus, the independent factor predicts a 20.7 percent of fluctuation in the dependent variable (supply chain complexity) (customer integration). The model revealed a statistically significant and positive link between supply chain complexity and customer integration (Beta = 0.455; t-value = 4.508; Sig = 0.000). Furthermore, the model's predictive ability for internal integration was high with an R square of 0.201. Thus, the independent factor predicts a 20.1 percent of fluctuation in the dependent variable (supply chain complexity) (internal integration). The model revealed a statistically positive link between supply chain complexity and internal integration (Beta = 0.449; t-value = 4.433; Sig = 0.000). Finally, the model's predictive ability for supplier integration was

high with an R square value of 0.233. Thus, the independent factor predicted a 23.3 percent of fluctuation in the dependent variable (supply chain complexity) (supplier integration). The model revealed a statistically positive link between supply chain complexity and supplier integration (Beta = 0.483; t-value = 4.873; Sig = 0.000). Table 8 presents a summary of the result.

4.7 Hypothesis

The outcome of the study's hypotheses is presented in this section. The results are summarized in Table 4.10. The supply chain complexity and supplier integration had a statistically significant beneficial association. As a result, hypothesis 1 was supported. Supply chain complexity and internal integration had a statistically positive link. As a result, hypothesis 2 was also supported. Finally, supply chain complexity and customer integration had a statistically positive association. As a result, hypothesis 3 was supported.

Table 9: Hypothesis Table

Hypothesis		Beta	t	Sig	Remarks
H1	Supply chain complexity is positively related to supplier integration	0.483	4.873	0.000	Supported
H2	Supply chain complexity is positively related to internal integration	0.449	4.433	0.000	Supported
H3	Supply chain complexity is positively related to customer integration	0.455	4.508	0.000	Supported

Source: Author's construct, 2022

4.8 Discussion of Findings

The study's main objective was to investigate the relationship between supply chain complexity and supply chain integration in a number of manufacturing firms. Specific objectives were set and

a research model was created around the study's goal, which backed up the hypothesis. Both descriptive and inferential statistics were used to assess the data obtained for the research.

4.8.1 Supply Chain Complexity and Supplier Integration

The study's primary goal was to determine how supplier integration is impacted by the complexity of the supply chain. However, the analysis showed a statistically significant relationship between supply chain complexity and supplier integration (Beta = 0.483; t-value = 4.873; Sig = 0.000). To give a consumer the most value possible, highlights the necessity of joint partnerships, knowledge transfer, risks, and incentives among partners (Zhu et al., 2016). Every supply chain partner must firmly commit to SCI (Bruque et al., 2016). Integration techniques successfully integrate every component of the process, from vendors to customers, resulting in on-time and accurate delivery of the products (Ngai and Gunasekaran, 2004). Supplier integration as a strategic ability could be able to handle the complexity of the supply chain and boost resilience in this circumstance. Firstly, integrating suppliers facilitates effective communication, real-time information exchange, and collaborative planning (Wieland and Wallenburg, 2013).

4.8.2 Supply Chain Complexity and Internal Integration

The study's second goal was to determine how supply chain complexity influences internal integration. The analysis showed a statistically significant relationship between supply chain complexity and internal integration (Beta = 0.449; t-value = 4.433; Sig = 0.000). Thus according to Flynn et al. (2010), internal SCI is crucial because it establishes the framework for buyers and supplier integration, even though it is generally less acknowledged (Frankel and Mollenkopf, 2015). Internal integration describes how well a company's departments can interact and coordinate operations. Chang et al. (2016) used information sharing and collective decisionmaking to manage plans, activities, and operations (Qi et al., 2017). Integrating and harmonizing a

company's internal practices, strategies, and procedures is hence internal integration's main goal (Chai and Kim, 2016). According to Zhang et al., (2018), internal integration connects functional areas including buying, manufacturing, and sales. This study's concept of internal integration was preserving cross-functional collaboration and working together to reach overall strategic goals. The nature of the connections, cooperation, and teamwork between organizational departments was evaluated using a series of questions.

4.8.3 Supply Chain Complexity and Customer Integration

Finding out how supply chain complexity influences consumer integration was the study's third goal. However, the analysis showed a statistically significant relationship between supply chain complexity and customer integration (Beta = 0.455; t-value = 4.508; Sig = 0.000). Organizations need to gather customer feedback and cultivate enduring relationships with them (Ayoub et al., 2017). Successful customer integration increases an organization's capacity to anticipate and respond to changes in consumer demand (Droge et al., 2012). Agility involves the ability to forge mutually beneficial alliances with outside partners, which is essential in highly unpredictable and dynamic circumstances. Companies may assess external developments and their surroundings, forge advantageous alliances with stakeholders, customers, and vendors, and react to these shifts faster than their competitors in the new environment.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The findings, conclusions and recommendations for supply chain complexity and supply chain integration are summarized in this chapter. Supply chain complexity and supplier integration, internal integration in the supply chain, and customer integration were the three main areas of attention in the study.

5.1 Summary of Findings

The section enumerates the finding from the analysis.

5.1.1 Supply Chain Complexity and Supplier Integration

The study's primary goal was to determine how supplier integration is impacted by the complexity of the supply chain. To attain this goal, a literature study was done and a structured questionnaire was created to help in data collection. The data analysis revealed a positive and statistically significant association between supply chain complexity and supplier integration.

5.1.2 Supply Chain Complexity and Internal Integration

Examining how supply chain complexity impacts internal integration was the study's second goal. To attain this goal, a literature study was done and a structured questionnaire was created to help in data collection. The data analysis revealed a positive and statistically significant association between supply chain complexity and internal integration.

5.1.3 Supply Chain Complexity and Customer Integration

Finding out how supply chain complexity impacts customer integration was the study's third goal.

To attain this goal, a literature study was done and a structured questionnaire was created to help in data collection. The data analysis revealed a positive and statistically significant association between supply chain complexity and customer integration.

5.2 Conclusion

The study's objective was to empirically explore the relationship between supply chain complexity and supply chain integration in a sample of Ghanaian manufacturing firms, placing particular emphasis on the connections between supply chain complexity and supplier integration, internal integration, and customer integration. Once the study's goals were met, it was discovered that supply chain complexity and supplier integration had a favourable and statistically significant association. It was further discovered that supply chain complexity and internal integration have a favourable and statistically significant link. Finally, the study indicated that there is a statistically positive association between supply chain complexity and customer integration. In conclusion, industrial companies are attempting to control supply chain complexity to have a consistent flow of raw materials, which will boost productivity. To avoid potential supply delays from their suppliers and thereby enhance supply chain performance, the study's findings suggest that management should have a deeper awareness of supply chain complexity and supplier integration. One of the most urgent concerns facing modern supply networks is the complexity of the supply chain. This study discovers that SCC is not necessarily harmful after reviewing and evaluating earlier empirical evidence. Despite the possibility that logistics managers may have unintentionally discussed SCC in the past by defending their supply chains' ability to reduce transaction costs, the findings suggest that managers might also adopt a comprehensive strategy and consider the different impacts of SCC elements on various performance outcomes. A company's capacity to compete may be improved by monitoring and assessing, monitoring, and controlling SCC.

5.2.1 Implication for Theory

To provide a new theoretical framework, this research project combines supply chain integration and complexity in a highly dynamic business environment. The study, which attempts to examine the correlations between supply chain complexity and integration concurrently, makes it feasible to develop an effective supply chain strategy. Supply chain managers will be able to take a unified strategy for making informed decisions if relational models of supply chain integration and complexity are developed. The study's findings expand on the features of supply chain complexity and the effects of supply chain integration on business performance, which contribute to the theory of organizational information processing. There are two main ways that downstream complexity might improve the performance of innovation. In a B2B setting, the probability of discovering customers with original ideas grows with access to a broad and diverse customer base with special assets and talents. Second, the company is prompted to be more inventive in both B2B and B2C settings by the fluctuating demands and expectations of consumers (i.e. high dynamic complexity). The considerable beneficial impact of downstream complexity is consistent with Chesbrough's (2011) assessment that wealth generation is an iterative process, which is built on open innovation. Through consumer involvement, tacit knowledge is shared from the outside in and from the inside out, resulting in the co-creation of value and the development of new ideas. By concentrating on particular levels or aspects of SCC and related connections to particular performance facets, future SCC research may enhance theory. A company could, for instance, have a very complicated consumer base and a considerably less complex supplier basis. A company's supplier base and customer base may have different prominent sub-dimensions of complexity. Knowledge of SCC can be improved by theoretical frameworks that make distinctions between these categories and more clearly identify how they relate to one another. To better understand the antecedents,

outcomes, processes, and contingencies of SCC, additional thinking is needed surrounding its unique dimensions and levels.

5.2.2 Implication of Practice

The research provides numerous useful techniques to aid managers in ensuring the implementation of supply chain integration throughout the supply chain. Focus companies may use it to identify the key areas they need to manage to influence suppliers toward sustainability, which makes it a particularly useful tool for them. These findings also relate to first- and second-tier suppliers, helping them to promote sustainability not just from an economic standpoint but also from an SC viewpoint. Based on their position in the supply chain, firms may use the study's conclusions to establish best practices. The study provides information on the technique selection and gives recommendations for the prospective roles of many additional SC actors, making it possible to pick SC practices that are in line with the level of complexity that each actor must deal with. One of the main challenges executives have when it relates to supply chain integration is deciding which initiatives should be prioritized for execution. To reduce interruptions and preserve customer service, supply chain managers must be aware of the negative operational performance effects of SCC and use tactics that expand their effective control outside of the parent organization (Maestrini et al., 2017). In a more global business context, there is a growing desire to work with a wider range of suppliers, especially when there are cost-cutting demands from rivals. The establishment of multiple sales channels, the pursuit of new customers, or downstream complexity might all result in similar problems. However, the results imply that as the quantity and variety of suppliers rises, along with the uncertainty and volatility that characterize upstream and downstream interactions, supply chain managers must undertake specific activities to sustain operational success.

5.2.3 Implication of Policy

Top management of firms must develop policies that improve supply chain integration to reduce supply chain complexity to boost supply chain performance. Additionally, decision-makers should put research and development at the top of the priority list only if they have an urgent need for relevant IT innovation to boost operational performance. That is, it is advisable to conduct a thorough examination of the technological innovation to confirm its compatibility and alignment with present operations before allowing a specific IT innovation for usage in the industrial context. This is because, even if IT is essential to ensuring improved operational efficiency, it also carries several hazards that, if properly and thoroughly assessed, might endanger an organization's existence. As a result, leaders and managers in manufacturing firms must take research and development into consideration while developing strategies for the endorsement and application of IT innovation. Supply chain managers should not, for instance, attempt to minimize product diversity or the number of vendors just for operational reasons because SCC increases financial performance. The business plan of the company should serve as a guide for these choices. SCC reduction could be chosen if businesses prioritize a cost leadership approach. On the other hand, adopting an innovation strategy can need absorbing SCC to get access to the information produced by a variety of players, and it might also require businesses to lower transaction costs through suitable governance structures, including supply chain integration.

5.3 Recommendation for Further Studies

The study suggests areas for additional study. The results of the current study need to be validated by additional research using a larger sample size because it was a quantitative study. Additionally, the only actors in the Ghanaian context working in two areas were taken into account; expanding the study to include providers with a worldwide view will enhance the research’s relevance.

Research along those same lines may be conducted in other industries where the adoption of sustainability concepts in complex SCs is crucial. To confirm this study and look at other potential discrepancies in how SC partners apply sustainable principles, more research is advised in these other scenarios.

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APPENDIX

QUESTIONNAIRE

Does supply chain complexity drive or lower supply chain integration survey

Thank you for considering to participate in this research that seeks to understand whether supply chain complexity drives supply chain integration in the manufacturing sector. While this research is for academic purposes, it also seeks to generate practical insights to help business executives in such companies better manage supply chain complexity issues in supply chains to derive a competitive advantage.

For confidentiality reasons, please do not indicate your name or provide information about your organization to us. Only reflect on your personal experience (as a manager or executive in your company) and your company's environment to respond to the statements/questions in the questionnaire. We can assure you that your responses will be anonymized and used only for statistical and academic purposes.

The questionnaire has specific instructions to follow and scales to use to indicate your responses. Every statement/question included in the questionnaire is relevant, and although some appear quite similar, they are unique in many ways, so **kindly do well to respond to each**. The questionnaire will take about **20 minutes** to complete.

All questions and concerns about the research can be directed to **Ms. Amanda Buah** (via +233 26 163 3979), a postgraduate researcher who is leading the fieldwork. As a token of appreciation for participating in the study, you will receive a summary report of the study's key findings and recommendations. Please provide your email address here (in case you are interested in this package): …….

By continuing, you are consenting to participate. Thank you in advance for participating.

SECTION A

This section presents different scales for evaluating different sets of statements. Using the respective scales, kindly tick/circle a number that represents your opinion on each statement.

Kindly use the following scale to evaluate the statements in the subsequent table:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Please* answer these questions based on the actual and current situation and not on beliefs.** **(VERTICAL SUPPLY CHAIN COMPLEXITY*)	***Strongly disagree***				***Strongly agree***
Our firm has been relying on a small number of suppliers.	1	2	3	4	5
Our suppliers' lead times are too long compared to our competitor's suppliers.	1	2	3	4	5
We can depend on on-time delivery from suppliers in this supply chain.	1	2	3	4	5
Our company uses a global supply base with variable collection per collection.	1	2	3	4	5
Our company is managing several direct suppliers.	1	2	3	4	5

Kindly use the following scale to evaluate the statements in the subsequent table:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Please answer these questions based on the actual and current situation and not on beliefs. ***(*HORIZONTAL SUPPLY CHAIN COMPLEXITY)**	***Strongly disagree***				***Strongly agree***
We face a high variability of customer requests (quantity, number, and types of service/product features, means of delivery, etc.).	1	2	3	4	5
The demand for our products is unstable and unpredictable.	1	2	3	4	5
The percentage of orders requires a customer-motivated scheduling change.	1	2	3	4	5
Each customer has specific requirements.	1	2	3	4	5
Our products last less than one season.	1	2	3	4	5

Kindly use the following scale to evaluate the statements in the subsequent table:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Please answer these questions based on the actual and current situation and not on beliefs. ***(*SPATIAL SUPPLY CHAIN COMPLEXITY*)***	***Strongly disagree***				***Strongly agree***
The variety of products produced in our plant is extensive.	1	2	3	4	5
A percentage of products are made based on customer specifications.	1	2	3	4	5
We offer our customers direct add-ons and the option of product individualization.	1	2	3	4	5
The schedule is difficult to predict in advance as it might change on a daily level.	1	2	3	4	5
There are variations in our processing times.	1	2	3	4	5

Kindly use the following scale to evaluate the statements in the subsequent tables:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Please answer these questions based on the actual and current situation and not on beliefs*.** **(SUPPLIER INTEGRATION*)	***Strongly Disagree***	***Strongly Agree***
The company shares information with suppliers through the electronic network.	1 2 3 4	5
The company is working to build a partnership with suppliers.	1 2 3 4	5
The company is working with suppliers through clear contracts (regarding the quantities, specifications, costs, and delivery).	1 2 3 4	5
Suppliers are committed to the required specifications.	1 2 3 4	5
Suppliers contribute to product design.	1 2 3 4	5
The company holds regular meetings with suppliers to review business issues.	1 2 3 4	5
There are joint activities between the company and suppliers (training programs, joint celebrations, exchange of experience).	1 2 3 4	5
The company and suppliers are connected with an electronic system to control inventory.	1 2 3 4	5
The company and suppliers discuss significant changes that affect the continuity of their relationship.	1 2 3 4	5
There are common awareness programmes held between the company and suppliers to develop the business.	1 2 3 4	5

Kindly use the following scale to evaluate the statements in the subsequent tables:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Please answer these questions based on the actual and current situation and not on beliefs*.** ***(*INTERNAL INTEGRATION*)	***Strongly Disagree***	***Strongly Agree***
The company is constantly striving to unify its culture with stakeholders (mission and vision).	1 2 3 4	5

The company involves different departments in the preparation of strategic plans.	1 2 3 4 5
The company uses a material requirement planning (MRP) system to harmonize forecasting, procurement, production, and sales.	1 2 3 4 5
The company departments share in the development of production processes.	1 2 3 4 5
There is an internal network for the exchange of information between employees.	1 2 3 4 5
The company holds a training programme to increase employees' competencies.	1 2 3 4 5
The company is keen on holding regular meetings with departmental managers to coordinate work.	1 2 3 4 5
The company holds extensive meetings to increase the homogeneity among employees.	1 2 3 4 5
The company allows employees to participate in solving problems, internal conflicts, and settlements.	1 2 3 4 5
Multiple teams are working interactively.	1 2 3 4 5

Kindly use the following scale to evaluate the statements in the subsequent tables:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Please answer these questions based on the actual and current situation and not on beliefs. ***(*CUSTOMER INTEGRATION*)***	***Strongly Disagree***				***Strongly Agree***
Customer satisfaction is a central goal the company aims to achieve.	1	2	3	4	5
The company seeks to build a partnership with customers.	1	2	3	4	5
There is a specialized customer service department in the company.	1	2	3	4	5
The company has a fast system to receive orders from customers.	1	2	3	4	5
The company reserves full database about its customers.	1	2	3	4	5

The company sets up seminars for its customers.	1	2	3	4	5
Company customers are encouraged to provide feedback.	1	2	3	4	5
The company deals with complaints and observations of customers properly.	1	2	3	4	5
The company engages its customers in the preparation of marketing programmes.	1	2	3	4	5
The company engages its customers in the design of the company's products.	1	2	3	4	5

SECTION B

This section collects profile information about you and your company.

- Which of the following products does your company produce/manufacture*? (Tick all that apply)*

  ☐ Furniture and Fittings ☐ Plastic Manufacturing ☐ Automobile ☐ Aluminium Smelting
  ☐ Paper Manufacturing ☐ Food Processing ☐ Beverage Processing ☐ Metal Processing
  Other products (kindly indicate): _____

- *Which part of Ghana is your company or head office located in?*

  ☐ Northern belt (e.g. Northern Region) ☐ Middle belt (e.g. Ashanti Region) ☐ Southern belt (e.g. Greater Accra)

- How many years (approximately) has your company been in existence/operation?
  _____ years

- *How many people has your company employed on a full-time basis?*

  _____

- Does your company have a dedicated supply chain management department/unit? ☐ Yes ☐ No

- Are the people managing/supervising your supply chain function generally well-educated (e.g. have at least Higher National Diploma (HND) or bachelor's degree)? ☐ Yes ☐ No
- Have you been part of your organization for the past 3 years? ☐ Yes ☐ No
- What is your highest level of education? ☐ Senior high school ☐ Diploma ☐ Higher national diploma (HND) ☐ Bachelor's Degree ☐ Master's degree ☐ PhD
- What is your position in your company? ☐ CEO ☐ Managing Director ☐ General Manager ☐ Sales Manager ☐ Operations Manager ☐ Marketing Manager ☐ Supply Chain/Logistics Manager ☐ Purchasing Manager ☐ Other (kindly indicate)

  _____
- *How long (in years) have you held this position*? About _____ years

To what extent do you disagree or agree with the following statements?	***Strongly disagree***				***Strongly agree***
The questionnaire deals with issues I am knowledgeable about.	1	2	3	4	5
The questionnaire deals with issues that I am interested in.	1	2	3	4	5
I am completely confident about my answers to the questions	1	2	3	4	5
I am confident that my answers reflect the organization's situation.	1	2	3	4	5