THE EFFECTS OF SUPPLY CHAIN COMPLEXITY ON FIRM'S OPERATIONAL PERFORMANCE, THE MEDIATING ROLE OF SUPPLY CHAIN DISRUPTION IN GHANA'S RICE INDUSTRY: A CASE STUDY OF TAMANAA COMPANY LTD.

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DECLARATION

I hereby declare that this thesis is my own work towards a partial fulfilment of the requirements for the award of Master of Science in Business Administration (Logistics and Supply Chain Management). To the best of my knowledge, this is solely my genuine work and has not been submitted anywhere else by anyone for a degree or any academic purpose; and that all materials of other authors used in this study have been accordingly acknowledged and cited.

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ABSTRACT

This study had the objective of examining the mechanism through which supply chain complexity affects the operational performance of a firm in the rice industry of Ghana and what role supply chain disruption plays in complexity-performance relationship. The study was qualitative in design, and the researcher adopted a case study approach for data collection by creating a questionnaire for collection of information about the supply chain complexities and firm performance. The field survey was conducted in the operations, production and supply chain management divisions of a case company, Tamanaa Company Ltd, gaining permission from the Heads of Department of the organization. The study shows that supply chain complexity increases firms' operational burdens and therefore reduces operational performance in both cost and schedule attainment. These findings are in conformity with the opinion of Brandon-Jones and Choi and Krause. Though the review works such as Shah and Ward have shown a concentration on how to reduce supply chain complexity, available literature on flexibility and operations strategy emphasizes the need for firms to appreciate how to accommodate high levels of supply chain complexity when it is required. This study limited the scope to cost performance and schedule attainment dimensions of firm's operational performance. Further research should be conducted in order to identify other important dimensions as well as identify other sources of complexity in the supply chain that have not been addressed in this study and that might also explain performance differences among manufacturers. Future research should focus on sustaining the rice Supply Chain, the current practices, Prospects and challenges. Again, future research may focus on increasing the sample size and case study firms to elaborate on existing practices, prospects and challenges.

DEDICATION

This work is dedicated to my family, especially my lovely mother, Azara Mahama. I love you very much.

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First of all, and most importantly, I would like to thank Almighty Allah who made this dream come true. My profound gratitude also goes to my mother, Azara Mahama, a.k.a Azar'bla for sponsoring me by the edge of your cloth throughout the turbulent years of my education, and my immediate family for giving me the peace of mind.

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God bless us all.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The real competition in today's dynamic market is not company against company but rather supply chain against supply chain (https: llwww.martin-christopher.info). Supply chains of firms have become increasingly complex owing to the increased level of customer expectation, as well as the need for global sourcing and technology (Perona and Miragliotta, 2004): (Isik. 20 11): (Brandon- Jones et al., 2015); (Lin et al.,20 15); (Vachon et al., 2009); (Gao et al., 2015). Most firms have turned their attention to the global market for their sourcing, selling, product development and even manufacturing and engineering their products (Deloitte Research. 2003).

According to Kotabe and Murray (2004), firms take advantage of the cost-benefits of sourcing globally, resulting in higher levels of outsourcing activities. This global supply chain expansion brings about complexity for the firms especially on the international difference in culture and language, regulatory and logistical problems (Kavilal et al., 2017; Lorentz et al., 2012, Manuj and Sahin, 2011).

Supply chain complexity has become a topic of high interest for both practitioners and academicians. Companies are faced with meeting the varying demands of customers at the lowest cost possible, and providing the appropriate support services at all times. This is the sure way for firms to stay competitive in the market. Managers of firms resort to various strategies in order to meet the varying demands, including the use of joint ventures, acquisition, mergers, and of course, the use of cheaper sourcing or production options, and product development. These strategies would not only enhance customer satisfaction, but also would ensure that the firm achieves market penetration, and position the firm amid market volatility. The implementation of these strategies

however results in a more complex supply chain. The involvement of more firms of varying levels of contribution to the chains that calls for a coordination of all these elements as well as their tiers in the supply chain.

The systems or supply chains are complicated, according to Bozarth, Warsing, Flynn & F'lynn (2009), because of the wide variety of enterprises, goods, and processes they contain, as well as the intense interaction between these components that results in unexpected system behavior. Supply Chain complexity is said to be mostly influenced by trends in corporate innovation, globalization, and consumer demands (Christopher, 2010).

1.2 Statement of the problem

For the past 20 years, supply chain complexity has undoubtedly been a research topic. Numerous studies' findings support the idea that a firm's performance is impacted by the complexity of the supply chain (Choi and Hong, 2002; Isik,20 11). On the nature of the impact SCC has on company performance, there does not appear to be a strong consensus in the findings: As a result of their research, Bozarth et al. (2009), Fridgen et al. (2014), Brandon J. et al. (2014), and Kavilal (2017) draw the conclusion that supply chain complexity typically has a negative effect on the performance of the company. Other research supports the idea that the complexity of the supply chain has some positive effects on the firm's performance (Hurlye Mem ls, 2019). However, other findings in the literature show that, despite the fact that supply chain complexity has a negative impact on operational performance, it positively affects the firm's financial performance and innovation performance (Seyda Serdarasan. 2012). The conceptual approach used may be to blame for the issue of lack of agreement in the findings in this field. Hurlye Mernls, for example, looked at just one level of the supply chain while

other research omitted crucial factors (2019). As a result, no research has been able to definitively answer the issue of how supply chain complexity impacts each of the firm's performance areas. Additionally, little empirical research has been done to determine how much the supply chain's complexity impacts both the firm's performance in particular areas and its overall performance. Therefore, this study seeks to add to the literature by empirically examining the mechanism by which supply chain complexity has an impact on firm performance through the introduction of a recently or understudied dimension of supply chain disruption (SCD) as a mediating variable.

It is impossible to overstate the significance of supply chain complexity. In a world that is becoming increasingly globalized and outsourced, complexity plays a significant role in deciding how well a company performs (Lorentz et al., 2012; Tan et al., 2002). Numerous studies on the complexity of supply chains have been conducted across a wide range of industries and developed nations. However, neither the rice industry nor developing nations have sufficiently studied this issue. As a result, it's crucial to examine the intricacy of the rice supply chain, with Ghana serving as a key example of a developing nation.

1.3 Research objectives

The following research objectives are identified based on the gap identified in the literature:

1. to investigate the effects of SCC, on firms' operational performance
2. to investigate how SCC affect supply chain disruption (SCD)
3. to investigate how SCD affect firm's performance

1.4 Research questions

Based on these objectives, three research questions were developed for this study.

Research Question 1: *What are the effects of SCC on operational performance?*

Research Question 2: *How doe SCC affect Supply Chain Disruption?*

Research Question 3: *How does SCD affect firm's operational performance?*

1.5 Significance of the study

In the examination of the link between SCC and business performance, the addition of Supply Chain Disruption as a variable adds new information. The importance of this study comes from the way it adds a new variable to better locate supply chain complexity and its impact on company performance. This study first establishes a relationship between complexity and businesses' operational performance, making it clear how the SCC at each supply chain level affects a firm's operational success. The study explores the effects of supply chain disruption from a complexity-performance standpoint, providing a useful and trustworthy tool for the operationalization of the research model. The paper also highlights important business lessons about supply chain complexity and offers empirical evidence for the model.

1.6 Overview of research methodology

In order to examine the study's goals, questionnaires were used in a descriptive research design. This approach provided flexibility for the researcher to interact with the members of the target population and also to determine the sample size. The study's population constitutes staff of the purchasing, logistics, processing and marketing departments of a rice processing firm in Ghana. The researcher used purposive sampling techniques to select the case firm and respondents. With a known population size. a sample size of III was mathematically determined. Data obtained from respondents was coded and analysed using SPSS version 26.

1.7 Scope of the study

The study was conducted within the Tamanaa Company Ltd premises, in the West Mamprusi Municipality of the North East region of Ghana. Based on the area's strength in the local rice industry, the corporation was selected for this area. Since it produces 61 percent of all the rice produced in Ghana, the northern region is the main producer of the grain. The study's context was on evaluating how the example firm's rice processing operations were affected by the complexity of the supply chain. Supply chain disruption's mediation effect on the link between the two aforementioned factors was also evaluated.

1.8 Limitation of the study

Reaching out to respondents across the departments in the referred firm was a major challenge for the researcher. Respondents' inability to respond to the questionnaire on google forms due to computer illiteracy was another major challenge.

1.9 Organisation of the study

Chapter one focuses on the background to the study, statement of problem, research objectives, research questions, significance of the study, overview of methodology, scope of study, limitation of the study and organisation of the study. The Chapter two of the study reviews related literature on the shea supply chain and focuses on conceptual review, theoretical review, empirical review and conceptual framework. The methodology adopted in this study was captured in the chapter three. This chapter provides detail on the study's research design, population of the study, sampling techniques and sampling size. data collection method and data analysis. The study's findings based on the data gathered on the field is presented in the fourth chapter.

Frequency tables and pies chats are used to provide clarification on the results of the study in addressing the research objectives. Chapter five concludes the study by summarising the results, provided conclusion on the study and recommendations for implementation. The chapter also provides suggestions for future studies by indicting areas where researchers can explore for improvement.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The relevant literature on supply chain complexity (SCC), supply chain disruption (SCD), and businesses' operational performance is reviewed and discussed in this chapter. Every research project needs a literature review to show how relevant and significant the study topic is to the scientific community. A researcher can choose their study question and important variables with the aid of the literature review. Sekaran & Bougie (2010) claim that a literature review evaluates the prior research that has been done in the topic under question. A critical appraisal of prior research is known as a literature review (Shuttleworth, 2009). Thus, a literature review is both a summary and an explanation of the full and current state of knowledge on a specific subject in academic journal articles. 2012's (Normansyah Syahruddin). A literature review is described by Fink (1998) as an explicit, repeatable, and systematic strategy for locating, assessing, and interpreting the corpus of recorded materials. The benefits of using a literature review are numerous:

According to Bourner (1996), one important goal of using a literature review is to provide intellectual context for one's own work, identify other people working in the same field, identify gaps in the existing literatures, avoid redundancy, advance existing works, broaden knowledge in a particular area, identify opposing views, identify pivotal works in a certain research area, and identify methods relevant to the work.

The conceptual framework that gives rise to the hypothesis is based on the examination of this literature. There are several complexity-related dimensions in general, therefore Supply Chain Complexity aims to focus on the particular complexity dimension

pertinent to the supply chain. In other words, this evaluation takes into account the many aspects before concentrating on the supply chain viewpoint of complexity.

Six smaller pieces make up this chapter. The history of the supply chain management concept is examined in Section 2.2. The knowledge of supply chain complexity is built on an examination of supply chain and supply chain management ideas. The idea of complexity and supply chain complexity are discussed in Section 2.3. In Section 2.4, the idea of supply chain disruption and the aspects connected to supply chain complexity are covered. In section 2.5, a summary of prior SCC investigations is presented. The structures and variables utilized in this study are defined in Section 2.6, along with some assumptions based on how those components relate to one another. The summary of this chapter is included in section 2.6.

2.2 Supply Chain Management (SCM)

The companies involved in the upstream and downstream flows of a channel make form a supply chain (Zaheed 2015). La Londe and Masters define a supply chain as an association of enterprises that exchanges goods (1994). In the 1970s, the integration of logistics management and close coordination across departments with a focus on logistics were seen to be efficient ways to deliver high service and performance levels while also reducing total costs. This is when the notion of SCM first emerged (Christopher, 2000). According to Burgess, Singh, and Koroglu, SCM as a concept is now a hot topic in research and practice (2006).

A supply chain, according to the description provided by La Londe & Masters in 1994, is often composed of several businesses that collaborate on a product's production and delivery to the consumer. These independent companies usually work on the manufacture of raw materials and product assembly. By distributing and/or selling the

goods, they play a significant part in the supply chain. A supply chain is how companies coordinate their efforts to bring products or services to market (Lambert et ai, 1998). Mentzer et al. (2001) defined a supply chain as a network of three or more businesses that are linked directly by one or more upstream and downstream flows of products, services, capital, and information from a source to a consumer.

They argue that supply chains and their management are two distinct ideas and that supply networks can exist whether or not they are controlled. Because of the inclusive nature of the system, any supplier, manufacturer, or distributor who participates as well as any company that offers services to the chain, such as a third-party financial provider, a third-party logistics (3PL) provider, a market research firm, and so on, are all regarded as members of the supply chain (Zaheed, 2015).

The concept that the supply chain should be controlled from the viewpoints of several businesses rather than as a single entity is expressed by the phrase "supply chain management," which refers to a group of businesses functioning constantly and consistently (Christopher, 2010). Therefore, when all links in the chain cooperate to carry out specific managerial actions, the supply chain can be said to be managed (Mentzer et al., 200 I).

Mentzer et al. (2004) define SCM as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a specific company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual firms and the supply chain as a whole."

Resources flow toward end users, money goes to suppliers, and information travels both ways in a typical supply chain (Chopra & Meindl, 2004). From the perspective of relational flows, SCM may also be seen as the methodical control of these flows through an interconnected system of companies that manufacture and provide goods and services to consumers (Tang, 2006).

2.2.1 Supply Chain Relationship Management

Supply chain connections have been categorized based on where they fall on a governance spectrum (Williamson, 1975; Zaheer & Venkatraman, 1995). According to this governance spectrum, SC interactions can be viewed as falling anywhere between market governance and hierarchical government.

The term "arm's length" is used to describe market governance, whereas "vertical integration" is another name for hierarchical governance. Webster (1995) and Hoyt & Huq (2000) state that "firms within the typical supply chain attempt to attain the highest economic position through the adoption of arm's length transactions." According to Spekman & Carraway (2006), arm's-length partnerships are less likely to last since customers and suppliers compete on price, leading to less information exchange. Effective SCM is often achieved when all supply chain organizations collaborate and are integrated (Ghosh & Federowicz, 2008; Zaheer & Venkatraman,1995).

The integration at the core of the supply chain is taken care of by supply chain relationship management in order to boost efficiency and effectiveness. Uncertain supplier relationships might come from a misaligned supply chain, which can make it difficult to manage and unproductive. Christopher (20 I 0) asserts that instead of being "firm-to-firm," market competition is now "supply chain-to-supply chain." This viewpoint contends that for the supply chain to function more effectively, firms should

adopt a holistic outlook, consider themselves as essential links, and make use of the resources and talents of all participants (Zaheed H. 2015).

2.2.2 Scope of SCM

According to Cooper, Lambert, and Pagh's (1997) definition of the scope of supply chain management, a supply chain's size, the activities it engages in, and the roles it plays in reaching its final aim are all covered. From both organizational and functional viewpoints, SCM's breadth may be analyzed (Mentzer et al. 2001). The functional scope of SCM refers to all business operations, including marketing, sales, logistics, and manufacturing, whereas the organizational scope of SCM refers to the separate businesses that play a variety of roles in satisfying the demands of the end customer. By integrating the company's internal activities, the SCM must begin the relationship (Christopher, 20 I 0). The evolution of the notion has led to supply chain management shifting from tactically managing logistical activities to one with a far more strategic emphasis (Zaheed H. 2015). SCM may be characterized as having a strategic orientation toward the cooperative management of the supply chain as a whole, according to Mentzer et al. (2008).

They argue that current SCM has a lot more strategic emphasis than the conventional method to managing supply chains since the scope of SCM involves both integrating intra-firm activities and inter-firm operations. This argument is supported by Chopra & Meindl (2004), who believe that the scope of SCM goes beyond inter-functional coordination to include planning and controlling the flow of goods from the source to the end user as an integrated system.

2.3 Supply Chain Complexity (SCC)

The degree to which a company's supply chain is made up of several unique components that interact in unforeseen ways is known as supply chain complexity (SCC) (Aitken et al., 2016; Bode & Wagner, 2015: Bozarth et al., 2009). Uncertainties brought on by unreliable lead times and supplier turnover have made the SCC problem much more complicated (Serdarasan, 2013; Vachon & Klassen, 2002). Supply Chain Complexity is one of the issues for modern supply chains that Bode & Wagner (2015) say is most persistent. Given the rise in consumer demand, the variety of products available, technological advancements, and globalization, supply chain complexity has become inevitable (Aitken et al., 2016; Dong et al., 2020; Wiengarten et al., 2017). There is a review of the complexity literature in this section. Various authorities have provided the definitions listed below for supply chain complexity:

Table 1: Some SC Definitions by various authorities

No.	Definition	Reference
1	SCC uses information and material flow to explain all operational uncertainties and structural changes that may occur throughout the supply chain as a result of internal or external causes, whether they are known, unknown, expected, unexpected, forecast, or unpredicted.	(Kavilal et al., 2017)
2	SCC is described as the network's interdependencies and interconnections, where changes to one part might have an impact on other elements..	(Tse et al., 2021)
3	SCC is the term used to describe the unpredictable nature brought on by fluctuating demand and interactions within the supply network.	(Roscoe et al., 2020)
4	SCC is defined as a collection of operational, structural, and behavioral changes brought on by uncertainties and variations that happen both predictably and unexpectedly as a result of internal and external SC system drivers.	(Sopha et al., 2021)
5	Depending on how it is produced, SCC may be classified as static, dynamic, or decision-making. It is defined as any attribute of a supply chain that increases complexity.	(Chand et al., 2020)
6	The supply chain The degree of complexity represented by SC objects, processes, and interactions is measured by the level of detail and dynamic complexity.	(Turner et al., 2018).
7	Supply chain complexity refers to the quantity of players and product lines in a focal firm's network of supply chains (SCC)	(Anin et al., 2021)
8	The definition of SCC is the unpredictability of a system's behavior in response to a certain set of inputs.	(Piya., et al., 2020)
9	SCC is defined as internal fluctuations or discrepancies caused by the quantity of subsystems or degree of interdependence in the organization.	(Budiono et al., 2021)
10	SCC refers to the degree to which the supply chain of a business is made up of numerous components that unexpectedly intersect.	(Fernando & Wulansari, 2020)

2.3.1 Complexity as a Concept

The phrase "Supply Chain Complexity" has been defined in several ways throughout the literature, although its earliest meanings included deterministic chaos, parallel interactions, and amplification (Wilding. 1998). Complexity, in the words of Simon (1962), is "a system having a vast number of diverse pieces that interact in a non-simple manner." Many of the definitions used now are based on this systems theory. According to this perspective, SCC may be divided into two categories: dynamic, or operational complexity, and specific, or static, or structural complexity (Bozarth et al., 2009; Fernandez Campos et al., 2019).

Dynamic complexity is the outcome of interactions between system components that cause a system's behavior to be unexpected, random, or to vary often in response to a certain set of inputs (Bode & Wagner, 2015: Serdarasan, 2013). The complexity of the supply chain is highlighted by its three primary levels, upstream, internal, and downstream (Bozarth et al., 2009). Some research has been done on the three layers of SCC (De Leeuw et al., 2013; Serdarasan, 2013), upstream complexity just (Brandon-Jones et al., 2015; Choi & Krause, 2006; Dong et al., 2020), or internal complexity (Chaudhuri & Boer, 2016; Wiengarten et al., 2017).

Upstream complexity rises with a firm's size, organizational culture, or technological skills, claim Bode & Wagner (2015), Chae et al. (2019), and Gao et al. (2015). Inconsistent and lengthy supplier lead times further compound the complexity of the upstream chain (Brandon-Jones et al., 2015; Vachon & Klassen, 2002). High process variance, frequent schedule adjustments, and a range of products and/or parts all lead to a rise in internal complexity (Blome et al., 2014; Caniato & Grof3ler. 2015: Eckstein et al., 2015). The lengthening of product lifecycles, a rise in the number and diversity

of customers, and the company's dedication to adjusting to shifting customer needs and demands are all factors that have contributed to this (Chen. 20 I S) (Caridi et al., 20 I 0).

There have also been several research studies on the effect of supply chain complexity on a firm's success. While some studies assert that SCC negatively affects performance (Cecil C. Bozarth et al., 2009), other research shows that some supply base complexity drivers actually enhance a firm's performance (Hurlye Mernls, 2019). There is also the assertion that Supply Chain Complexity may, on sometimes, be strategically appropriate (International Journal of Operations & Production Management, 20 IS). Recent studies have found that SCC is not always solely concerned with producing subpar performance results (e.g., Lu & Shang, 2017; Sharrna, Pathak, et al., 2019).

2.3.2 Upstream complexity

The complexity that arises from the firm's supplier base is known as upstream complexity. Detail and dynamic intricacy serve as its defining characteristics. The quantity of supplier connections that must be handled, the suppliers' lead times for delivering goods and their dependability, as well as the degree of global sourcing, may all contribute to upstream complexity (Bozarth et al., 2009).

According to Bozarth et al. (2009), when there are more information flows, physical flows, and connections to manage, there will inevitably be more details and complexity as there are more providers. Since the length and/or dependability of supplier lead times can have a significant impact on the planning and material management processes of the company's operations, upstream complexity may be driven by supplier lead-time performance (Vollmann et al., 2005). Because the bullwhip effect is primarily driven by the replenishment lead time, longer supplier lead times increase the supply chain's

dynamic complexity and increase its magnitude (Chen et al. 2000). Upstream complexity will inevitably rise as the supply base expands internationally. Global currency swings, lengthier and unpredictable lead times, cultural differences, and legal/regulatory concerns, according to Cho and Kang (2001) and Nellore et al. (2001), might expose businesses to higher degrees of dynamic complexity with the upstream supply chain.

2.3.3 Internal complexity

According to Bozarth et al., (2009)"internal complexity" refers to the level of specificity and dynamic complexity found in the products, procedures, and planning and control systems of the company's facility. The variety of internal corporate details increases together with the breadth of the supported products and components.

The dependability of production schedules, the volume of components and items supported, and the kinds of manufacturing processes can all have an impact on internal complexity (Flynn and Flynn, 1999). The performance of a company's internal production has long been recognized to suffer from product proliferation, according to Slavador et al. (2002). Most recent studies on the subject have concentrated on the impacts of product proliferation on setup costs and/or replenishment lead times, as well as supply chain costs when a single manufacturer supplies numerous stores (e.g., Yano and Dobson, 1998). Toonemann and Bradley (2002). Increasing product diversity leads to greater costs for retailers and longer operational lead times, according to studies, which also demonstrate that process changeover times increase.

The number of distinct components in a firm's internal environment also affects detail complexity, according to Fisher et al. (1999), Krishnan and Gupta (2001), Ramdas & Sawhney (2001), among others. Internal complexity is generally a result of the level of

dynamic complexity and intricacy inherent in the company's production processes. Lower volume production processes are usually the source of greater levels of complexity and dynamic complexity in industrial settings (Bozarth et al., 2009). Complex linkages across plant departments and higher levels of decentralized decision-making are required for managing a large number of unique jobs in a complex environment since the requirements of each work are likely to differ (Hill, 1994).

In the operational environment of a corporation, changeable production schedules are what lead to dynamic internal complexity, claim Vollmann et al. (2005). Manufacturers are only given two options: either build planning and control systems to manage the intricate interactions needed to link production plans and execution operations, or be restricted by erratic production schedules. or have an unforeseen adverse, nonlinear effect on lower-level production and material plans (Bozarth et al.. 2009).

2.3.4 Downstream complexity

Our definition of downstream complexity is that it is the level of dynamic complexity that originates in a manufacturing plant's downstream markets. There are several factors that might contribute to downstream complexity, including the size of the customer base, the variety of their needs, the typical product life cycle, and the cyclicality of demand.

Along with increasing upstream complexity, clients' diversity and number continue to increase. Demand management responsibilities, order management responsibilities, and customer relationship management responsibilities all expand in scope as the number of customers increases. demanding driving conditions (Vollmann et al., 2005). There's also a bigger chance that different client groups will qualify for and win different orders. lower production performance standards and the potential for manufacturing activities

that contradict (Hill. 1994: Bozarth and Edwards, 1997; Bozarth and McCreery, 2001). additionally the chance of a discrepancy between manufacturing capabilities and customer needs (Bozarth and Berry, 1997; da Silveira, 2005).

The influence of shorter product life cycles on downstream complexity is twofold. First, shorter product life cycles will force an increase in the number of items and parts that must be serviced over time, leading to an increase in detail complexity (Fisher et al., 1999; Krishnan and Gupta, 2001; Rarndas and Sawhney, 2001). The desire for innovative goods by consumers exposes production facilities to increased degrees of dynamic complexity as personnel and systems adjust to the market's continuously changing needs.

Demand volatility is primarily responsible for the supply chain's dynamic complexity. This is because, depending on the degree of demand, certain supply chain actions (such reordering to a set stocking level) can either produce positive inventory or stockouts. The bullwhip effect is a famous example of how poorly coordinated ordering techniques at different supply chain nodes may cause huge swings in upstream ordering patterns while downstream demand changes very little over time (Forrester, 1961; Lee et al., 1997; Chen et al., 2000).

2.4 Supply Chain Disruption

Unexpected events that impede or hinder the regular flow of materials are known as supply chain disruptions (Craighead et al. 2007). When unforeseen events occur at a specific point in a supply chain, they might have an impact on a company's performance or have the potential to do so. This is known as a supply chain disruption (Craighead et al., 2007). If disturbances are not quickly resolved where they originated, they may spread in other directions and damage the functioning of several organizations in the

extended network (Swierczek, 2014). Because the disruption has a greater gravitational pull and lasts longer, the cost of supply multiplies (lvanov, 2017). A supply chain disruption is a stoppage in the operation of any of the organizations involved in the manufacture, marketing, and distribution of a particular commodity or service.

Inter-firm networks' interrelated flows of goods, information, and money are susceptible to disturbance, which raises the possibility of supply chain disruptions, according to Pfeffer and Salancik (1978). All businesses are exposed to this type of risk since they are dependent in some manner on external resources and relationships with their supply chains (Christoph B., Stephan W., 2014).

The language used in the literature on supply chain disruption varies, however research by Bode et al. (2011), Craighead et al. (2007), Ellis et al. (2011), and Rao and Goldsby (2009) have all defined the meaning of terminologies used in the domains of supply chain risk management. In these study inquiries as a distinct event, the loss for the affected businesses is frequently linked to a supply disruption. Disruptions often affect at least two supply chain levels. Disruptions, however, may occur in the supply chain from a range of internal and external sources, making them quite diverse in character (Rao and Goldsby, 2009; Sodhi et al., 2012). A delayed shipment of non-critical material on the supply side may result in a less substantial interruption than a large product recall on the demand side (Christoph B., Stephan W., 2014).

2.4.1 Effects of Supply Chain Disruptions

Ding et al. (2015) claim that supply chain interruptions have an impact on a firm's performance both in the short and long term that is both beneficial and bad. Supply chain disruptions are related with an abnormal drop in shareholder value, as assessed by abnormal stock returns during a two-day trading period starting the day before the

announcement, according to a sizable sample of supply chain disruptions disclosed between 19S9 and 2000. (Hendricks and Singhal, 2003). They contend that businesses with stronger growth potential see stock market reactions that are more adverse. Hendricks and Singhal (2003) discovered, however, that the aberrant returns were not substantial over a longer 60-day period (equal to a single quarter in calendar time) following the interruption, announcements.

2.5 Operational Performance

Performance evaluation is all about quantifying the effectiveness and efficiency of activity (Neely, Gregory, and Platts, 1995). Gunasekaran and Kobu (2007) outline six objectives for performance reviews. Analyze (I) if goals are attained and (II) whether customers' demands are being satisfied. (3) ensure a deeper understanding of the processes, (4) identify inefficiencies, waste, problems, and opportunities for improvement, (5) encourage well-informed decisions, and (6) track progress. These objectives highlight the value of performance measurement in setting priorities and focusing efforts.

One of the factors that contribute to supply chain efficiency improvement is the formulation of thoroughly thought-out performance. metrics (Langfield-Smith and Smith, 2005). Business metrics must be selected or created with the company's long-term goals in mind in order to be effective (e.g., Arzu Akyuz and Erman Erkan, 2010).

There are several performance measures used by businesses that are part of a supply chain, according to the literature. These measures are categorized as either financial or operational by Bearnon (1999) and Gunasekaran, Patel, and McGaughey (2004). Financial health indicators compare a company's performance to factors outside of its control.

Market share, ROI, present value of the company, net income, and profit after sales are examples of common performance indicators (Gunasekaran and Kobu, 2007). Measures of operational success provide a more direct examination of the effectiveness of various initiatives and attempts (Chen and Pau Iraj, 2004). Christopher and Gattorna (2005), Hult, Ketchen, and Slater (2004), Swafford, Ghosh, and Murthy (2008), Fbster Jr. and Ogden (2008), Hwang, Radhakrishnan, and Su (2006), and innovation-based metrics (e.g.) As indices of operational performance, we focus on manufacturing cost and schedule achievement in our research. Costs of production can be used to determine internal efficiency (Gunasekaran et al., 2004). It covers the cost of raw materials, salaries, and other production-related costs (Ostwald and McLaren, 2004). How closely the project adheres to its timetable may be used to measure delivery timeliness. The qualities of the lead time affect timeliness. A similar phrase, "on time order fill," is used by Christopher (2010) to describe a situation in which a consumer obtains both predictable delivery and a fully filled order. The outcome of a delivery will rely on a series of earlier actions and administrative decisions. Additionally, there are supply chain nuances like future demand uncertainty. The variability of customer requirements and other elements could potentially negatively affect the timeliness and dependability of services. Therefore, when assessing delivery performance, it is crucial to explicitly recognize the upstream and downstream supply chain activities (Brown and Vastag, 1993; Vachon and Klassen, 2002). Manufacturing cost and schedule achievement are two of the five crucial strategic criteria of performance measurement for supply chains, according to the Supply Chain Operations Reference model (Supply Chain Council, 2008). Given that a supply chain crosses functional boundaries, it is fair to expect that the manufacturing cost and schedule achievement will reflect the effect of complexity and the impact of complexity-related measures (e.g. Bozarth et al., 2009).

The degree to which a business satisfies client demands can be seen as quality performance in the manufacturing setting (Crosby, 1996). A product's quality would decline if its design or specifications were altered after they were established. While acknowledging consumers' concerns about quality, this definition of quality gives more weight to how well something is made on the inside (Garvin, 1984). By first examining the product's essential components, then identifying probable failure causes, and then recommending alternative designs, the design process may be improved to boost quality (Kapur and Pecht, 2014).

In order to maintain good quality throughout the manufacturing process, statistical approaches are used to identify whether a production process is running outside of permissible bounds (Feigenbaurn, 2005). Therefore, it was reasonable to anticipate that, with the exception of supply quality, the effects of the SCC factors would not be reflected in the firm's quality performance. Afuah (1998), in contrast, defined innovation as the conversion of novelty into usable application. Innovation is essential to a company's performance in order to create greater rents and gain temporary monopolistic advantages.

As a result, innovation is essential to the ongoing success and growth of any firm, according to study by Corsten and Felde (2005). Innovation-based performance is measured by the introduction of new products, processes, or technologies (Gilley and Rasheed, 2000). In the context of the supply chain, this performance is influenced by firm capability (Lawson and Samson, 2001), R&D expenditures (Olson, Walker, Ruekerf, and Bonnerd, 2001), and buyer-supplier cooperation (Petersen, Handfield, and Ragatz. 2005). Therefore, it was believed that the components of SCC had little effect on innovation-based performance metrics.

2.6 Research Gaps Identified

Despite the notion that supply chain complexity is a pressing issue in contemporary supply chains (Bode and Wagner, 2015), scholarly consensus regarding its effects on operational performance of firms has not yet been reached. There isn't a survey on supply chains with complexity and disruption concerns, despite the fact that there is a lot of research on supply chain complexity with other factors. With the advent of Supply Chain Disruption as a mediator, this research aims to contribute to this evolution by examining the impacts of SC Complexity on company operational performance. A company may have an extremely complicated supplier base and a significantly less complex client base, or the other way around (Melek, A. et al, 2021). Between a company's client base and its supply base, the key complexity sub-dimensions may vary (Melek, A. et al, 2021). We'll look at supply chain complexity in terms of the SCC levels in accordance with this literature: (i.e. upstream, internal, and downstream). Additionally, using supply chain disruption as a mediating factor, we investigate the relationship between SCC and various performance dimensions. The complexity of the supply chain affects the company's capacity to excel at its competitive goals, including price, delivery, quality, and flexibility (Ward et al., 1998).

This could have an impact on the company's operational success, say Vachon & Klassen (2002). Innovation, which is frequently taken into account separately from the conventional competitive priorities, is another significant strategic achievement on the list (Melek, A. et al. 2021). The effect of SCC on the firm's business performance as a result of SC interruption should also be looked at. The impact of supply chain complexity on costs and schedule achievement will be the main focus (Z. Halirn, 2015). In conclusion, the study aims to investigate if and the degree to which SCC impacts

operational performance within the two main aspects of company performance: (I) cost performance, and (II) schedule attainment performance.

2.7. Research questions development

The hypothesis development is essential for a sound and well-developed research study. The research hypothesis is a contributor to solving the problem of the study. As a result, we construct our theories regarding how SCC affects a firm's operational performance in this part.

2.7.1 SCC impact on operational performance

According to Turner et al. (2018), a complex supply chain is linked to subpar operational performance. According to other study, complex systems produce a chaotic environment for the organization (e.g., Choi & Krause, 2006; De Leeuw et al., 2013; Skilton & Robinson, 2009). The operational burden of managing several actors is so increased. Businesses run the danger of vulnerability and operational hazards when the influence of a negative and chaotic environment combined with the high levels of uncertainty and unpredictability associated with complexity (Isik, 2010; Serdarasan, 2013). According to Serdarasan, both internal and external (upstream and downstream) complexity can cause disturbance (2013).

Operational risks increase a company's vulnerability to failure, such as supply chain disruptions (Birkie & Trucco, 2020; Blome et al., 2014; Bode & Wagner, 2015). Disruption can lead to higher costs for production, inventories, logistics, and communication as well as decreased productivity, slipped timelines, and inconsistent quality (Choi & Krause, 2006; Dittfeld et al., 2018; Lorentz et al., 2012; Lu & Shang, 2017; Vachon & Klassen, 2002).

Upstream complexity has been determined to have the largest detrimental effect on operational performance (Melek, A., et al., 2021). The cost of managing a supply base is directly correlated with the number of interfaces and links (Choi & Krause, 2006; Giannakakos et al., 2018; Lu & Shang, 2017). The risk that upstream complexity may result in disruptions increased along with the managers' need to take disruptions into account or prevent them (Bode & Wagner, 2015). The complex upstream supplier base of the target business is more likely to produce frequent and challenging interruptions (Melek, A. et al, 2021). The rising information processing requirements of the focus company are noted as one factor contributing to upstream complexity, which in turn results in a greater cost of communication (Bode & Wagner, 2015; Lu & Shang, 2017). Bode & Wagner (2015), Dong et al. (2020), and Lu & Shang (2017) all point out that the focal firm's difficulties in working with suppliers from different language and cultural backgrounds are made worse by the variety of the suppliers' industries and locations. As a result, the focus firm's transaction costs increase and it becomes impossible for it to cope with any potential supplier opportunism (Giannoccaro et al., 2018; Grover & Malhotra, 2003; Choi & Krause, 2006). Both Vachon and Klassen (2002) and Lu and Shang (2017) note that the focus business may also lose control over issues like the necessity of high-quality communications and the homogeneity of inputs bought from many vendors. These, according to Melek, A. et al. (2021), are the main elements that contribute to the complexity of finer points.

The complexity of the upstream environment makes supply chain management even more challenging. When a business must often alter its inventory choices and production schedules in response to variations in supplier lead times, operational costs increase (Caridi et al., 2010; Lu & Shang, 2017). Businesses must pay more to find and evaluate suppliers because of the supply base's unpredictability, heterogeneity, and

uncountability, and they might not have formed cooperative relationships with any of their potential suppliers (Bozarth et al., 2009).

According to Jacobs (2013), a small supply base is a prerequisite for successful strategic alliances. Since customers can more easily access the company's improved goods and services and distribution network, this indirectly improves operational performance (Melek, A. et at, 2021).

Because of the difficulty in obtaining preferential treatment from suppliers owing to upstream dynamic complexity, the firm's performance is negatively impacted (Autry & Griffis, 2008; Pulles et al., 2016).

Again, research to far shows a negative correlation between internal complexity and operational success. According to Caniato and Grofsler (2015) and Weingarten et al., low-volume production with a large variety of products and parts is linked to increased capacity unreliability and higher planning and execution costs (2017). When there are numerous possible build configurations, production quality and efficiency in the automotive industry suffer significantly (Hu et al., 2008). This is an example of the proliferation of products, which, according to Melek et al., (2021), results in greater inventory costs and decreased efficiency. The same is true for operational performance: too many internal procedures lead to problems with quality control, continuous improvement, and delivery delays (Wiengarten et al., 2017). Melek A. et al., (2021)'s argument that the unpredictable nature of the business environment has an influence on operational performance since it results in less exact production planning lends greater credence to this viewpoint.

Finally, Melek et al., (2021) reported that existing research indicates a negative relationship between downstream complexity and operational effectiveness. Larger

client bases with large demand fluctuations reduce the company's operational efficiency since they require more setups and lower production volumes (Bozarth et al., 2009).

According to Lorentz et al., greater consumer diversity brought on by regional heterogeneity is likely to result in higher inventory costs and longer cash-to-cash cycle times (2012). This can make it less efficient for a business to manage its clientele and drive up transaction expenses (Melek, A., et al., 2021). Additionally, the operations of the central organization may be significantly impacted by the bullwhip effect brought on by a change in the downstream supply chain caused by the diverse client base of distributors, retailers, third-party logistics service providers, and end customers. The extent to which customers may customize items and the effectiveness with which firms can deliver those products to clients are both anticipated to be impacted by such disruptions (Melek et al., 2021).

We finally pieced together the following hypothesis based on the aforementioned grounds. We started with the broad, overarching premise and then proceeded to deconstruct it into sub-hypotheses that would help in the examination of the supply chain's complexity upstream, internally, and downstream.

Research Question 1: *How does Supply Chain Complexity affect a firm's operational performance?*

2.7.2 SCC impact on SC Disruption

Supply chain disruptions are described by Craighead et al., (2007) as "unplanned and unforeseen occurrences that disrupt the usual flow-of products and commodities within a supply chain." The goal of this study is to better understand how a company's operational performance is impacted by the complexity of its supply chain and how supply chain interruption affects this connection. Supply chain complexity has been

found to negatively impact a firm's performance in the following areas: overall plant performance (Bozareth et al. 2009), the severity of disruptions (Craighead et al. 2007), responsiveness (Choi and Krause 2006), reliability and delivery speed (Vachon and Kla sen 2002), and quality (Vachon and Kla sen 2002). (Zhuo et al. 2009). High scale/detail complexity businesses are more prone to have increased delivery unreliability (Choi and Krause. 2006). On the other side, a company with a streamlined supply base may suffer from single sourcing's drawback and may be at high risk because of its less flexibility, according to Choi and Krause (2006). Despite this, Melek A. et al. (2021) contend that because there are more actors involved in the latter supply chain, it is more likely to experience fewer disruptions on a more frequent basis than a more complex supply chain. As information transmission between organizations within the supply chain is altered, delayed, or even blocked entirely, structural complexity reduces responsiveness (Smith et al., 1991).

According to Choi and Krause (2006), businesses with significant differences in their suppliers' technical proficiency or scale may have trouble coordinating their supply base. Coordination frequently leads to disruptions, such as poor demand fulfillment or delayed delivery, and this has a significant influence on organizational performance since it increases the amount of information processing and uncertainty needed.

Long lead periods and uncertain delivery schedules, both of which fall under the category of delivery complexity (Stecke and Kumar 2009), as well as slower than expected reactions to demand changes (Simangunsong et al., 2012), and bullwhip, are the main causes of frequent interruptions (Lee et al., 1997). Given that physical movement of goods and services within the supply chain can be affected by information flow delays, there is a high likelihood that the organization's operations will be disrupted; thus, the question,

Research Question 2: *How does Supply Chain Complexity affect Supply Chain Disruption?*

Sub-questions are: How is SCC in the form of upstream complexity, internal complexity and downstream complexity affects supply chain disruption?

2.7.3 The mediating impact of SC Disruption

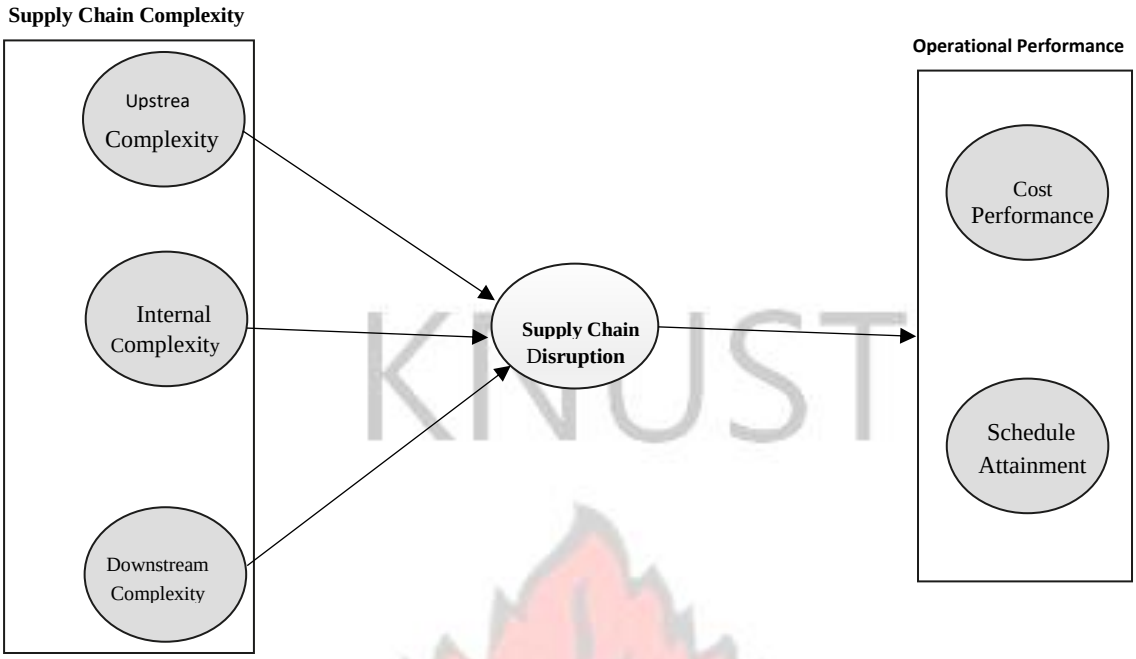
Despite the general circumstantial evidence about how disruptions affect firm performance, empirical evidence is still insufficient (Melek A. et al., 2021). Supply chain interruptions are likely to have a negative impact on a company's operations performance in terms of profitability, including net sales, expenses, assets, and inventory performance (Hendrick and Singhal 2005).

There is evidence that supply chain risks have a detrimental impact on performance (Wagner and Bode, 2008). However, this is not true for all risk types. This study aims to look at how interruptions affect operational performance, which is a measure of the firm's operational success in terms of cost and schedule achievement. The more frequently a disruption happens inside a particular company, the more probable it is that performance would suffer as a result, according to Melek A. et al. (2021).. This leads to hypothesis,

Research Question 3: *What is the mediating role of Supply Chain Disruption on the relationship between SCC and firm's operational performance?*

2.8 Conceptual framework

The conceptual framework gives the researcher guidance in addressing the goals of the investigation. The approach for this study uses supply chain disruption as a mediating factor to show how supply network complexity affects a firm's operational performance.



Conceptual frame work

CHAPTER THREE

RESEARCH METHODOLOGY AND PROFILE OF ORGANIZATION

3.1 Introduction

Research methodology includes all methods utilized to carry out research activities (Kumar, 2008). The approach that the researcher chooses greatly affects the study's findings. The impact of supply chain complexity on business performance has been the subject of several research.

The literature study demonstrates that numerous opposing ideas have, nevertheless, been put forth. This is not to suggest that those research did not further our understanding of how supply chain complexity influences outcomes, but rather to highlight the need for a conceptual framework that explains how supply chain complexity affects company performance.

The qualitative research approach was employed for this investigation. The word "qualitative" is derived from the word "quality," which describes the process by which knowledge is created using the appropriate researcher's attitude and behavior, together with the technique they have selected and the type of data they have collected (Kabiru, 2012). Jonker (2010) defines qualitative research as an endeavor in which the researcher tries to understand the reality of a particular organization and the happening phenomena from the viewpoint of individuals concerned. Instead of using quantitative tools, qualitative ones enable the researcher to fully comprehend the reality of events within the business.

In research investigations when it is hard to isolate the phenomena from its environment, case studies are suitable for answering "how" questions (Yin, 1994). The best way for examining the viability of the hypotheses is the case study approach.

Through the use of supply chain disruption in Ghana's rice industry, we are interested in examining how supply chain complexity affects a firm's operational performance. In-depth interviews and on-site observations offer an approach that is more effective than other methods for achieving this aim.

One of the most effective techniques in operations management, according to Vose et al. (2017), has always been case studies. Meredith (1998) emphasizes the deeper comprehension and breadth that may be attained via the use of case studies in her work. The "lived experience" (Williams, 2015) was researched utilizing subjective methods and interviews with employees and managers at the supply chain function of the company who address SCC concerns, as taken from the works of Cicmil et al. (2009), Maylor and Turner (2017), and Shenhar and Holzmann (2017).

To give the alignment framework empirical backing, we especially performed an analytical case study at Tamanaa Company Ltd. It is crucial to keep in mind that analytical case studies are appropriate for presenting proof and putting established research hypotheses to the test. Interviews and company-specific materials are used to gather data. Interviews with directors of buying, administration, logistics, and supply chains have been conducted.

The study's methodology aims to describe the methodical steps the researcher used while selecting the right data to analyze in order to achieve the goals. Research design, study population, sample strategy and size, data collecting method, and data analysis are all included in the methodology.

The techniques and tools used to obtain information together are referred to as research methodologies, as was described before. The two most crucial methods used to gather pertinent information for the study's goal are content analysis and interviews.

Thomas (2003) asserts that content analysis encompasses more than just documents and also includes audio recordings, films, still images, and a search through one or more communications that the researcher brings to the investigation. Content analysis is a fractional and frequency assessment that examines the situation's intensity. The character of spoken contents is studied via content analysis. A review of research entails a basic or in-depth study of the published research publications' content. Kothari, 2004, defines basic and subtle levels published articles as those that are pursued based on certain aspects of the document or verbal materials that can be detected and tallied, and when researchers examine its attitude and determine its meaning.

In order to gather information useful for responding to the study's questions, the researcher also conducted interviews. Interviews are merely conversations with questions on a research project as the main topic (Merriam 2009). The two types of interviews are structured and unstructured. An unstructured interview is characterized as a realistic autobiographical, in-depth, narrative, or non-directive interview that is modeled after a conversation. Unstructured interviews have their own set of interpersonal standards that may be more or less specific since they seem to be a social event. The researcher and the participant converse during an interview, which occasionally turns into a learning process when the participants understand how the game is played and its underlying causes. By adapting to the participant to elicit the desired response, the interviewer exhibits excellent situational awareness (Blaxter, et al; 2006). One-on-one, focus group, telephone, or email interviews are all options. The information gathered during the interview may be written down in the form of notes or a record. For the sake of this thesis, pre-written questionnaires, phone calls, emails, and one-on-one interviews are used to produce the required outcomes. Further employed to allow for generalizations is confirmatory case study analysis.

3.2 Research design

Designing a research study is the process of setting up the circumstances for data collection and analysis in a way that ensures the procedure and goals are aligned. When discussing research design, we're talking about the conceptual frameworks that the research is conducted in. The plan for gathering, measuring, and analyzing data is referred to (Kumar, 2008). The blueprint or framework for conducting the research process in order to address the research challenge is known as the research design (Babbie and Mouton, 2001).

By developing a questionnaire to get data on the supply chain complexity and company performance, this study used a case study methodology to gather its data. The emphasis in a case study is more on a thorough contextual investigation of fewer instances of events or situations and how they relate to one another (Cooper and Schindler, 2003). When a "how" or "why" inquiry is posed concerning a recent series of events that the researcher has little to no influence over, this is the circumstance that gives case studies its particular benefit (Yin, 1994). By engaging a wide range of issues via interviews, questionnaires, or observation, the survey approach seeks to fully characterize and explain current situations. By sharing comments on the current practices that are particular to the population of the study, it gave the researcher the chance to understand the viewpoints of the respondents.

3.3 Population of the Study

The entire number of participants in a research, or subjects, who meet specified criteria is referred to as the population (Polit and Hungler, 1999). In other words, the population of the study is the researcher's chosen target audience for the study. According to Babbie & Mouton (2001), a population is a group of things, occasions, or people that the researcher is interested in researching and who share some features. The same

Babbie & Mouton (2001) claim that the population may be seen as an analytical unit. According to Bless and Higson-Smith (2006), the subject or object that a social researcher may get data from is the unit of analysis.

The goal of this study was to thoroughly examine the mechanism through which supply chain complexity influences business performance. Thus, it follows that the firm serves as the study's primary analytical unit. The managers and employees at Tamanaa Company Ltd.'s supply chain, production, warehousing, administration, and transportation divisions may be clearly identified as the study's population.

3.4 Sampling technique and sample size

Choosing individuals or groups from a population of interest in order to accurately generalize the results to the population from which they were selected is the process of sampling (Trochim, 2006). According to O'Sullivan (1989), sampling is split into probability sampling, which includes systematic, stratified, and cluster sampling, and non-probability sampling, which includes basic random sample (convenience sampling, purposive sampling and quota sampling).

The quantity of respondents the researcher uses to gather data is referred to as the sample size. A sample size that is too small might cause one to overlook significant study findings. A lot of time and money could be lost if it is too big. For the study results to be accurate and legitimate, the sample size is essential. When compared to larger populations, the sample size from a small population or group of respondents is thought to be more accurate and reliable when it comes to drawing conclusions. The sample should make up a sizable portion of the population if the population as a whole is tiny (De Vos et al. 2005).

The study of supply chain complexity is currently highly valued by both academics and companies. According to Tan et al. (2002) and Lorentz et al. (2012), this is mostly because complexity has been carefully considered as a factor in predicting business success in the rapidly growing global setting. Research on supply chain complexity has mostly focused on the manufacturing industry. This is also shown by the global database from the Global Manufacturing Research Group, the works of Bozarth et al. (2009) and Vachon Klassen (2002), which covered manufacturing companies from three industries, respectively (machinery, electronics, and transportation components). This approach has been used as a base to establish the sample frame for this inquiry.

The SC department workers of the organization in question were carefully chosen for this study, and they were all asked the identical questions to get their thoughts on the issues at hand. The researcher decided to use this sample technique while conducting research using the qualitative approach utilizing information gathered from interviews with case firm personnel.

The target audience of this study is decided to be the list of employees at Tamanaa Company Ltd. who work directly in the departments of supply chain, purchasing/procurement, logistics, transport, inventory, administration, and warehousing. In other words, the purposive sample approach was used to choose executives from the example company's buying and supply chain departments. Targeting replies from the executives in the buying and supply chain departments of the company, an expert sampling strategy was utilized to gather the most precise and trustworthy responses (Etikan et al, 2016). Additionally, this served the research's goal of determining how supply chain complexity affects business performance. Finally, due to the small number of employees in the aforementioned departments of the case

company, the researcher spoke with all 47 of them. As a result, it was decided that the target sample for this study would be the personnel in the departments listed above.

3.4.1. Purposive or Judgmental sampling

In a non-probability sample known as a purposive sample or judgmental sample, the researcher selects the units to be observed based on his or her own evaluation of which ones will be the most valuable or representative (Babbie and Mouton, 2001). By choosing participants from a specified set of departments, purposeful sampling was employed in this study to find managers and staff at Tamanaa who are educated about how supply chain complexity affects the operational performance of the organization.

3.4.2. Choice of instrument

For data collection with respondents one-on-one, the researcher conducted semi-structured interviews. The researcher was able to verbally clarify several ideas using this tool, which helped the respondents react to the interview schedule's questions.

3.5 Data collection method

The researcher collects data from his respondents in order to obtain information from them. It outlines the steps taken by the researcher to collect the data necessary to meet the study's goals. The data source, data collecting tool, and data collection process are all covered. Data collecting method and technique are different in that the former relates to a systematic strategy to gathering data, whilst the latter refers to the practice of inquiring, listening, and interpreting (Voce, 2002). Quantitative, qualitative, or a combination of both approaches are most often utilized.

This study uses a qualitative methodology and data from semi-structured interviews to examine how supply chain complexity affects business performance. This enables the researcher to follow up on important topics brought up in the interview, giving

participants the chance to clarify their responses by being prompted for more information. The employees are selected from the firm's designated SC divisions, and they are subsequently asked comparable questions to establish their opinions on the matter at hand. A qualitative method will be employed since the study will look at how supply chain complexity affects the company's operational performance. When collecting data from documents, records, and artifacts, qualitative researchers use historical and anthropological context to understand and describe a culture or institution, according to Goodwin (1996). This helps researchers better understand the actions, knowledge, attitudes, beliefs, and perceptions of the subject whose material is being analyzed. Research questions were created using the main hypotheses found in the literature on supply chain complexity.

3.5.1 Source of data

Accessing information relevant to the study is a critical factor for addressing the objectives of the study. The data for this study was obtained from two major sources:

3.5.1.1 Primary Sources of data

These are sources where data is obtained by the researcher, and are usually first hand or original data since they are collected in person. These data are usually first hand or original data because they are collected in person for the first time. The primary sample of this thesis is determined as the employees of Tamanaa Company Ltd. The researcher contacted colleagues and friends who are working in the case company and got them to convince their co-workers in the procurement, logistics and supply chain departments to participate in the study.

3.5.1.2 Secondary Sources of data

Secondary sources are sources of data other than first-hand sources. Secondary data are mostly obtained through the use of articles, newsletters, magazines, internet, journals, and peer-reviewed documents. The researcher obtained data from these sources in order to complement the primary data in the analysis, and to provide clarity to the understanding of the study's objectives. The researcher employed the use of computer and mobile phone to obtain secondary sources of data.

Important and relevant industry information was obtained through various search options using the computer and mobile phone; these tools helped in gathering data from empirical researches done in the rice industry in Ghana.

3.5.2 Collection instrument

The adopted design offered the researcher specific tools to facilitate data collection aimed at obtaining data in answering the study's objectives. The study involved interacting with employees involved in the supply chain activities of Tamanaa Company Ltd. The instruments used by the researcher include factual questionnaires, inventories of documents and test (Thomas 2003). By virtue of this process, the study employed a semi-structured interview as an instrument to guide the researcher in sourcing primary data. The interview was designed in accordance with the study's objectives and carried out at production site. This tool or instrument provided an opportunity for the researcher to observe and understand in context the perspectives as shared by the respondents.

Then, computer and mobile phone were used to obtain secondary sources of data. These tools offered various search options for the researcher to obtain key industry information from empirical studies carried out on the supply chain activities in the firm,

especially on how complexities at the upstream, internal, and downstream dimensions impact on the operational performance of the firm.

3.5.3 Collection procedure

The first method of data collection in this study was a telephone interview. This study is based on information gathered from informants, who are all Tamanaa employees but come from various departments within the supply chain division. Through email, open-ended, pre-formulated questions were distributed to the participants. With the intention that they would become familiar with the questions, this was done so that they could then provide their replies or comments during a phone conversation. The phone interviews, however, did not go as well as expected due to network issues. The questionnaire was produced and physically delivered by the researcher to the company's administration office for distribution to the appropriate responders. The researcher collects pertinent data through interviews and company-specific materials. The CEO, Operations manager, Procurement manager, Production manager, and/or Purchasing Director have all been questioned throughout the interviews. Multiple actors were interviewed in order to increase the reliability of the data collected from respondents. Additionally, this helped to triangulate and capture various viewpoints. Direct visits to factories and warehouses allowed for on-site inspections, and databases from the companies were utilized to collect extra data as necessary.

In order to learn firsthand about how SCC affects company performance, the researcher also conducted field observations. One cannot overlook the value of field research when evaluating how supply chain complexity affects company performance.

3.6 Data analysis

The data obtained from the respondents was analysed in conjunction with literature, and the information was captured and coded in SPSS software. the research data was coded at the variable view with compliance to parameters defined for each case. Frequency tables and graphs were then generated to clarify the various responses from the respondents on their views of how supply chain complexity affects their firms' operational performance. The theoretical foundation of the study's design was taken into consideration when doing data analysis. In addition to screening the qualitative data, the data was classified into thematic categories for analysis. The qualitative and certain quantitative measurements were combined for a more thorough interpretation and analysis.

3.7 Instrumentation and Measurement

Supply chain disruption and supply chain complexity, especially its levels (dimensions) of upstream, internal, and downstream complexity, were the independent factors in this study. The dependent variable was business performance, particularly in terms of meeting costs and deadlines. Single-item measures may be employed in cases when many and uncertainty are taken into account for assessment as elements of SCC, according to earlier research by Bozarth et al. (2009) and Vachon and Klassen (2002). Numerousness and diversity in the product portfolio, for instance, may be determined objectively by the number of goods the company offers, while numerousness and variation in the supply chain can be measured by the number of suppliers (Huriye Mernis, 20 J 9). The following questionnaire questions were selected to test the components based on the research.

3.8 Measurement

Combining data collection techniques like interviewing, surveying, looking through archives, and making observations is the best way to gather evidence for a case study (Collis & Hussey, 2003). Based on the literature research that Bozarth et al. implemented, the case study questionnaire has five components divided into two halves (2009). A brief description of the objective of the survey is in the cover page at the beginning of the survey. Respondents are also reminded of the voluntary basis of the questionnaire in the cover page. Part One comprises sections I and 2 of the questionnaire, where the demographic information of the participants, as well as their experience at the procurement and supply chain departments of their firm, and the firm's background are measured. Part Two is made up sections 3 to 5 where questions about supply chain complexity, firm operational performance as well as supply chain disruption are asked.

3.8.1 Supply chain complexity measures

As per the literature review, this research used sixteen measures of supply chain complexity, comprising eight closed-ended questions requiring "yes", "No", or "Don't Know" answers, and eight open-ended questions requiring the respondent to provide information to help compare with existing data.

3.8.2 Operational Performance (Cost performance and schedule attainment)

In this study, two business performance metrics were used. These metrics—operational schedule achievement and cost performance—were used to address issues 1-3. In this study, performance and planned attainment were viewed as two separate entities as opposed to two first order operational performance components Hurlye Memls (2019). This was done in order to make it possible to independently assess how SCC affected each of those performance parameters. A multi-item scale measuring schedule

attainment was created from the answers of the firm's supervisor in charge of operations, the inventory manager, and the production control manager. On a likert scale, respondents were asked to rate the performance of the plant 1 ("Poor, low end of industry") to 7 ("Superior") in order to measure cost performance (adopted from Bozareth et al., 2009).

3.8.3 Supply Chain Disruption

SCD was measured using an open-ended measurement model. The researcher believes the model is appropriate in order to answer the question of how SCD relates to cost performance and schedule attainment of the firm.

The vast majority of the items in the questionnaires were drawn from the existing measures used in prior research published in the literature in order to increase the study's reliability and validity.

3.8.4 Control Variables

As control factors in this study, the business size, industry, and the proportion of purchasing expenses to total expenses are all taken into consideration. Because of this, the impact of economies of scale, the various operational and competitive situations in each sector, and the significance of purchasing inside the company were all managed by these variables (Gonzalez-Benito, 2010).

3.8.5 Firm Size

The logarithm of the number of full-time workers (FTE) employed by the organizations is used to calculate the size of the firm.

3.9 Ethical consideration

The study's goal was to investigate the link between supply chain complexity faced by businesses and how it affects those businesses' performance. Confidentiality is essential to obtaining trustworthy data from businesses for the achievement of the purpose. Therefore, the questionnaire asked participants to assess how their companies performed in comparison to the industry standard and their suppliers from a variety of angles.

The responders from the rice processing companies were informed of the study's goals. Before the work began, permission was first and foremost given in writing. The respondents were informed of their choice to participate or not in the study. Additionally, they had the freedom to participate in the study for as long as they wanted and to discontinue it whenever they wished. Numerous guarantees, including privacy, confidentiality of personal information, and respondents' anonymity, were given to the respondents.

3.10 Profile of Ghana's rice industry

In Ghana, rice is an important crop for the development of the economy. Rice is cultivated for both food and as a cash crop, and constitutes a major component of the Ghanaian food basket. It is a grain that is consumed by everyone in different dishes. The consumption of rice continues to grow due to population growth, urbanization and change in consumer behaviours. Data available from Ministry of Food and Agriculture (MoFA) indicate that in the year 2020 a total of 1,450,000 MT of rice was consumed in Ghana. Meanwhile, paddy rice production in the country were 302,000 MT and 987,000 MT between 2008 and 2020 respectively. Out of the paddy produced during this period, 181,000 MT to 622,000 MT were milled between 2008 and 2020. Thus about 57.10% of total rice consumed in 2020 were imported to augment the local

demand. The data also show that about 37% of rice produced in Ghana are not processed or milled. Source: Concept note on Rice Fair 2022, By Zakaria Alhassan.

Rice is the second most preferred food staple in Ghana accounting for 16% of total grain output. It is a major source of carbohydrate and forms an important component of most household meals. Rice is also considered an important food crop for food security and poverty reduction.

3.10.1 The Ghana Rice Value Chain and distribution Network

The domestic rice value chain comprises:

1. Input Suppliers: They supply farmers with agrochemicals, fertilizers and varieties of seed for production.

2. Producers/Farmers: Local rice production is undertaken mainly by smallholder farmers with farmlands usually less than one hectare with just a few large-scale producers.

- Aggregators: They serve as intermediaries between smallholder farmers and nee
- processors and they collect rice from farmers and supply in bulk quantities to processors.
- There are also aggregators who are involved in processing.
- Processors/millers: They process paddy from farmers and traders to milled rice for sale in the market. The sale of milled rice is done by the millers themselves or by traders.
- Some processors sell their output to rice importers who re-bag the rice to wholesale.
- Wholesalers: Wholesaling of local rice is done on a very small scale by some processors.

- The rice wholesale market in Ghana is dominated by imported rice.
- Retailers: Rice is sold to consumers in open markets, some modern shops, supermarkets and convenience shops.
- Consumers: They are the end-users of local rice. Consumers purchase local rice from traditional open markets, modern shops, supermarkets and convenience shops in the country.

The rice industry is segmented into the domestic and the imported rice industry and is valued to be over USD I billion with the domestic industry accounting for an estimated 47%.

3.10.2 Local Rice Industry

Rice is produced in all 16 regions in Ghana with the Volta Region currently the leading producer (with 266,303.01 Mt) followed by the Northern Region (178.455.28 Mt) as shown in Figure 4.

These two regions account for close to 70% of domestic rice production. Other major rice producing regions are the Upper East (114,524.76), Ashanti (42,686) and Eastern (38.524.11)

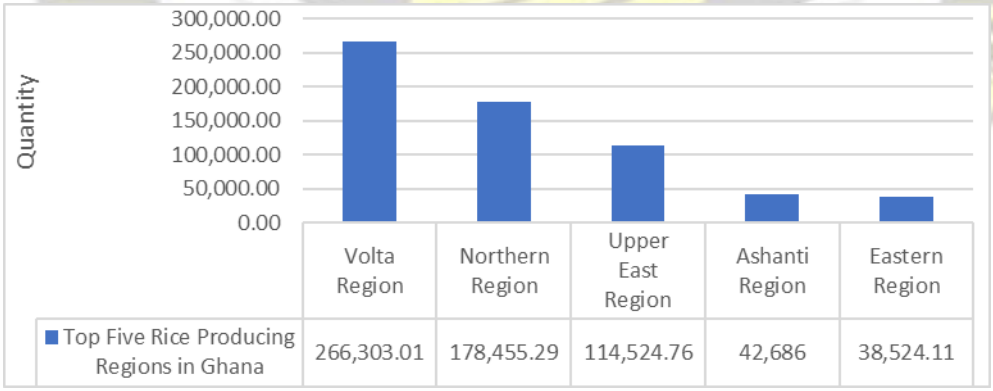


Figure 1: Top five rice producing regions in Ghana (2016-2018)

Source: MoFA Agric Facts and Figures (2018)

3.10.3 The Case Organization

Tamanaa Company Limited is a registered rice mill into rice farming and processing based in Nasia in the North East Region of Ghana within the West Mamprusi Municipality. The company was founded in 2011 and was formally registered in 2013 as a limited by guarantee organization with a social enterprise focus.

Tamanaa Company Limited has a 250 tons per day rice mill and processes rice under the brand "Nasia Star Rice" known for quality and nutritious value. Rice varieties marketed by Tamanaa are: perfumed rice, brown rice, broken rice, and parboiled rice. In addition, the company also provides inputs and mechanization services to out-growers.

3.10.3.1 Vision a Mission

The vision of Tamanaa Company Limited is to become a leading producer of local rice for the domestic market and for export, whiles the mission of Tamanaa is to provide integrated agribusiness services within the rice value chain to support rural folks to increase their levels of income sustainably.

3.10.3.2 Current Operations

Tamanaa Company Limited currently works with over 4,000 smallholder farmers with 5 acres each and provides mechanization services, inputs (certified seed, fertilizers), credit, to facilitate the production and aggregation of paddy rice for milling. The Company takes repayment in-kind through aggregation of the paddy rice from the out growers at premium prices for onwards processing and supply to the end markets. TCL owns 2 tractors for its mechanization services and outsources other tractors and equipment from private entities. Tamanaa sources paddy from its out growers but also works with 1500 women parboilers and aggregators who are involved in parboiling

paddy from farmers before milling. Tamanaa has a rice milling machine with 290 tons per day capacity that mills approximately 200 tons of paddy rice daily. The company also has a 500 MT capacity warehouse that stores paddy and milled rice. Although Tamanaa is based in Nasia, its areas of operation spans the Northern and North East Regions of Ghana, specifically West Mamprusi, Savelugu Nanton, Mamprugu Moaduri and East Mamprugu Districts. Tamanaa investment in rice mills has dramatically boosted the interest of rice farmers in the North of Ghana, as it has provided a ready market for some 5,000 farmers within its catchment area. The branded product for rice is "Nasia Star Rice".

3.10.3.3 Products and services

The main products sold by Tamanaa Company Limited are parboiled and non-parboiled rice. The company currently processes and markets 60% of its rice as parboiled and the remaining 40% as non-parboiled. The parboiled rice is targeted at the Northern market (the three northern regions) and health-conscious consumers whiles the non- parboiled rice is targeted at the general rice market. The company sells its milled rice under the brand name “Nasia Star Rice”. The varieties of Nasia Star Rice sold by the TCL are:

- Brown Rice
- White Perfumed Rice
- Broken Rice
- Parboiled Rice

3.10.3.3 Organizational structure

The operations of the factory is divided into three departments: Production, Business development and Administration. The Production Department is overseen by an operations manager who is supported by one Factory Manager, and one Warehouse Manager. The Factory Manager oversees the activities of 10 Mill Operators (who run

morning and evening shifts), and the Warehouse Manager oversees the activities of two drivers.

The Business Development Department is overseen by the Business Development Manager supported by an Out-grower Manager who oversees the activities of 40 Field Extension Agents- and two sales officers who oversee the activities of 10 regional agents.

The Administration Department is headed by the Finance and Administration Manager, who is assisted by an Accountant and a Human Resource Officer. The Accounts Officer oversees the activities of 10 Regional Agents. Overall, the three departments will requires 63 staff, in addition to the Chief Executive Officer (CEO) to operate efficiently as shown in the organogram below.

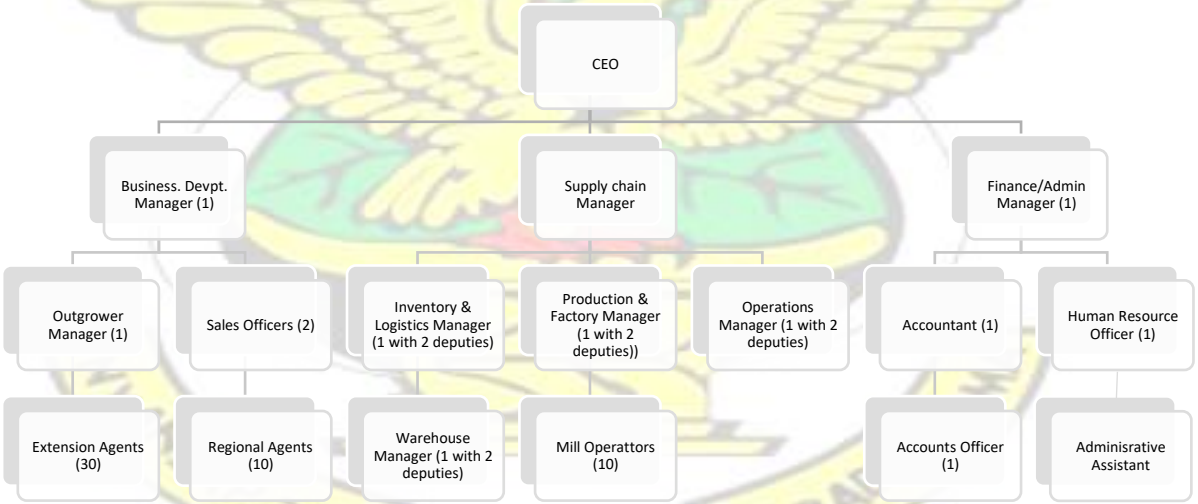


Figure 2: organizational Structure of Tamanaa.

3.11 Pre-testing

Before beginning data collecting, a pilot test of the questionnaire was conducted. The purpose of the pilot survey was to identify potential data collection issues ahead of time. After conducting a comprehensive literature analysis, we ensured that our survey contained all the questions and measures needed to accurately assess supply chain complexity and company performance. It is essential, however, to check the items because of the potential for confusion introduced by their translation from the articles' original measuring units. The questionnaire was also pilot tested to guarantee that the survey questions would be comprehended by the target audience.

Before conducting the pilot study, the researcher had to get approval from the company's Head of Department in the SC/Operations division. The researcher then prepared questionnaires for the pilot study, revising them slightly before administering them to the whole sample. Pre-testing feedback led to adjustments to several of the statements, phrases, and language.

Furthermore, the feedback was used to rearrange the items for a more logically structured survey. An academic expert in the field of supply chain management then assessed the questionnaire, making suggestions for changes and additions. The final version of the questionnaire took into account feedback from academics and business leaders and was revised accordingly.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1. Introduction

In this chapter, data obtained through interviews and field observation are analysed and interpreted. This chapter as well, aims to present the information about the effect of supply chain complexity on a firm's operational performance, with supply chain disruption as a mediator. Graphs, tables and pie charts will be used in analysing and interpreting the data.

4.2 Demographic characteristics of respondents

Demographic data is a statistical expression of socioeconomic information that includes employment, education, income, marriage rates, birth and death rates, and more. The study of a population's characteristics based on elements like age, race, and sex is known as demographic analysis (https://www.investopedia.com). Gender and age of respondents were taken into account for this study's purposes.

4.2.1 Gender

30 out of the sample of 43 respondents, representing 70% were males and 13 respondents representing 30% were females as shown in Figure 6. From this data, it is clear that the proportion of male participants is higher than their female counterparts.

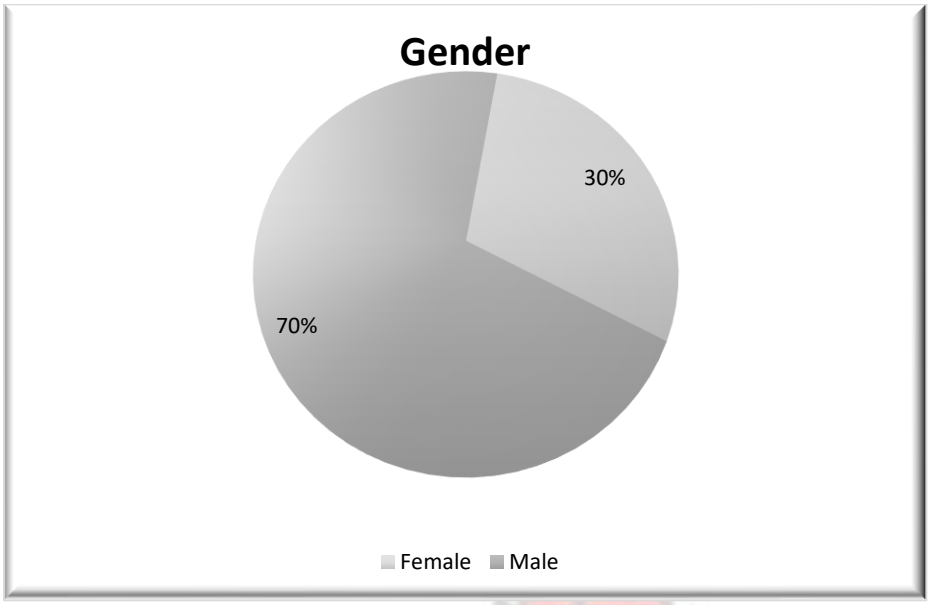


Figure 3: Gender distribution

4.2.2 Age

The data records 11% of respondents below 25 years, with non-below 18 years. 9% of the selected population were respondents above 54 years of age. Greater percentage of the respondents were within the ages of 25-34 years and they formed 30% of the target group, followed by respondents within the brackets of 35-44 and 45-54 who formed 25% each. The ages of the respondents are as shown below in pie chart 2.

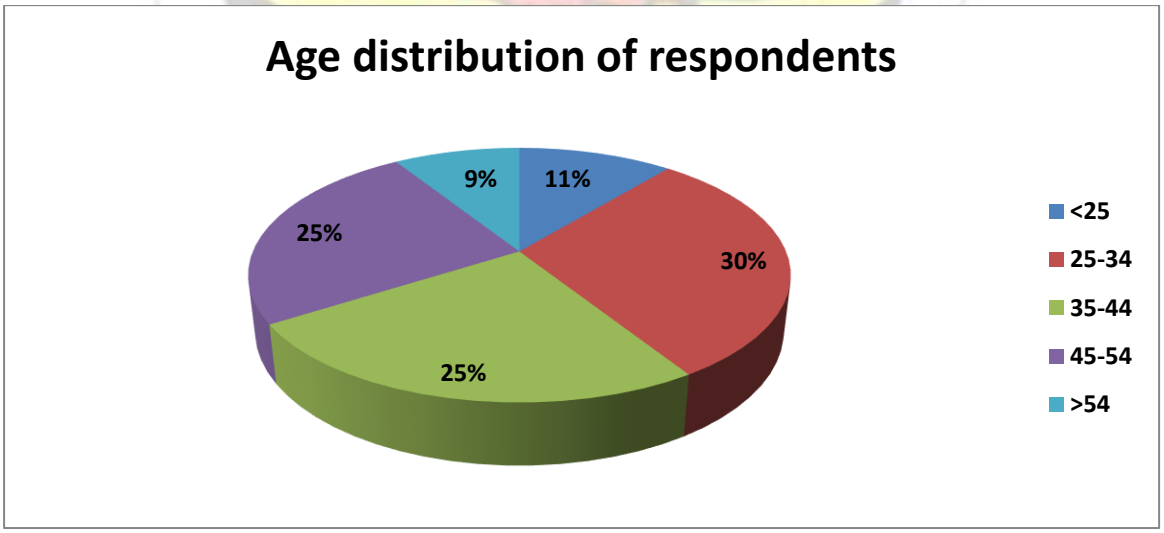


Figure 4: Age Distribution

4.3. Organizational background and respondents' job titles

In response to section two of the part one of the questionnaires, the study revealed that the organization is wholly owned by Ghanaian owners. It was also revealed that the organization has been in existence for more than ten but less than twenty years, and has more than 200 employees. Data was collected from the General Manager, line Managers and deputy managers in charge of logistics, Supply Chain, operations, warehouse, distribution, customer service and purchasing/procurement, as well as others who specified their roles as administrators. Majority of the participants were the deputy managers and administrators who formed 80% of the respondents as against 20% of senior managers. This is not surprising considering that each functional unit had not less than 2 deputies and 3 administrators. ln addition, the proportionate high percentage of responds from the administrative offices could be attributed to the fact that they possess in-depth knowledge of supply chain management, and precisely because they are the ones who are responsible for the operational day to day activities of the supply chain department.

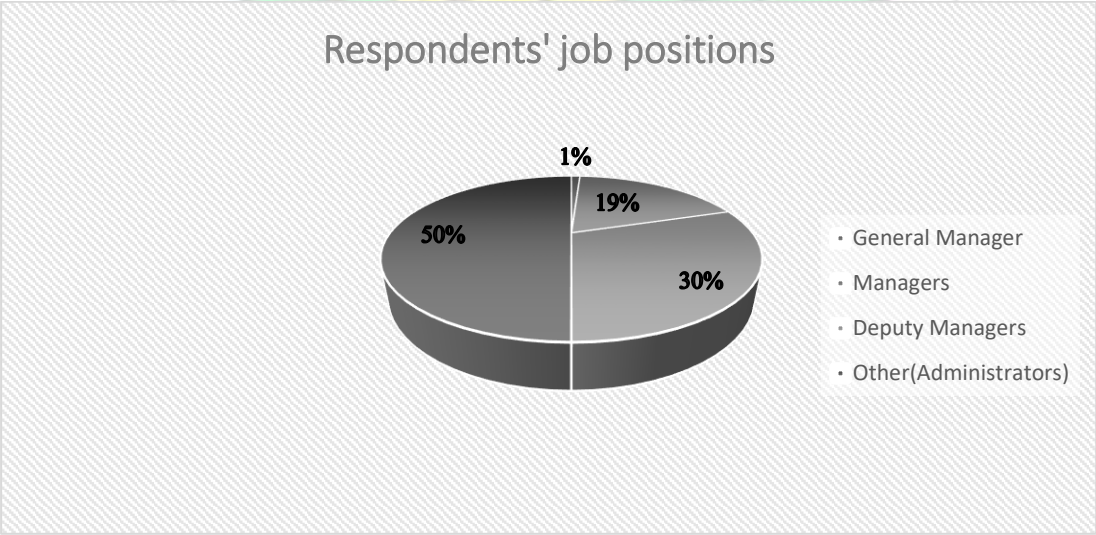


Figure 5: Respondents' job positions

4.4. Supply chain complexity and firm performance

The respondents state that unreliable supplier delivery and long supplier lead times both have a significant, negative impact on cost performance and schedule attainment of the firm.

The respondents however admitted the number of suppliers, though more than planned, has no substantial impact on any of the operational performance measures. In other words, both cost and schedule attainment measures of the firm's operational performance are negatively affected by unreliable supplier delivery as well as long supplier lead times as shown in the table in figure 5 below. The results from the respondents indicate that internal complexity have negative effect on the firms schedule attainment and cost performance. The results pointed out specifically that, lack of stability at the internal operations can impact negatively on lower-level planning and control activities, consistent with the argument of Vollmann et al., (2005). The results further show negative impact of the increment of low volume batch production on the performance of unit cost of manufacturing as compared to other firms in the industry.

The effect as captured from the respondents is that higher levels of upstream, internal and downstream complexity all have a negative impact on firm's schedule attainment and cost performance, answering question 1 of the researcher.

When asked to indicate the level to which they agree or disagree to the statement that supply chain complexity impact negatively on their firm's schedule attainment and cost performance, 80% of the respondents agreed (figure 4). The results however, show a positive impact the number of active parts or products have on firm performance as compared to other firms in the industry. It is clear from this finding that, managers focus

should be on confronting sources of dynamic complexity rather than reducing detail complexity within the firm.

Table 2: SC Complexity on firm performance

Please indicate the Yes/No/Don't know to the following questions.			
Upstream complexity	**YES(%)**	**NO(%)**	**DON'T KNOW(%)**
Does your firm serve more customers than planned?	60	25	15
Does your firm seek short lead times in the design of your supply chains?	60	10	30
Does your company strive to shorten supplier lead time, in order to avoid inventory and stockouts?	65	20	15
Is time taken for shipments to arrive from your suppliers Inconsistent?	75	15	10
Does your firm has more suppliers than planned?	50	45	5
Do your suppliers produce materials with inconsistent quality?	60	35	5
Are you worried about your supplier's quality performance failure?	60	20	20
Are you worried about your suppliers' on-time delivery failure?	70	20	10
AVERAGE (%)	**62.5**	**23.75**	**13.75**

4.5. SC complexity and SC Disruption

Question 2 of the researcher was aimed at assessing relationship between SC Complexity and SC Disruption. The results from the respondents show a positive association of supply chain complexity with disruption. In other words, frequent occurrence of disruption increases the complexity of the firm's supply chain. The results suggest that firms with more suppliers and/or longer and unreliable lead-times are prone

to more recurrent supply chain disruptions. Out of the respondents who answered the questions relating to whether or not their firm experience SC complexity due to the mediating role of SC disruption, 65% ticked "yes", 15% ticked "no", and 20% said they “don’t know". This is illustrated in figure 6 below. In contrast however, the results indicate that geographic dispersion of the firm's supply base and their differentiation do not significantly lead to disruptions.

SC complexity and SC Disruption

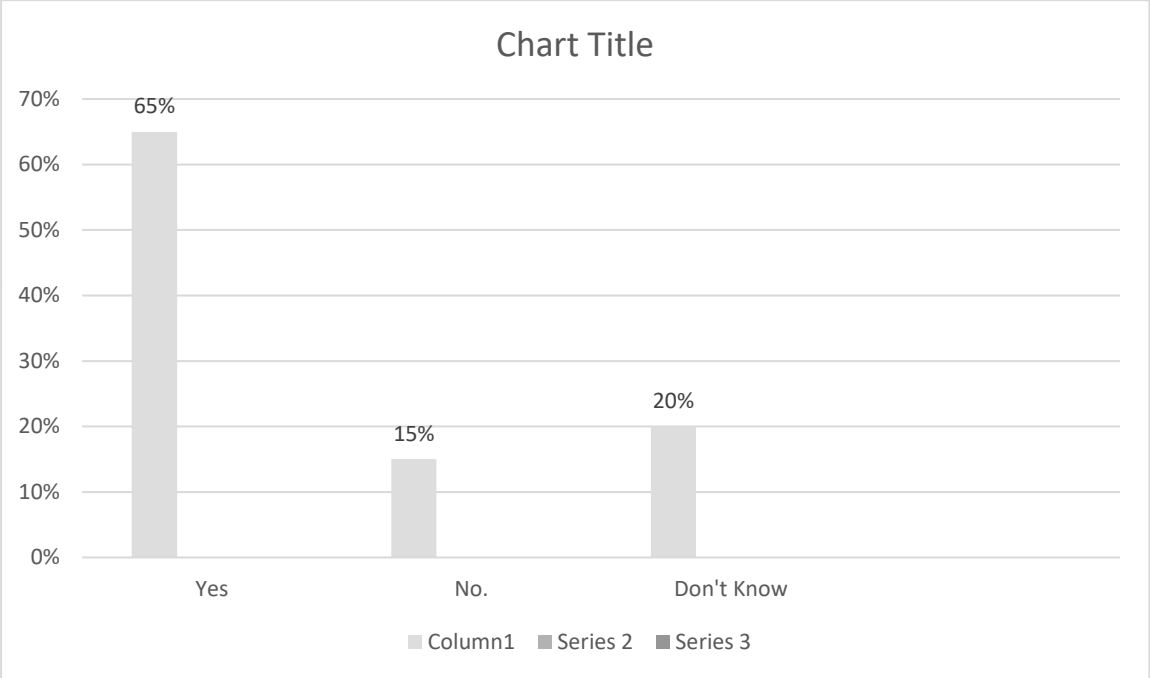


Figure 1: mediating role of SCD

4.6. Mediating role of SC Disruption between SCC and firm performance

The results show a negative association between supply chain disruption and the cost performance and schedule attainment of the firm. The question of whether there is frequent occurrence of disruptive events in the firm was answered in the negative by 83% of the respondents, 7% said no, and 10% said they don't know. This suggests that the frequency of occurrence of disruptions is very low.

Frequency of occurrence of se disruption

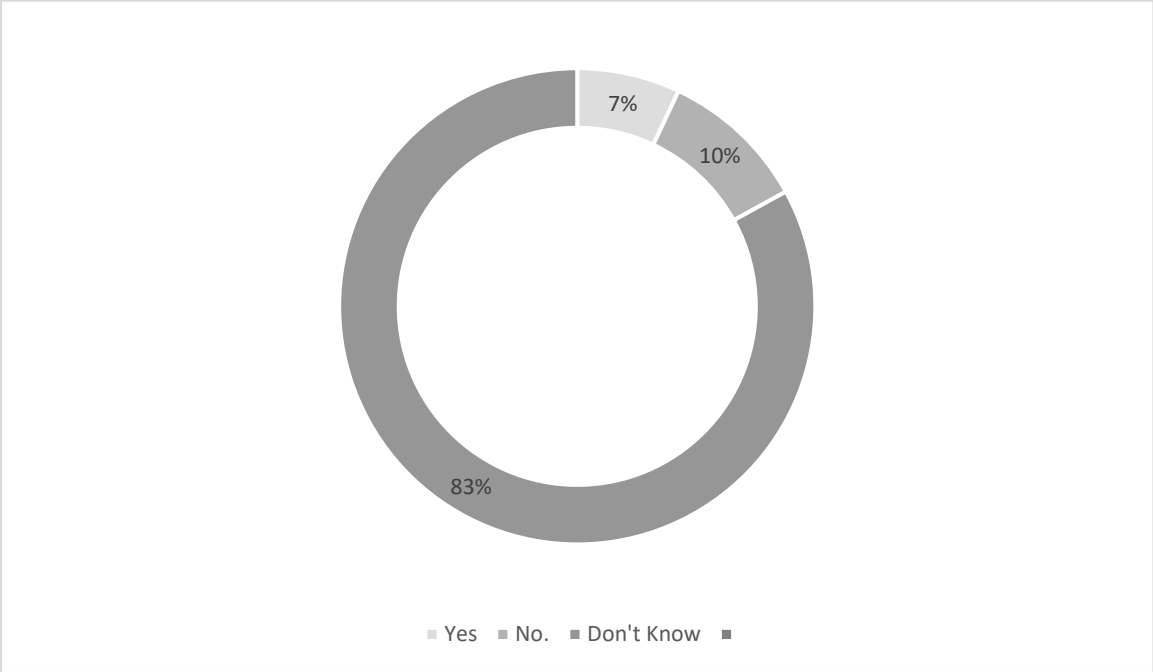


Figure 2: Frequency of Occurrence of SCD

The research shows that supply chain disruption leads to increased operational cost of the firm. Out of the 43 respondents, 28 representing 66% of the respondents answered in the positive when asked the question of whether their firm incurs extra cost as a result of the occurrence of unforeseen (disruptive) events. 22% said they don't know, with only 12% answering in the negative.

Effect of SC disruption on cost performance

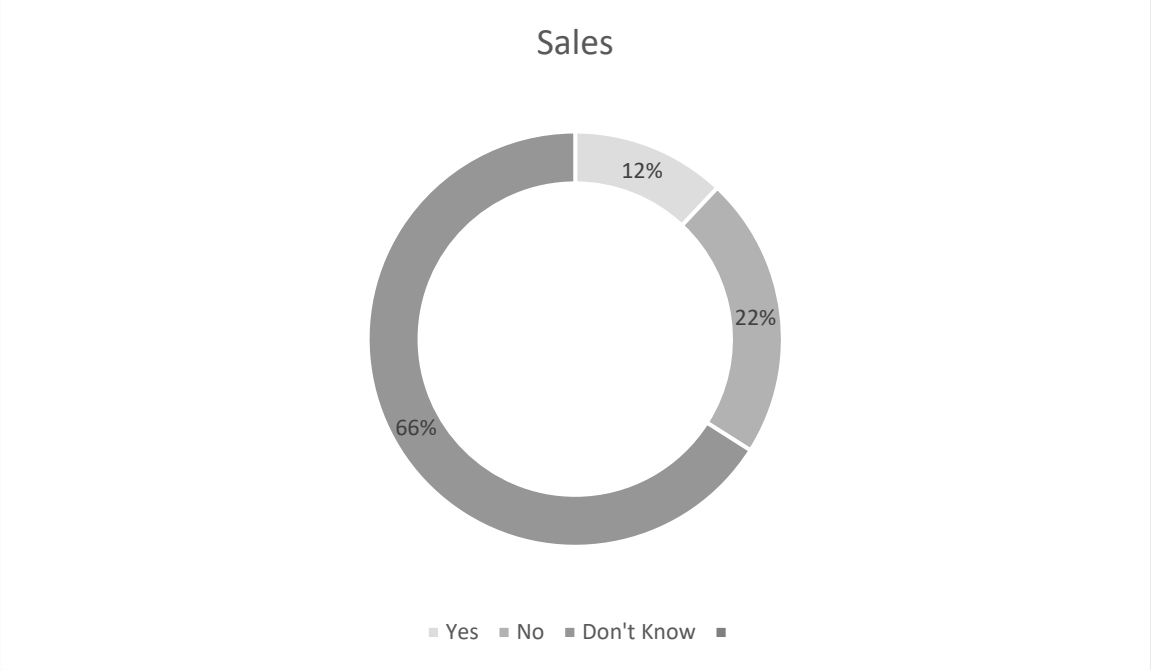


Figure 3: Effects of SCD on cost performance

However, the researcher's observation reveals that supply chain disruptions lead to a positive control-adjusted change, and positively affect total assets of the firm. These effects may appear positive, but it is likely to result in negative cost performance and lower turnover.

In summary, the results obtained from the respondents and the field observations made by the researcher point to the fact that supply chain complexity and disruptions, are indeed directly and indirectly associated with negative changes in operational performance and cost attainment of the firm. This is in line with the findings of Baghersad, M., and Zobel, C.W (2020).

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter includes an overview of the key results, a discussion of the chapter's conclusions, limitations, and suggestions for further study.

In this study, the disruption of the supply chain in Ghana's rice business serves as a mediator between the impacts of supply chain complexity on company performance. Shannon (1948); Sivadasan et al. (2002); and other authors claim that complexity has been a topic of management study in the fields of information sciences. In the fields of organizational sciences, industrial management, and supply chain management, respectively, complexity is seen as a management study topic by Anderson (1999), Flynn & Flynn (1999), and Bozarth et al. (2009).

A thorough, in-depth empirical study is required to pinpoint the causes causing SCC from the perspective of operational performance since the literature evaluation revealed that the examination into SCC has yielded conflicting results. The project responds to the following three research issues as a result of this request for additional investigation:

Research Question 1: How does SCC affect a firm's operational performance?

Research Question 2: How does SCC affect SC Disruption?

Research Question 3: What is the mediating role of SC Disruption on the relationship between SCC and firm's operational performance?

This study conceptualized SCC as multi-dimensional and proposed three dimensions of complexity – upstream complexity, internal complexity and downstream complexity.

5.2 Summary

From the data, it is clear that the proportion of male staff is higher than their female counterparts in the field of supply chain, with greater percentage of the respondents being within the ages of 25-34 years.

Administrators and deputy managers formed majority of the respondents as compared to senior managers because each functional unit had not less than 2 deputies and 3 administrators. In addition, the proportionate high percentage of responds from the administrative officers is attributed to the fact that they possess in-depth knowledge of supply chain management, and precisely because they are the ones who are responsible for the operational day to day activities of the supply chain department. The case organization has been in existence for more than ten years and has 200 permanent employees.

According to Deloitte and Touche, (2003) researchers and industry players are gradually shifting attention (in seemingly contrast to the lean production literature) to the effects of supply chain complexity on plant's operational performance.

This research approaches the study of the effects of supply chain complexity on firm's operational performance in the three supply chain forms of upstream, internal and downstream complexities. Generally, the results show that, the levels of upstream, internal manufacturing, and downstream complexity will have a negative impact on plant performance. The results indicate empirically that, based on responds from 43 respondents from the case study, and based on the researcher's observation, and consistent with the findings of Bozarth et al, (2009), the three stages of supply chain are affected by supply chain complexity in terms of their impact on operational

performance in the areas of long supplier lead times, instability in the master production schedule, and variability in demand.

The study has revealed that unreliable supplier delivery and long supplier lead times both have a significant, negative impact on cost performance and schedule attainment of the firm. It has been revealed that both cost and schedule attainment measures of the firm's operational performance are negatively affected by unreliable supplier delivery as well as long supplier lead times. The results however, show a positive impact the number of active parts or products have on firm performance as compared to other firms in the industry.

The results from the respondents show a positive association of supply chain complexity with disruption. In other words, frequent occurrence of disruption increases the complexity of the firm's supply chain. The results suggest that firms with more suppliers and/or longer and unreliable lead-times are prone to more recurrent supply chain disruptions.

In terms of the role and frequency of disruption, the findings suggest that the frequency of occurrence of disruptions is very low, but has negative impact on schedule attainment and cost performance of the firm.

The researcher's observation, however reveals that supply chain disruptions lead to a positive control-adjusted change, and positively affect total assets of the firm. These effects may appear positive, but it is likely to result in negative overall cost performance and lower turnover.

5.3 Conclusion

Given the study's key findings, it is possible to draw the conclusion that supply chain complexity raises the operational costs for businesses, which lowers operational performance in terms of meeting costs and deadlines. These results are consistent with Brandon-Jones et al(2015) .'s and Choi & Krause's (2015) assessments (2006).

Though the review works such as Shah and Ward (2003, 2007) have shown a concentration on how to reduce supply chain complexity, available literature on flexibility and operations strategy emphasizes the need for firms to appreciate how to accommodate high levels of supply chain complexity when it is required (Closs et al., 2008; Swink et al., 2005; Sethi and Sethi, 1990 and Swafford et al., 2006).

The researcher discovered through observation that company managers use Galbraith's (1973, 1974, 1977) advice to account for supply chain complexity. Therefore, managers either implement systems that mitigate the effects of uncertainty or they improve the organization's capacity to do so.

5.4 Recommendations

In order to mitigate the effects of SCC on firm's operational performance, the following recommendations are made to firm managers in view of the findings.

1. Practice the 2-way prescription of Galbraith (1973, 1974, 1977) to accommodate supply chain complexity: (1) put in place mechanisms that absorb the effects of uncertainty or (2) enhance the organization's ability to manage uncertainty. Though there is no empirical proof of its impact, the prescription nonetheless would stand a better chance of reducing, if not curbing the impact of SCC on performance.

2. Proper records must be kept to keep track of frequency and magnitude of disruptions. This would keep management properly informed in making decisions.

3. The research and development function of the firm must embark on continuous research in order to develop mechanisms to curb frequent occurrence of supply chain disruptions.

5.5 Suggestions for future research

As mentioned in the conclusion, managers turn to employ the prescription of Galbraith (1973, 1974, 1977) to accommodate supply chain complexity. The impacts of such strategies within the manufacturing plant have been studied by Flynn and Flynn (1999). But to our view, which supports the view of Bozarth et al, (2009), the effectiveness of these strategies in moderating the impacts of upstream and downstream complexity is yet to be examined.

Reviewed literature has shown that, there is a greater prospect for the rice industry given the increasing nature of demand for its products across the food value chain. Future research should focus on sustaining the rice Supply Chain, the current practices, Prospects and challenges. Again, future research may focus on increasing the sample size and case study firms to elaborate on existing practices, prospects and challenges.

The scope of this study was restricted to the aspects of a firm's operational performance that dealt with cost performance and schedule accomplishment. Additional investigation should be done to determine other crucial factors and other sources of supply chain complexity that were not covered in this study but may also contribute to the performance variations between manufacturers.

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APPENDIX

SURVEY QUESTIONNAIRE

I am a postgraduate student at the Supply Chain and Information Systems Department of Kwame Nkrumah University of Science and Technology, Kumasi. This survey instrument was designed to aid me in studying the following topic: **The Effects of Supply chain Complexity on Firm's Operational performance. The Mediating role of Supply chain Disruption. The case of Ghana's rice processing Industry**. Any information you provide will be used exclusively for academic purposes and kept strictly confidential.

Participation in this exercise is entirely voluntary. The survey duration is approximately 10-15 minutes.

PART ONE

Mark your answers by ticking the responses as

Example: □□;□□

shown:

Section 1: Demographic Information

Q1.1 Gender (Please tick one box only)

Male □	Female □

Q1.2 Age

<25 □	25-34 □	35-44 □
45-54 □	55-64 □	>65 □

Section 2: Organisation Background

Q2.1 What is your job title?

CEO □	General Manager □	Director of Purchasing □
Director of Logistics □	Director of Supply Chain □	Director of Manufacturing □
Supply Chain Manager □	Operations Manager □	Logistics Manager □
Purchasing Manager □	Other *(please state)*:	

Q2.2 Please indicate the total number of employees in your firm at all sites/plants within Ghana.

Less than 20 □	20 to 200 □	More than 200 □

Q2.3 How long has this business been operating?

Less than 1 year □	More than 1 but less than 5 years □	More than 5 but less than 10 years □
More than 10 but less than 20 years □	More than 20 but less than 50 years □	More than 50 years □

Q2.4 Please indicate which of the following characterizes your company?

Ghanaian Owned □	Joint Venture □	Foreign □ owned

PART TWO

Section 3: Supply Chain Complexity

Please indicate the Yes/No/Don't know to the following questions.				
3.1	Upstream complexity	YES	NO	DON'T KNOW
3.1a	Does your firm serve more customers than planned?			
3.1b	Does your firm seek short lead times in the design of our supply chains?			
3.1c	Does your company strive to shorten supplier lead time, in order to avoid inventory and stockouts?			
3.1d	Is time taken for shipments to arrive from your suppliers inconsistent?			
3.1e	Does your firm has more suppliers than planned?			
3.1f	Do your suppliers produce materials with inconsistent quality?			
3.1g	Are you worried about your supplier's quality performance failure?			
3.1h	Are you worried about your suppliers on-time delivery failure?			

3.2	Internal complexity
Please provide your answer in the space provided	
3.2a	How consistent is the weekly Master Production Schedule?
Ans	
3.2b	How frequent do you make unplanned changes in your weekly manufacturing schedule?
Ans	
3.2c	How consistent is the weekly manufacturing output rate?
Ans	
3.2d	How level-loaded is the master schedule in your plant, from week to week?
Ans	
3.2e	How much of individual active part numbers of material items does your firm's output require?
Ans	

3.3	Downstream complexity
Please provide your answer in the space provided	
3.3a	How many customers does this firm serve (approximately)?
	Ans
3.3b	Do all your customers desire essentially the same products? Please explain
	Ans
3.3c	What is the average life cycle of your products (years)?
	Ans

Section 4: Operational Performance

Please indicate the level to which you are agree or disagree with the following statements using the supplied 7-point scale (where 1 = strongly disagree, 7 = strongly agree).

		Strongly Disagree						Strongly Agree
4.1	Schedule Attainment	1	2	3	4	5	6	7
4.1a	We usually meet the production schedule each day.	□	□	□	□	□	□	□
4.1b	Our daily schedule is reasonable to complete on time.	□	□	□	□	□	□	□
4.1c	We can adhere to our schedule on a daily basis.	□	□	□	□	□	□	□
4.1d	We are always behind schedule.	□	□	□	□	□	□	□
4.2	Cost	1	2	3	4	5	6	7
4.2a	Our unit manufacturing cost compared to our competitors in the industry is high.	□	□	□	□	□	□	□
4.2b	Please rate your firm's performance with regards to unit cost of manufacturing (1=Poor, high unit cost, low end of industry, 7 = Superior, lower unit cost, high end of industry).	□	□	□	□	□	□	□

Section 5: Supply Chain Disruption

Please indicate the Yes/No/Don't know to the following questions.				
5	Supply Chain Disruption	YES	NO	DON'T KNOW
a.	Does your firm frequently experiences unforeseen events?			
b.	Does your firm incur extra cost due to unforeseen events?			
c.	Does your firm often operate behind schedule due to your supply base size?			

Thank you. I really appreciate your time