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IMPACT OF BLOCKCHAIN APPLICATION ON PROCUREMENT PROCESS EFFECTIVENESS AND SUPPLY CHAIN PERFORMANCE (A CASE STUDY OF MANUFACTURING FIRMS IN GHANA)

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MSC. PROCUREMENT AND SUPPLY CHAIN MANAGEMENT

A THESIS SUBMITTED TO THE DEPARTMENT OF SUPPLY CHAIN AND INFORMATION SYSTEMS, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (INSTITUTE OF DISTANCE LEARNING), KUMASI IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE IN PROCUREMENT AND SUPPLY CHAIN MANAGEMENT

SEPTEMBER, 2023

DECLARATION

I hereby declare that this submission is my work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgement is made in the thesis.

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DEDICATION

My thesis is dedicated to my family and a few close friends. A particular thanks to my dear Mother and siblings especially to my big brother George Ampratwum and Ransford Ampratwum whose words of support and push for persistence continue to ring in my ears. I also want to thank my friends and church family for their help throughout the process. I will be eternally grateful to them all, specifically Anthony Twum-Barimah for assisting me in developing my technological skills and Daniel Duedu for the countless hours of proofreading.

ACKNOWLEDGEMENT

I am eternally grateful to the Almighty God for the gift of life, strength, and mercy during my studies. Honestly, without Him, it would not have been possible to complete this research successfully. I am also thankful to my family and friends for their support and prayers. I am extremely grateful to my supervisor, Dr. Dorcas Nuertey, for providing the necessary advice for this research. Finally, I am grateful to my colleagues, who offered me many sorts of aid throughout my studies. God bless you all in abundance.

ABSTRACT

This study's objective is to analyse the impact of blockchain applications on supply chain performance by analysing the function of procurement efficiency as a mediator. Although previous research has examined many SCP determinants, the function of procurement effectiveness as a mediator between procurement blockchain applications and supply chain performance remains uncertain. Descriptive and cross-sectional research methods were used for this investigation. A total of 136 purchasing and supply chain managers participated in this quantitative investigation. Much of the information was gathered by using a predesigned questionnaire. Both SPSS and SmartPLS were used to decipher the information gathered. Descriptive and inferential research techniques were used to analyse the data. The result demonstrated that the blockchain application's ability to improve procurement efficiency had a positive, significant direct influence. The outcome showed that the blockchain application to SC performance had a significant, considerable direct impact. The results demonstrated a considerable positive direct relationship between SC performance and procurement effectiveness. The findings showed that procurement effectiveness mediated the relationship between blockchain applications and SC performance positively. This implies that managers and organizations in the attempt of implementing BCT, should carefully consider the components of SC cooperation as it plays a critical role in driving superior supply chain performance.

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LIST OF ABBREVIATIONS

ACMA	Automobile Component Manufacturers Association
AVE	Average Variance Extracted
BCT	Blockchain Technology
BWM	Best Worst Method
CA	Cronbach's Alpha
CPFR	Collaborating Planning, Forecasting and Replenishment
CR	Composite Reliability
DCT	Dynamic Capability Theory
ERP	Enterprise Resource Planning
FM	Facilities Management
GDP	Gross Domestic Product
IAPWG	International Anorectal Physiology Working Group
IT	Information Technology
KPI	Key Performance Indicator
OSCM	Operations and Supply Chain Management
PE	Procurement Effectiveness
PLS	Partial Least Squares
RBV	Resource-Based View Theory
SC	Supply Chain
SCM	Supply Chain Management
SCP	Supply Chain Performance
SEM	Structural Equation Modelling
SIAM	Society of Indian Automobile Manufacturers
SPSS	Statistical Packages for Social Sciences
SSCP	Summary of Safety and Clinical Performance
VMI	Vendor Managed Inventory

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Ghana's government adopted an Industrial Strategy in 2010, with the goal of reaching middle-income status by 2020 and accelerating the transition to an economy driven by industry (Ghana Industrial Policy Report, 2010). The Industrial Policy emphasizes the importance of research and development, scientific and technological progress, and other types of technological advancement in the context of the manufacturing industry. The policy's overarching goal is to address the myriad of issues that plague the manufacturing sector and have a negative impact on product quality, output capacity, and overall productivity (Ghana Industrial Policy Report, 2010). The Ghanaian government developed the Industrial Policy with the goal of assisting the country's businesses in their efforts to compete successfully on the global market by creating conditions in which those businesses can generate and deliver world-class products and services of the highest possible quality.

According to Chime (2023), the manufacturing industry can be divided into four distinct sub-industries: engineering, operations, information technology and finance, and sales and marketing. Each of these four departments has subcomponents that are all aimed towards ensuring that the manufacturer's ultimate product reaches the consumer; consequently, the supply chain is considered the lifeblood of every manufacturing organisation (Ameyaw and de Vries, 2021; Busse, 2016). Everything along the supply chain, from raw materials acquisition to finished goods distribution, is part of the product life cycle. The supply chain architecture and foundation are complex in all industries. All sectors, regardless of focus, must seek to strengthen their supply networks if they want to increase efficiency and profitability (Gohil and Thakker, 2021). Recent literature congeals towards the assessment that in the ever-evolving world of innovation and technological advancement, modern supply chains have become much more complex, especially during the COVID-19 pandemic (Abbas et al., 2020; Abidi et al., 2020; Abou-Maroun et al., 2020). Businesses are implementing innovative technologies such as the Internet of Things (IoT), business analytics, blockchain, artificial intelligence, machine

learning, and cloud computing to remain competitive in today's fast-expanding market (Rejeb et al., 2019; Ahmad et al., 2020). The proliferation of linked devices known as smart devices or things, as well as the range of technologies that are frequently deployed concurrently, enables value chain exchange (or trade) partners to attain unprecedented levels of efficacy and efficiency.

Blockchain, the subject of this research, is a distributed, decentralised, and digitally controlled ledger that is used to record transactions in an unalterable manner. Its features will be helpful in applications that require trust, transparency, and traceability (Yaqoob et al., 2021). Beyond its original application of facilitating financial transactions, the technology is now widely used in the healthcare, manufacturing, retail, and government sectors (Bhusan et al., 2020; Angraal et al., 2017). Blockchain-based applications may help businesses keep track of employee spending habits (Thio-ac et al., 2019) to negotiate more favourable quantity discounts (Joshi, 2017). Blockchain technology benefits enterprises in the supply chain risk mitigation process because it enables more accurate demand forecasting and better management of SC resources (Ivanov et al., 2018). Blockchain technology can monitor and validate the manufacturing parameters in the manufacturing domain (Kurpjuweit et al., 2021; Leng et al., 2020).

It has been demonstrated that the effectiveness of procurement has a positive impact on the effectiveness of the supply chain (Waithaka, and Kimani, 2021). E-procurement and other forms of modern technology have had a significant influence on the operational procedures of supply chains, leading to an increase in the effectiveness of the procurement process (Waithaka and Kimani, 2021). To further improve procurement activities, there has been a focus on the incorporation of blockchain technology, which was initially utilised in cryptocurrency trade. Additionally, other research has demonstrated that using blockchain applications has increased procurement efficiency compared to manual procurement (Bienhaus and Haddud, 2018; Zhu et al., 2020; Waithaka and Kimani, 2021).

By guaranteeing appropriate inventory management, manufacturing enterprises in emerging nations may endure unhealthy competition and continually satisfy varying client needs (Opoku et al., 2020). Inventory management also involves identifying, acquiring, planning, storing, packing, and transporting goods to satisfy customer

satisfaction (Wu and Dunn, 1995). Fiati (2019) urged that Ghanaian manufacturing companies recognise the importance of sustainable procurement to the company and the environment in general.

1.2 Statement of the Problem

As a relatively new technology, blockchain technology (BCT) may be able to solve most supply chain management (SCM) problems (Casey and Wong, 2017; Kshetri, 2018). Blockchain records all network transactions in a transparent and secure manner. Technology integration is essential to achieve competitive supply chain performance in today's environment). As a result, effective procurement management is critical for improving supply chain efficiency. According to the findings, blockchain technology is positively correlated with supply chain performance (Mondol, 2021; Paul et al., 2021; Vaio and Varriale, 2020; Yousefi and Tosarkani, 2022). At the moment, the primary focus of blockchain technology is on improving operational capabilities rather than strategic capabilities. Supply chain performance objectives like quality compliance, optimization, continuous improvement, versatility, lower price, and lowered production cycle are brought about by combining blockchain technology with operational and strategic competencies. Nevertheless, outcomes may vary based on the specific risks associated with each sector (Nandi et al., 2022). Moreover, Park and Li (2021) suggested that using blockchain systems could significantly enhance supply chain performance's sustainability.

Similarly, it has been demonstrated that procurement effectiveness influences supply chain performance positively (Waithaka and Kimani, 2021). E-procurement and other modern technologies have significantly altered supply chain practices and increased procurement efficiency and significantly (Impactedi, 2021). Priority has been placed on incorporating blockchain technology, which was originally used in cryptocurrency transactions, in order to enhance procurement processes. Additionally, other research has shown that the usage of blockchain technology applications increases procurement efficiency compared to manual procurement (Bienhaus and Haddud, 2018; Zhu et al., 2020; Waithaka and Kimani, 2021). Based on a literature analysis done before, a specific void in the literature about this topic's setting was identified, and it revealed that

numerous studies had looked at the influence of procurement effectiveness on supply chain performance.

Blockchain technology is still a relatively recent innovation, and its applications in various fields are constantly evolving. Therefore, Blockchain technology applications have been essential for achieving supply chain performance and procurement effectiveness (Cole et al., 2019, Nandi et al., 2022; Mondol, 2021; Paul et al., 2021; Vaio and Varriale, 2020; Yousefi and Tosarkani, 2022). Procurement efficiency's potential mediating influence on the connection between blockchain applications and supply chain performance, however, has not been studied. "The Mediating Effect of Procurement Effectiveness on the relationship between Blockchain Applications and Supply Chain Performance" lies in the lack of comprehensive research that specifically examines the interplay between these three variables. This will contribute to a more comprehensive and nuanced understanding of the complex relationship between blockchain applications, procurement effectiveness, and supply chain performance, potentially leading to more effective implementation strategies and improved outcomes.

1.3 Objectives of the study

The study examines the mediating effect of procurement effectiveness on the relationship between blockchain applications and supply chain performance in the manufacturing sector. The specific objectives are;

1. To determine the impact of blockchain applications on supply chain performance.
2. To examine the effect of blockchain applications on procurement effectiveness.
3. To investigate the influence of procurement effectiveness on supply chain performance.
4. To assess the mediating impact of procurement effectiveness on the relationship between blockchain applications and supply chain performance.

1.4 Research Questions

1. What is the impact of blockchain applications on supply chain performance?
2. What is the effect of blockchain applications on procurement effectiveness?
3. What is the influence of procurement effectiveness on supply chain performance?
4. Does procurement effectiveness mediate the relationship between blockchain application and supply chain performance?

1.5 Justification of the Study

The research has theoretical, practical, and policy implications. Even in advanced economies, blockchain technologies are a new phenomenon; therefore, studying their application by a multinational corporation in the context of an emerging country will serve as a launching point for future research in other sectors, such as health, finance, and similar developing economies to Ghana.

The phenomenon of block technology and procurement and the insights derived from it might serve as a strategic point of reference for business and government sectors seeking to enhance the procurement process. The findings of the study are beneficial to those responsible for formulating public policy, most notably the Ministry of Trade and Industry. The findings would enable the Ministry of Trade to address significant efficiency obstacles in the country's manufacturing sector. The study provides stakeholders with the necessary knowledge of supply chain factors that will aid in the formulation of improved policies such as inventory control, transportation, warehouse management, customer interactions, and SCI. The findings of the study will enable manufacturing organisations to investigate the most appropriate supply chain aspects to support the organization's development and performance.

1.6 Methodology of the Study

This study used quantitative methodology and an explanatory layout. Due to its reliance on numerical techniques like descriptive and inferential statistics to summarise the study's key findings, the quantitative approach was used (Hoover and Donovan, 2010). The research population include managers from Ghanaian manufacturing companies. According to Creswell (2012), a study's population is the whole set of things that share specific attributes or characteristics. Purposive sampling is used for the study because the

researcher is solely interested in a population that possesses skills and knowledge related to the subject under study. The data were obtained primarily using a structured questionnaire adapted from other studies. Data were analyzed using Smart PLS. Both descriptive and inferential statistics were used to determine the relationships among the variables.

1.7 Scope of the Study

This research analysed the effects of blockchain procurement on the performance of supply chains with procurement process effectiveness as a mediating factor. The research was situated within the manufacturing sector, which typically involves the production and assembly of physical goods. Manufacturing firms are known for complex supply chains, involving the sourcing of raw materials, production processes, and distribution of finished products in Ghana.

1.8 Limitations of the study

Since blockchain is still in its infancy, many parties involved including suppliers and partners may have a nascent knowledge of the technology and its potential applications. This lack of understanding hinders collaboration and adoption across the supply chain.

1.9 The Organisation of the Study

There are five sections to this research. The first chapter presents an introduction to the study i.e., the background, research problem, objectives and a discussion of the relevance and scope of the research. A literature review is included in this thesis's second chapter. The theoretical, empirical, and conceptual basis are all included in the literature review. The methodology details are presented in chapter three. These methods include sampling techniques, the study's population, data sources and ethical considerations. The fourth chapter delves into analysing the data gathered and comparing it with the relevant literature. Finally, Chapter five, the final part of the thesis, presents the study's conclusions, recommendations, and further areas of study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The second chapter of this thesis is broken down into four sections. Information is presented in this chapter in the form of a conceptual review, a theoretical review, an empirical review, and, lastly, the construction of a research model and hypotheses. Definitions, operationalizations, and examples of application of the notions at play in this investigation may all be found in the review's conceptual section. The theoretical foundations of the work are also provided in the theoretical review section. A conceptual framework was used to effectively illustrate the numerous prepositions offered in this research, and their varied interactions were examined at length. The chapter concludes with a summary that emphasises the research deficit.

2.2 Conceptual Review

The constructions employed in this investigation are defined, operationalized, and discussed in this part. The constructions employed in this investigation are defined, operationalized, and discussed in this part. The model has three main constructs (blockchain application, procurement process effectiveness, and supply chain performance). These constructs have been operationalized in subsequent sections below (see 2.2.1-2.2.3).

2.2.1 Blockchain

There is no need for a central clearinghouse or trusted third party while using the blockchain since transactions occur directly between users. For commercial reasons, the various participants operate as "nodes," and the whole thing is verified via the use of cryptography (Crosby et al., 2016). All involved entities share a decentralized ledger in which the transaction records are kept. Due to the fact that it is the result of a number of technologies coming together, including computer programming, cryptography, database engineering, etc., blockchain might be considered a meta-technology in and of itself (Mougayar, 2016). Since the fifteenth century, the double-entry system of accounting has been the standard. Blockchain technology eliminates the drawbacks of the system's trust-related problems and, as a result, lowers transactional friction (Davidson et al., 2016).

Considering its advantages, the blockchain is sometimes referred to as the coming digital revolution. It is frequently likened to how the internet developed in the early 1990s (Tapscott and Tapscott, 2017). Blockchain is said to cause a change from the "Internet of Information" to the "Internet of Values" (Froystad and Holm, 2016). Blockchain will speed up and reduce the cost of transactions (Peters and Panayi, 2016). Blockchain technology (BT) is expected to speed up processes and make them substantially more reliable in today's complicated supply chains (Kim and Laskowski 2016). The nodes in a supply chain, such as suppliers, factories, warehouses, etc., allow for the flow of goods, cash, and data. These points of contact are crucial to the running of any supply chain since they are where various transactions take place. Between, say, a manufacturer and its supplier or a production facility and its warehouse. Record-keeping costs double up, creating a breeding ground for trust issues (Ammous, 2016). Blockchain has the potential to streamline and centralise all supply chain operations (Korpela, et al., 2017). Many value-enabling tasks, such as collecting, monitoring, and sharing information, may be accelerated by employing blockchain, and instant scalability may be accomplished. A blockchain-enabled supply chain provides businesses with a transparent, immutable digital log of all transactions and activities involving any participant in the supply chain.

In a conventional supply chain, the sum of an organization's purchases is muddled by the actions of its affiliates, business associates, and anyone else involved in the chain. The BT in supply chain management (SCM) makes it easy to monitor sales volumes independent of who initiated the purchase (Joshi, 2017). This information, which is kept in one digital location, may help businesses improve their negotiations with vendors and qualify for bulk discounts. Incorporating BT into business processes allows for more accurate demand forecasting, more efficient use of resources, and lower inventory holding costs. These helps supply networks in risk mitigation at lower costs than typical supply chains (which stockpile goods, have surplus capacity, and rely on third parties in case of disruptions) (Ivanov et al., 2018). Using BT in the supply chain primarily serves to improve supply chain visibility and transparency via the use of record-keeping features (Ivanov et al., 2018). However, this is dependent on the organization’s big data analytics capabilities, which include its capacity for reliable data collection, data storage, data analysis, and real-time decision-making.

2.2.2 Block Chain Technology

It is generally agreed that Block Chain Technology (BCT) will have a significant impact on several industries, including supply chain management (Casey and Wong, 2017; Korpela et al., 2017; Kshetri, 2018). The blockchain concept, which originated in a paper written by Satoshi Nakamoto (2008), is predicated on two pillars: a distributed ledger system and cryptographic tools. This eliminates the need for Central Banks, notaries, and other governmental institutions to act as an intermediary auditing entity (Sikorski et al., 2017; Yarmack, 2017). The distributed ledger system serves as the mechanism for the verification of transactions using a predefined consensus mechanism among the participating entities. The term "cryptographic tools" is used to describe the many processes that keep blockchain data secure and unmodified. For instance, blockchain employs a hash function, a sort of encryption that converts information into a fixed-length hexadecimal code that cannot be reverse-engineered to reveal its original input (Yarmack, 2017).

In the context of supply chain operations, blockchain technology (BCT) exhibits several advantageous characteristics. These encompass expedited transaction approvals facilitated by decentralised consensus techniques, the capacity to trace the chronology of transactions, quick access to information, and robust data security measures. The blockchain phenomenon, which encompasses a collection of technical artefacts and human interactions, is anticipated to have significant implications for supply networks, the environment, and societies at large. These technical artefacts, as put forward by Reijers and Coeckelbergh (2018) from the perspective of science and technological studies, are embedded in a human-social context, and as such, have shaped and are shaping the social realities in which they are embedded.

2.2.3 Procurement Process Effectiveness

Businesses all across the world have employed "procurement" extensively (Ambekaret al., 2020). One of the most important resources for companies today, including industrial companies, is procurement (Lysons, 2020). Obtaining or sourcing products and services is what it is (Ambekar et al., 2020). Some companies have just linked this concept to the act of purchasing, while others have linked it to the whole sequence of events from procurement to consumption to disposal that surrounds the product in question. A significant percentage of manufacturing companies' contribution goes toward procurement, which is also crucial to the success stories of their customers (Ambekaret

al., 2020). Therefore, the methods used to complete purchasing responsibilities are crucial components of procurement.

To properly acquire goods and services and achieve desired goals, several procedures must be identified, defined and put into action (Sonnichsen and Clement, 2020). It includes the organized actions taken in the selection, acquisition, and disposal of a good or service. The process acts as a manual for all procurement; therefore, it has a significant impact on whether an organization succeeds or fails (Raj et al., 2020). Studies show that although most businesses follow a similar sequence of steps throughout their procurement procedures, each firm's process ultimately differs in its focus, its methods, and its outcomes (Ambekar et al., 2020). If these phases of the procurement process are not well managed, they could be exposed to a variety of hazards, which would undermine the quality of the overall procurement process.

The economic dimension of a firm's capacity to utilize its resources to meet objectives is measured by its performance (Alabdullah, 2021). In any commercial activity, firm performance demonstrates the relationship between resources used as inputs and outcomes, according to Tran et al. (2015). It takes into account a company's efficacy and efficiency throughout both production and consumption. Efficiency, quality, evaluation, profitability, growth, efficiency, and competitiveness are all interconnected with a company's performance, as stated by Taouab and Issor (2019). Firm performance allows businesses to assess their strategies and allocate the necessary resources and efforts (Kamble and Gunasekaran, 2020). Procurement performance evaluates how well a function can meet its expected goals and objectives while spending as little money as possible to do so (Kamble and Gunasekaran, 2020). Measuring the performance of the procurement department is crucial for determining how productive it is. According to Kamble et al. (2020), the procurement aspect of a firm is the focus of the new dimension of firm performance known as procurement performance. Higher procurement performance is correlated with cost-effectiveness, competitiveness, and success for businesses, and vice versa.

Bag et al. (2020) claim that to save around 60% of total costs related to procurement, performance evaluations are necessary. To provide quality, acquire more reasonably priced items, and drive value addition, it helps manufacturers cut down on input wastes

and maximise resource consumption during procurement (Malesios et al., 2020). Ndolo and Njagi (2014) state that the efficiency of the procurement process may be measured by looking at three key performance metrics: the timeliness, quality, and quantity of the purchase. Ndolo and Njagi (2014) identified many indications of an efficient procurement process, including the level of satisfaction among internal customers with procurement operations and supplier management methods such as decreased supplier numbers, supplier training, and continued collaboration. The growth of cross-functional teams and the elevated professionalism of the procurement department are two further markers.

2.2.4 Supply Chain Performance

Supply Chain Performance (SCP) is a company's capacity to quickly, effectively, and affordably meet customer needs. SCP has been theorized and measured using a variety of methods in the literature. These include time-to-market, cost savings, on-time delivery, shortened lead times, process improvement, flexibility, and customer responsiveness (Al-Shboul, 2017; Katiyar et al., 2018; Mani et al., 2018). Measuring SCP and determining its predictors and influences have both been investigated, as has their role in explaining why certain supply chains are more efficient and successful than others. Additionally, in the current competitive market, for maximum value and competitive advantage, SCP must be managed and monitored (Dubey et al., 2018). For analyzing supply chain performance in the past, studies have focused on cost, customer responsiveness, and activity time (Arntzen et al., 1995; Pyke and Cohen, 1994). Most of these studies used cost to evaluate the performance of the supply chain since cost is straightforward to calculate and has a quantitative nature. According to Sezen (2008), this practice of using such basic techniques to evaluate supply chain performance has a limited application. As a result, the author created a framework for selecting supply chain performance metrics. Consistent with other research (Al-Shboul, 2017; Katiyar et al., 2018; Mani et al., 2018), the present study evaluates SCP based on the parameters of adaptability, cost-effectiveness, responsiveness, speed-to-market, product quality, delivery, and lead time. A company has to prioritise improving supply chain efficiency since it is more complicated and crucial than ever. A supply chain is the interconnected system of producers, warehouses, and retailers that brings goods and services to customers (Mensah and Merkuryev, 2014; Peck, 2005).

The operations of supply chain management begin with manufacturers procuring raw materials from suppliers, followed by the production phase whereby the items or services undergo enhancements before being transported to distributors, who then distribute them to end customers (Mensah and Merkuryev, 2014). The links between and among clients, service providers, and their suppliers are more important in the service sector's supply chain (Maull et al., 2012). A business is typically considered a service provider if it can offer end customers the required resources, and all necessary resources are used to create the "core service" that is offered to end customers (Baltacioglu et al., 2007). Although it may be too early to determine precise measurements or KPIs, service provider performance must always be evaluated in relation to the whole service supply chain (Lillrank and Särkkä, 2011). An evaluation of modifications and the performance of the service supply chain is detailed as well as the highlighting of crucial tasks in a number of performance domains as they pertain to service innovation output (Cho et al., 2012). A service provider's actions in performing their obligations and providing the necessary high performance are affected by the nature of the contract and the incentives it contains (Ren and Zhou, 2008). Keeping customers requires providing them with highly valued services, which is vital (Giannakis, 2011).

2.3 Theoretical Review

The Resource-Based View Theory (RBV) and its extension, the Dynamic Capability Theory (DCT), are the theoretical underpinnings of this investigation. Theoretical frameworks serve as a lens through which a topic may be examined more thoroughly; they provide light on the subject's background and the relationships between its many aspects.

2.3.1 Resource-Based View (RBV) Theory

According to Resource-Based View (RBV; Barney, 1991), companies possess a variety of valuable resources and capabilities; the key to a company's success lies in how well its internal departments and external partners exploit these assets. The Knowledge-Based View theory, which builds on the RBV theory by arguing that an organization's knowledge is a valuable resource that may generate value, is based on the RBV's conceptualization of knowledge as intangible skills or assets. Different from other theories, the resource-based approach (Barney et al., 2001; Lonial and Carter, 2015) focuses on an organization's assets. According to Grant (2010), the resources of an

organisation may be broken down into three categories: physical resources, intangible resources, and human resources. According to Barney (2001), Barney et al. (2001), and Lau et al. (2010), such resources are what construct organisational strengths and weaknesses.

According to the Resource-Based View Theory (RBV), a company's innovation performance may be improved by involving and making the most of its resources to get a competitive edge (Lonial and Carter, 2015; Davis and Simpson, 2017). According to the RBV, a company's assets include both its internal (such as its workforce's expertise and raw materials) and its external (such as its customers) assets, as well as its physical (such as its products, facilities, and employees) assets. This exemplifies how the company should make use of its human capital, as well as its material and immaterial assets, to gain a strategic advantage. In order to increase the effectiveness of product innovation, RBV suggests that businesses make use of their available assets in their business development processes (Hong et al., 2016; Saji and Mishra, 2013).

Based on the Resource-Based View (RBV) theory, this research suggests that the efficiency of a company's procurement process and the value it places on its knowledge as an asset, both of which are bolstered by blockchain technology, together affect supply chain performance. Therefore, the antecedent constructs of blockchain technology and procurement process efficiency that might impact SCP are significant factors for these constructs in this research, which can help businesses understand more about how the external environment can affect their performance. The scholarly research (Koska, 2013; Liao and Barnes, 2015) proposes that businesses would fare better in the marketplace if they merged their value generation and retention capabilities to create a new source of competitive advantage.

From the perspective of RBV, an organization's knowledge, procedures, and skills that contribute to improved performance are its resources (Liao and Barnes, 2015). The insufficiency of resources and skills is a significant obstacle for companies when seen through the lens of the resource-based approach (Liao and Barnes, 2015; Ndiaye et al., 2018; Quaye and Mensah, 2019; Yamoah and Arthur, 2014). Additionally, economies of scale and scope tend to be diminished in such circumstances. Therefore, RBV is synonymous with the firm's skills, which are crucial assets for achieving top-tier

corporate success using blockchain technology and streamlined purchasing procedures. For this reason, the RBV may be used to inform the design of effective frameworks through which organisations can use blockchain technology and streamline their purchasing procedures to achieve a market edge. Knowledge resources, capacities, external support mechanisms, attitudes, and competences like blockchain technology and efficient procurement process efficiency may be deemed to have a significant impact on the success of SC performance, as deduced from the RBV research.

In this study, RBV is used as a basis for the development of knowledge resource-based analysis of blockchain technology and how procurement process efficiency may enhance SCP. This is further clarified by Liao and Barnes, (2015), and Osei et al. (2016), that firm performance depends on the firm's resources which, are linked to the innovativeness of the firm i.e., the firm's turnover, and total staff. Furthermore, RBV has been proven in several studies on product innovation (Alegre et al., 2013; Arslanagic-kalajdzic et al., 2017; Danneels, 2002; Eisenhardt, 2000; Liao and Barnes, 2015; Osei et al., 2016) Conclusively, resource-based view theory shed light in terms of how firms can utilize their resources in the perspective of their capacity to innovate, to gain enhanced performance. Relatively in this study, RBV theory was used as a basis for the development of relationships between the knowledge resources via blockchain technology and procurement process efficiency that can influence SCP. In this study, RBV theory was used as a basis for the development of knowledge resources such as blockchain technology and procurement process efficiency in finding its relationship with a firm's SCP.

2.3.2 Dynamic Capability Theory (DCT)

Due to the volatile and unpredictable nature of the economic climate and rising consumer power, businesses have been compelled to develop novel approaches to running their operations during the last decade. The latest covid-19 epidemic has severely impacted distribution networks. To restore order and improve the responsiveness of their supply chain, managers are using a broad variety of internal and external resources. In such regard, blockchain technology and procurement process efficiency have evolved as critical tools for businesses to be more innovative (Jing-Wen and Yong-Hui, 2017). The resource-based approach has been used extensively in the past to describe how businesses

use their assets to get an edge in the marketplace via innovation (Zhan and Yun, 2020; Agi and Nishant, 2017).

Companies can boost their innovation performance with the help of the RBV theory, which argues that doing so requires better resource management through proactive organisational responses (like top-down support, staff education, cutting-edge RandD tools, and stringent adherence to environmental regulations) (Keller et al., 2019). According to RB, a company's resources are its assets and opportunities, not its capabilities (Grobler and Grubner, 2006). Meanwhile, a business has to process or integrate both physical and intangible resources to gain a competitive edge (Sirmon et al., 2008). Furthermore, to sustain a competitive edge over time, they must integrate their resources with their capabilities in a specific context (Sirmon et al., 2008). Distribution systems were badly disrupted by the recent covid-19 pandemic. Managers are drawing on a wide range of internal and external assets to reestablish stability in their supply chain and boost its responsiveness.

Contrarily, a firm's capacity to get an edge in a competitive market is examined from the viewpoint of the dynamic capability perspective, which takes into account how and the specific context resources contribute to the success of an organisation (Sirmon et al., 2010; Singh et al., 2013). Dynamic capabilities, as defined by Teece et al. (1997), are an organization's means of adapting to a dynamic and ever-changing business climate by combining and reorganising its internal and external talents. Additionally, among the dynamic talents is the ability to recognise and mould promising developments, seize opportunities and sustain competitive advantage via improving, safeguarding, combining, and reconfiguring the resources of the firm. Prior studies (Eckstein et al., 2015; Dubey et al., 2018) contend that, in a highly uncertain environment, developing dynamic capabilities—which are essential in a volatile setting—relies on basic, experiential, unstable procedures that are underpinned by newly-emerging insights that permit the combining of renewable resources and competences.

Drawing from these earlier discourses, blockchain technology and procurement process efficiency have been cited as dynamic capabilities which result as a direct outcome of enterprises' innate configure and redesign production and operations of the firm. Thus, we anticipate a causal relationship between blockchain technology, procurement process

efficiency, and SC performance through the lens of DCT. Furthermore, the analysis assumes an impact of blockchain technology and procurement process efficiency on SCP in Ghana. Because this enterprise is seen as a critical component in the production and application of knowledge, it is necessary to comprehend how businesses generate and manage new knowledge (Jabbar et al., 2019). Given that both the RBV and the DCT advocate for the utilization and application of the firm's knowledge resources can be utilized for their benefit. Relatively in this study, DCT theory which is an extension of the RBV theory was used as a basis for the development of antecedent knowledge resources and in finding its relationship with a firm's SC performance.

2.4 Empirical Review

Arim and Huan (2021) looked at the governance efficiency, social justice, and environmental protection of blockchain-based supply chain management in the United States. The research uncovered a review of the relevant literature as well as two case studies. The findings suggest that blockchain technology may improve the efficiency and effectiveness of sustainable supply chains. According to the study's suggestions, future studies should do an empirical investigation of the effects of blockchain technology on sustainable performance.

Gohil and Thakker (2021) looked at how India's supply chain operations may benefit from blockchain technology. The research looked through a mountain of literature. The study found that using blockchain technology enhanced supply chain responsiveness and efficiency. In order to better understand the challenges faced by businesses while using blockchain technology, the paper suggests conducting more studies.

The connection between blockchain technology (BT) and SSCP was studied by Kamble et al. (2021). The hypothesis was tested by a survey strategy that used data from the ACMA and SIAM databases, which represent the automotive component manufacturing industries in India. The results of the investigation backed up the hypothesis that BT improved SSCP performance. Future research might benefit from considering certain technical integrations with BT that were not included in this study.

Ahmad et al. (2021) looked at how blockchain technology is being used and what effect it is having on sustainable manufacturing companies in Malaysia. This research

conducted a literature review to explain how blockchain technology has the potential to improve the financial, ecological, and social efficiency of commercial enterprises and their supply chains. The research showed that blockchain's potential to facilitate transparency, traceability, real-time information interchange, and data security may have an impact on manufacturers' long-term performance. The paper makes recommendations for further study of blockchain technology's potential in environmentally friendly production.

Using a conceptual framework, Wang et al. (2020) investigated the use of blockchain technology in the administration of low-carbon supply chains in New Zealand businesses. Low-carbon supply chain management, blockchain technology, and supply chain integration were all thoroughly researched. According to the findings, blockchain technology has the capacity to serve as a strategic management instrument for enhancing supply chain integration and mitigating carbon emissions. The framework might benefit from further empirical evaluation with larger data sets, and additional topics like digitization, risk management, and organisational integrity could be the subject of further study.

Joon-Seok and Nina (2019) investigated how blockchain technology may improve (or worsen) the efficacy and proliferation of supply chain (SC) collaboration and, in turn, influence SC performance outcomes. A total of 306 interviews were conducted with supply chain professionals from diverse sectors. According to the study's findings, the characteristics inherent in blockchain technology, such as the transparency and immutability of data, as well as the implementation of smart contracts, had notable positive effects on the expansion of partnerships. However, the influence on efficiency was comparatively less pronounced. Additional elements that affect a partnership's capacity for growth management, coordination, and collaboration with other organisations may be the subject of future research.

Petersson and Baur (2018) investigated how blockchain technology may be used in supply chains. Semi-structured interviews with eight companies across sectors (transport, automotive, healthcare) were utilised to compile this data. The findings demonstrated that blockchain technology improves coordination across the supply chain. Research exploring the potential of technology outside the realms of business and supply chains

may focus on various uses in the future. The literature discusses a wide range of applications for this technology, including government programmes and developing nations.

The impact and possible use of blockchain technology in digitally transforming transaction processes was studied by Hofbauer and Sangl (2019). Information was collected from German corporations. The results showed that using blockchain might achieve the most important goals for efficiency, cost savings, security, and trust. Future research might benefit from longitudinal studies of selected early users of blockchain applications to help fill the gap in operational experience and statistical data from real-world cases.

Nandi et al. (2020) conducted research to learn whether and how companies can improve their supply chains via the use of blockchain technology (BCT) in their day-to-day operations and infrastructure. Information was supplied by 126 companies interested in implementing a blockchain-based supply chain system (BCTeSCS). It was observed that operational and strategic level skills in combination with BCTeSCS produced a number of supply chain performance objectives, such as quality compliance and improvement, process improvement, flexibility, reduced cost, and reduced process time. The report recommended further investigation into a BCTeSCS framework centred on available resources and their related concepts.

To investigate how blockchain technology may be used in logistics and supply chain management, Berneis et al. (2021) conducted a comprehensive literature study. Using a systematic literature analysis, the study calculated the possible financial gains from using Blockchain Technology in the logistics sector. A cluster analysis was also performed on the issues found in the literature. The findings suggested that employing Blockchain Technology for high-value commodities might have significant advantages. The systematic literature review cited two databases for their research.

Bag et al. (2020) conducted a study to examine the impact of Procurement 4.0 on business process performance within the context of a circular economy. The study's analysis of the South African manufacturer survey was grounded in theory and conducted using a partial Least Squares Structural Equation Modelling (PLS-SEM) method. The research found

that the Procurement 4.0 method had a positive impact on the purchasers' desire to improve business operations. Second, Procurement 4.0's emphasis on measuring and improving past performance has a salutary effect on purchasers' plans to enhance internal operations. A small sample size and a focus on South African data are only two of the study's flaws. The study suggests that more research is necessary to have a comprehensive understanding of the methods for assessing and monitoring production planning in the era of Industry 4.0.

In order to better understand what variables, affect the incorporation of blockchain technology into supply chain management, Aslam et al. (2021) conducted research. The study's hypotheses were tested using a number of statistical methods, including a sampling strategy and measurements, a factor loading analysis, a descriptive and correlational analysis, and a regression analysis. The findings demonstrate that supply chain management (SCM) techniques boost productivity. In contrast, our study drew on the aforementioned literature to identify several properties of Blockchain and their implications on various supply chain operations. This study guides managers and decision-makers through the process of assessing their current supply-chain practises, learning how those practises relate to blockchain capabilities, and discovering how various blockchain capabilities can aid in enhancing supply-chain practises to boost operational performance.

The purpose of Mondol's (2021) research was to learn how green supply chain practices may be influenced by blockchain technology so that manufacturing companies can implement more environmentally friendly policies across their supply chains. A questionnaire was constructed using the existing research as the basis for this quantitative study. After that, information was gathered from Malaysian factories. PLS-SEM, which incorporates multiple regression and moderation, was used to analyse the data. The research results show that blockchain has a positive impact on green supply chain practices. Green supply chain practices are shown to have a positive correlation with blockchain technology, and this correlation is strengthened by the fact that technical orientation functions as a moderator. One of the study's flaws was that it relied only on data acquired from Malaysian factories. Researchers of the future would do well not to ignore small and medium-sized businesses in favour of those in the service industry.

In order to determine the effects of digitalization on procurement and its function within the context of supply chain management, Mubarik et al. (2021) performed research. The primary data was collected quantitatively using an online survey and then analysed using IBM's statistical programme for the social sciences, version 21. Information was collected from 414 individuals with direct involvement in procurement or related business responsibilities at companies across a wide range of industries. The findings demonstrate that there are a variety of positive outcomes that may follow from digitising the procurement process, such as improved efficiency in both everyday operations and the creation of cutting-edge new goods, services, and business models. However, owing to the scope of the research, the data analysis is restricted to the business process of procurement and its possible future growth within the discipline of supply chain management. More study is needed to determine whether or not the effects of digitalization are significantly different in nations with high levels of automation and industrialization vs. those with a large reliance on manual labour and a low per capita income.

Research was undertaken by Bienhaus and Haddud (2018) to determine which digital enablers have the most potential to enhance supply chain management (SCM). We ranked the most important IT and digitalization enablers for improving SC performance using the Best-Worst Method (BWM). The study found that the top three digitization and IT enablers that firms should prioritise are big data/data science capabilities, product tracking and localization, and appropriate feasibility studies to help in the selection and use of big data technologies and processes. One of the study's flaws was that it put too much weight on the opinions of SC and logistics professionals, which might have created prejudice. In the future, Bayesian BWM might be used to draw from a more diverse set of experts across companies and to give probabilistic validation of results.

For their 2020 research, Gupta, Kumar, Kusi-Sarpong, Jabbour, and Agyemang set out to determine what effect using blockchain technology will have on supply chain collaboration and efficiency. A list of 1693 specialists was developed, and all of them had more than three years of expertise in partnership management, namely in the fields of operations and SC. We used a screening procedure to identify respondents who did not meet the minimum criteria for direct engagement in SC partnership activities, such as having no involvement in service or product-based commercial transactions or

communication with a partner business. The results demonstrate the significant favourable effects of Blockchain technology's properties on partnership efficiency and development (information immutability, information transparency, and smart contracts). Therefore, to enhance coordination or inter-organizational abilities, future research should investigate other elements that contribute to the efficacy and growth management of partnerships.

To further understand how Blockchain technology may be used in the FM procurement process, Gunasekara et al. (2021) performed research. The research used a combined qualitative approach using case studies and survey approaches. Template analysis and content analysis were used to examine the collected data. The results demonstrated that manual procurement had flaws in terms of productivity, data safety, communication, and openness. E-procurement systems also have issues with data security, poor integration, and lack of transparency. Since BCT is still in its infancy in the Sri Lankan setting, the lack of IT professionals with a firm grasp of the topic was a major barrier to study. However, the seven experts picked gave enough information, and data saturation was reached.

Researchers Paliwal et al. (2021) looked at the potential of Blockchain for environmentally friendly supply chain management. The (5W+1H) framework was used to develop the study's research questions and objectives. Since there were no particularly noteworthy articles published in 2015 or 2016, this review solely considers papers published in 2017, 2018, 2019, and the first half of 2020. This totals 187 papers. The findings highlight transparency and traceability as primary advantages of using Blockchain technology. They also suggest that 2017 will be a watershed year for the adoption of Blockchain-based information solutions for environmentally responsible supply chain management. One of its drawbacks is the increasing scholarly interest in the issue at hand; within a few years, the amount of literature is expected to triple.

2.5 Conceptual Framework and Hypothesis Development

Our theoretical model rests on the two pillars of DCV and RBV (see Figure 2.1). As management researchers look for strategies to help businesses become more resilient in

the face of economic uncertainty, the dynamic capabilities view (DCV) has become more popular. Consistent with prior reasoning and the use of blockchain technology to enhance procurement process efficiency, the capacity to identify, grasp, and react to emerging patterns is seen as a solution to uncertainty. The necessity for blockchain technology and the effectiveness of the procurement process is made even more pressing by work environments that are volatile and complex, characterised by high levels of uncertainty that make it impossible to engage in effective planning and decision-making. The DCT suggests that in highly unpredictable circumstances, a diverse set of firm competences is most useful. In this paper, we provide a methodology for estimating how improvements in procurement process efficiency and blockchain technology could impact supply chain performance.

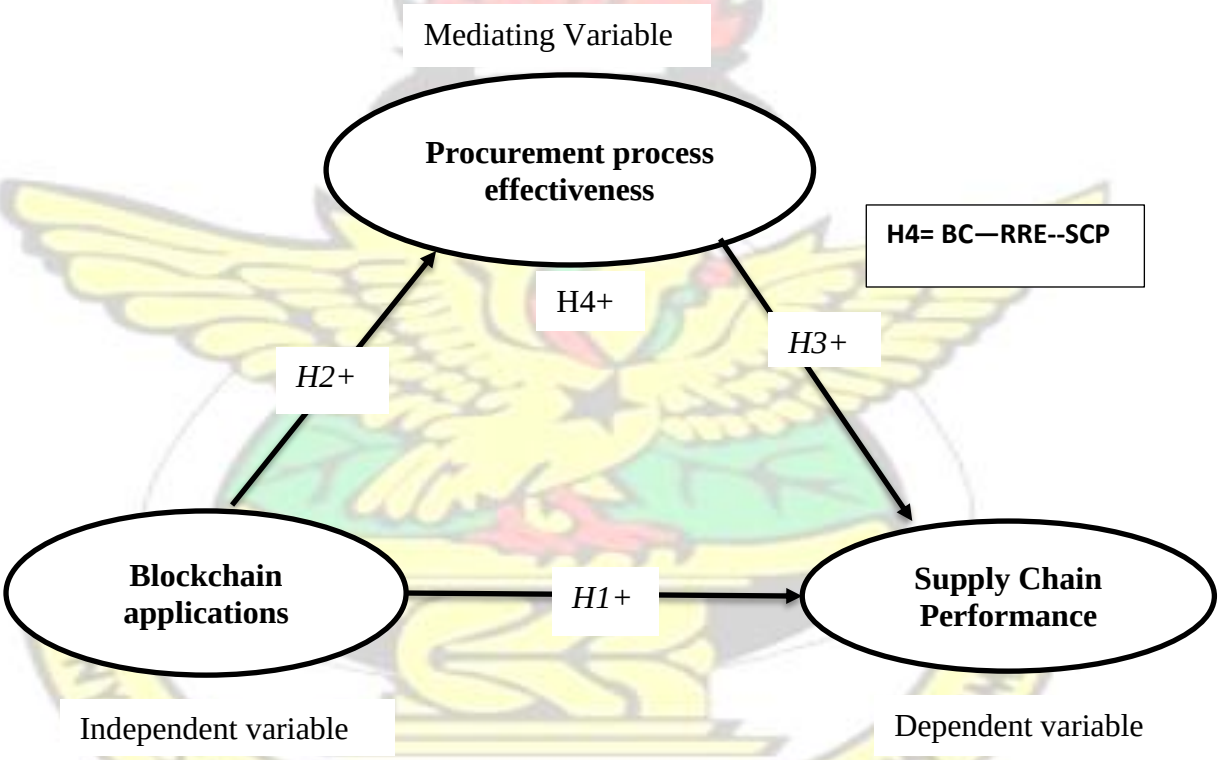

Figure 2.1: Conceptual Framework

2.5.1 Effect of Blockchain Applications on Supply Chain Performance

Daily, the participants in a supply chain network share a mountain of information. More complicated supply chains are often more successful (Qrunfleh and Tarafdar, 2014) due to the abundance of available technology and the problem of knowledge asymmetry. The

adoption of blockchain technology is therefore encouraged, not only to address such cases of complexity (Hyperledger, 2019; Maersk, 2018), but also to promote and improve performance in the OSCM (Delloite, 2019) and to significantly contribute to new business and revenue streams (see Appendix B for more details). In addition, the many advantages of adopting blockchain technology, such as enhanced accountability, are expected to make it a significant factor in resolving OSCM issues like the need for transparency and trust between members (Aste et al., 2017; Biswas et al., 2017; Kshetri, 2018; Zou et al., 2018). By keeping tabs on everything, supply chain management becomes more accountable and open to everyone's advantage. It stands to reason that trust and cooperation would boost supply chain performance if blockchain technology could eliminate information variability in supply chain management (Aste et al., 2017). Our deductions from this are as follows:

H1: Blockchain applications have a significant positive effect on supply chain performance.

2.5.2 Effect of Blockchain Applications on Procurement Process Effectiveness

One of the main advantages of effective partnerships is that formalised procedures, like VMI or CPFR, may drastically reduce the time and money needed to communicate between trade partners. They are also expected to boost the likelihood of collective decision-making as a consequence of their cutting-edge technology infrastructure (Wong et al., 2015). From digital supply management to hospital service management, effective collaborative management has been a longstanding difficulty from both the supplier's and the buyer's perspectives (Joon-Seok et al., 2019). Simply said, when people work together, they get an advantage that benefits everyone. Overbooking of supplies is a common problem in the supply chain, and cooperative efforts to reduce it can improve operational and financial results. Drawing from the above discussion, it is envisaged that blockchain applications will enhance procurement process effectiveness. Hence the second hypothesis:

H2: Blockchain applications have a significant positive effect on procurement process effectiveness.

2.5.3 Effect of Procurement Process Effectiveness on Supply Chain Performance

When introducing e-procurement technologies, it is important to think about the whole buying procedure (Deise et al., 2000; Presutti, 2003). The IAPWG (2006) common e-

procurement systems are shown as the base layer, which is based on Van Weele's (2009) generic procurement process model. Making and approving procurement requisitions and placing purchase orders are simplified with the use of an e-ordering system and Web-based enterprise resource planning (ERP) system (IAPWG, 2006). More and more siloed IT systems and individual buying support solutions are being implemented to facilitate operational purchasing, allowing for this trend (Rai and Hornyak, 2013). Research into the company's supply chains has been the subject of both operational purchasing and sourcing operations (Hult and Chabowski, 2008). Procurement experts have quick and easy access to integrated, consistent, and reliable data thanks to the various procurement platforms that contribute to integrated information management (Gattiker and Goodhue, 2004). All stages of the purchasing procedure have access to the accessible applications. The source-to-pay and deliver-to-pay procedures, for instance, are quite universal across various sectors and can be executed by a variety of software. E-sourcing, order/delivery tracking, billing, and enterprise resource planning (ERP) are all examples of such programs used in operations management. E-sourcing refers to the practice of leveraging the Internet to find new sources to fulfil specific types of procurement needs.

Additionally, an e-tendering tool is part of an e-sourcing solution, and it is used in the e-tendering process, wherein a company requests information from possible suppliers, such as product specs and pricing, and then receives responses from those vendors electronically (De Boer et al., 2002). Providers can submit bids and compete for business in this way, with the lowest bidder or other factors often being the deciding factor (Smart, 2010). Therefore, rather than focusing on individual applications, supply chain management should aim for a holistic digital transformation by fostering collaboration across departments, administering external resources, and creating supply market information (Srai and Lorentz, 2019).

H3: Procurement process effectiveness has a significant positive effect on supply chain performance

2.5.4 The mediating role of procurement process effectiveness on the relationship between blockchain applications and supply chain performance

A company's supply chain success is directly tied to the purchasing process, making it an essential part of supply chain management (Chang et al., 2013). Previous studies have

found that implementing and utilizing electronic processes and apps can have various positive effects on supply chain performance. E-procurement is a method of purchasing goods and services electronically, which has many benefits including the simplification of the purchase-to-pay cycle, the improvement of supply chain efficiency and optimization, and the mitigation of procurement-related risks (Kim and Shunk, 2004; Purchase and Dooley, 2010; Ronchi et al., 2010; Lenka et al., 2016). Evidence suggests that e-procurement platforms can improve supply chain performance by making it easier to see where goods are in the chain (Puschmann and Alt, 2005). The administrative and transaction costs of a business are reduced as well thanks to the digitization of procedures (Eadie et al., 2007; Ronchi et al., 2010). Processes in the digital supply chain may be more adaptable, faster, and more agile (Garrido et al., 2008; Christopher and Holweg, 2011). The advent of digitalization presents the chance to enhance performance and guarantee greater dependability (Porter and Heppelmann, 2014). What stages of the SCM process digitalization are used to determine the specific purposes and forms it takes? Improvements in supply chain efficiency and optimization can be achieved through the use of digital procurement capabilities (Purchase and Dooley, 2010; Lenka et al., 2016). Whether or not a company can reap the benefits of digital procurement depends on how well-established and rapidly expanding its digital procurement processes are. This leads to the following hypothesis:

H4: Procurement process effectiveness mediates the relationship between Blockchain applications and supply chain performance.

CHAPTER THREE

RESEARCH METHODOLOGY AND PROFILE OF THE STUDY AREA

3.1 Introduction

This section provides details about the study's research methods, including its research design, demographic, and sample. Data collecting strategies, ensuring data quality, and statistical analysis.

3.2 Research Paradigm

Research is a technique used in the scientific method to learn something new. Krichen, Ammi, Mihoub and Almutiq (2022) point out, that the research philosophy one adopts is inextricably linked to one's worldview. Though many researchers conduct studies without giving much thought to their philosophical foundations, even a cursory familiarity with research philosophies helps clarify the chosen study design and determine which is most suited to the issue at hand (Dikko, 2016; (Saunders et al., 2009). One of the numerous philosophical vantage points is epistemology, which investigates the origins and growth of information. Knowledge creation, interpretation and application are at the heart of epistemological assumptions, as stated by Sunders et al. (2009). The epistemological viewpoint acknowledges that the scientific process may provide reliable knowledge through the testing of hypotheses (Kshetri, 2018). As a result, the epistemological stance suggests a worldview in which new information always improves existing knowledge.

Two of the most well-known, and opposed, schools of thought within the field of social research are positivism and interpretivism. Both the first and second stances can be compared to quantitative and qualitative models, respectively (Kshetri, 2018; Saif, 2020). While the quantitative paradigm looks at numerical data, the qualitative one looks at how people understand those numbers. According to these presumptions, scientists must conduct their experiments differently. Positivists hold that a key purpose of research is to determine whether or not previously established theoretical assumptions can be successfully applied to the phenomena under investigation (Saunders et al., 2009). Results are considered relevant and genuine when actual evidence obtained supports the hypothesis. Specifically, positivist researchers employ quantitative approaches to test hypotheses and accomplish their aims (Zhu and Mostafavi, 2017). To avoid being swayed

by any potential biases in the study population, researchers adhering to the epistemological perspective will keep a safe distance from the research population as a whole (Zhu and Mostafavi, 2017; Creswell, 2014). The positivist research theory, the bedrock of quantitative research, is consistent with the study's goals when these methods are applied. Quantitative methods of data collection were used since it was the most appropriate approach given the focus of the project.

3.3 Research Design

Research design, according to Yousefi and Tosarkani (2022), is a systematic framework or action that illustrates the steps and techniques to gather and analyze the anticipated data/information in carrying out the research project. The research design involves making a decision that often than not includes the research question, diagnosing the problem of the study, envisaging and sticking to the contents of the study, gathering and interrogating the research data, and interpreting the findings (Zhu et al., 2020). The research design has to do with the specific data investigative procedures a particular researcher may deem fit for a study. It is therefore very important and critical in choosing the correct research design for any research project. The study was carried out in the quantitative perspective, where numerical data was used to assess the existing relationship between the study variables. Based on the data collection method involved in this study, the cross-sectional research design was an appropriate approach for the study because it is less expensive and takes less time (Park and Li, 2021; Asamoah et al., 2021). Cross-sectional studies are categorized into two types: descriptive and analytical (Wang & Cheng, 2020).

This classification is based on whether the dependent variable is evaluated for possible relationships with the independent variables (Wang & Cheng, 2020). In the context of this study, the study seeks to investigate how the independent variable, blockchain application influences procurement processes and supply chain performance. For this matter, the analytical cross-sectional design was deemed suitable for this study. The use of cross-sectional survey design in general has several benefits; one of them is that it enables researchers to collect data from a large and diverse sample of respondents, providing a broad representation of the population under study (Wang & Cheng, 2020). It is also easy to conduct because data on all variables are gathered at a single time point,

and also, it is easy for generating a hypothesis (Wang & Cheng, 2020). The choice of the analytical cross-sectional design lies in the fact that the study used multivariate methods to assess the interconnections between blockchain application usage, procurement process effectiveness and supply chain performance as supported by the studies of Cole et al. (2019), and Nandi et al. (2022).

3.4 Population of the Study

The population is defined as all individuals or objects with a common feature that one intends to study (Bhattacherjee, 2012). It consists of data whose features are supposed to be analyzed within a particular research context (Babbie, 2015). For this study, the population of interest consists of Ghanaian manufacturing companies in Greater Accra. Since the variables in the study are organization-level constructs, the single-respondent approach was employed. As a result, the study targeted only managers or supply chain officers.

3.5 Sample size and Sampling techniques

The term "sample size" is used to refer to the anticipated range of participants or variables in a research project. There were 210 employed participants in this survey. According to the research, a sample size of 136 was determined using the method developed by Krejcie and Morgan (1970). To select these 136 research participants, systematic approach was followed, which is the sampling technique. Sampling techniques according to Taherdoost (2016) refers to the actions used to choose a researchable subset of a population. In research, researchers utilise both probability and non-probability sampling methods. The current study adopted the nonprobability sampling technique, specifically the purposive sampling, where participants were selected based on their knowledge on the usage of blockchain in the firm. This technique was particularly appropriate in this study since not all the employees of the manufacturing firm are privy to the usage blockchain and how it influence firms supply chain and procurement. Thus, Wang & Cheng (2020) underscored the importance of this technique to include its ability to enable research elicit the required information from study participants.

3.6 Types and Sources of Data

The primary data source was used to investigate the study objectives. This data source is the first-hand information that is directly obtained from research participants (Saunders et al., 2009). The primary data obtained from the respondents was obtained at one point in time, when no historical information was required. Sekaran (2003) argues that there is more than one way to obtain data depending on the context. Examples include in-person, over-the-phone, and online interviews, paper and online surveys, audio and video recordings of interactions, and other forms of encouragement (p.221). Although it would have been possible to collect useful information through any of these other channels, a questionnaire survey was used instead. Researchers often turn to surveys when they need original data from a population that is too large to study using other methods.

To guarantee that all respondents provide responses that are consistent with one another, researchers using a survey technique must employ well-developed, standardised questionnaires, as stated by Dikko (2016). Standardised measures are cited as a strength of the survey technique by Malhotra and Birks (2007) and Saunders et al. (2009). The information is often quantitative, making it amenable to comparison and examination using several statistical methods (Creswell, 2014). Using a questionnaire to gather data again facilitates tabulation and analysis, while also adding a measure of dependability to the process (Smith and Albaum, 2005).

To test the study's hypotheses, the researcher developed a survey with a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to measure all the study variables. The analysis relies on both a theoretical framework and several scholarly articles for the adoption of the study measurement items and the analysis of the results (Paul et al., 2021; Raja et al., 2022). This study adapts questions from other related studies to fit Ghana's needs because they have been validated and tested for reliability. Likert scale questions were used for all of the study's quantitative assessments since they were found to be both user- and researcher-friendly and produced consistent, measurable findings.

3.7 Data Collection Method

Sekaran (2003) argues that there is more than one way to obtain data depending on the context. Examples include in-person, over-the-phone, and online interviews, paper and online surveys, audio and video recordings of interactions, and other forms of

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The survey consisted of a series of questions designed to gather the viewpoints of the participants regarding the aforementioned four specific objectives. To optimise the response rate, the researcher implemented strategies to expedite the collection of necessary data. Furthermore, the questionnaire was divided into four distinct sections to enhance user convenience. The initial segment of the survey was focused on collecting data pertaining to the respondents' backgrounds. Data on Procurement Processing Effectiveness was collected in the second section, while details of Supply Chain Performance were collected in the third section, and information on Blockchain Applications was collected in the fourth section. The questionnaires were administered by the researcher in person. The researcher further did any necessary follow-ups to ensure that the questionnaires were completed in a satisfactory and timely manner.

3.7.1 Measurement of Variables

Data	Measurement	Source
Dependent variable		
Supply Chain Performance	Using a questionnaire of 5 items	Raja et al., 2022
Independent variable		
Blockchain applications	Adopted questionnaire using 7 items	Paul et al. (2021)
Mediating variables		
Procurement process effectiveness	Adopted questionnaire using 14 items	Raja et al., 2022

Source Author (2023)

3.8 Method of Data Analysis

According to Mohajan (2018), data can be defined as a form of statistics that enables the drawing of inferences, contingent upon the presence of evidence that encompasses elements referred to as actual or current. The quality of the results, conclusions, and recommendations taken from the data is heavily dependent on the technique of data analysis chosen, making the method of data analysis a crucial part of any study. This research was quantitative; hence it used a variety of quantitative methods to analyse the data and reach the conclusion described in the first chapter. Once data collection was complete, it was imported into Excel for analysis. Some of the surveys were thrown out when they were determined to be missing important information. SPSS, a statistical program, version 26.0 was used for the study's analysis. Frequencies, means, standard deviations, independent sample t-tests, and correlation analyses were performed using the Statistical Package for the Social Sciences (SPSS). Partial least squares structural equation modelling (PLS-SEM), as used in SMART-PLS, was used to examine the connections between the variables. Chin et al.'s (2020) two-stage method for analysing SEM models is used here. This research was considered to be suitable for PLS-SEM because it is less restrictive on residual distribution assumptions (multivariate normality assumptions) than other analytic methods, such as the covariance-based approach to structural equation modelling (Chin et al., 2020). The PLS-SEM method of data analysis is used when the study's primary purpose is to predict certain target variables rather than do a confirmatory analysis.

3.9 Validity and Reliability Test

Reliability is the degree to which a test is consistent and stable in measuring what it is intended to measure (Heale & Twycross, 2015). Internal consistency reliability analysis, a key part of reliability evaluation, was conducted using Cronbach's alpha coefficient (Cronbach, 1951). The reliability of the research instrument was determined using Cronbach's alpha and a composite measure (Cooper et al., 2006; Cronbach, 1951). Cronbach's alpha is a statistic for gauging how well one set of things predicts another set of items used to evaluate the same construct (Creswell, 2014). While a 0.7 or higher correlation coefficient is considered acceptable in the literature (Hair et al., 2010), some researchers have found that a 0.5 or higher correlation coefficient provides sufficient reliability in exploratory studies (Malhotra and Birks, 2007). This study thus used the commonly employed Cronbach alpha and composite reliability tests in SEM research to evaluate the stability of the research instrument (see Hair et al., 2010). Cronbach's alpha can only tell you so much, so we also ran a composite reliability test to see how well each set of questions measured the construct in question.

This study's content validity was established by a pilot test of the measuring instruments and consultation with other experts in the area (Taherdoost, 2016). Content validity was established through the utilisation of expert validation, it evaluates how well the questions in the questionnaire accurately represent the intended constructs. The content of the questionnaire was evaluated by a group of experts in the fields of education and psychology to ensure its relevance, clarity, and alignment with the research objectives. The input provided by individuals was thoroughly evaluated and integrated into the ultimate iteration of the questionnaire, thereby enhancing its validity (Polit and Beck, 2017). Content validity was established through the utilisation of an expert review process, which is essential in ensuring that the interview guide adequately encompasses the comprehensive scope and profound aspects of the research topic. Educators and experts in qualitative research gave the interview guide their full attention before it was released. The feedback provided by the participants assisted in the process of refining the questions, resulting in a closer alignment with the research objectives. This, in turn, enhanced the validity of the instrument (Bryman, 2016).

3.10 Ethical Consideration

Ethical considerations play a fundamental role in research endeavours, as they are responsible for upholding the rights, welfare, and confidentiality of participants throughout the entire research process. The findings of this investigation were conducted in accordance with a comprehensive ethical framework in order to uphold the utmost standards of integrity and accountability (Fouka and Mantzorou, 2011). Selected respondents have the option to decline to take part in the study. In the consent form, the researcher said that all confidentiality and anonymity protections would be upheld. It was also noted that businesses have the freedom to decide when, how much and under what circumstances they provide data. In their interactions with subjects, the researcher refrained from engaging in any behaviour that could be construed as deceit. The researcher also avoided any instances of data manipulation and plagiarism.

3.11 Profile of the Manufacturing Sector in Ghana

Baah-Nuakoh and Teal (1993) assert that the manufacturing sector in Ghana plays a substantial role in the productive capacity of the nation. The primary sectors of the economy were the focus of diversification efforts during the immediate post-colonial period, leading to the establishment of its main industries. Despite not being as robust as desired, the manufacturing sector maintains a significant presence in the economy by making notable contributions to both employment and the overall gross domestic product (Steel and Webster, 1991). As previously mentioned in the initial chapter, the manufacturing sectors in Ghana encompass activities such as Aluminium smelting, Oil refining, Agro-food processing and Cement production. Additional sectors within the economy encompass the manufacturing of beverages, textiles, glass, plastics, paints, chemicals, apparel and pharmaceuticals, as well as the processing of metals and wood products.

According to Steel and Webster (1991), a significant majority of industries, specifically over 80%, can be classified as small-size enterprises with a workforce of less than 50 employees. Additionally, it is estimated that approximately 55% of all enterprises are situated within the Greater Accra/Tema Region. In 2009, the manufacturing sector accounted for 6.9% of the Gross Domestic Product (GDP), while in 2013, it accounted for 5.8% of the GDP.

Baah-Nuakoh and Teal (1993) assert that the manufacturing sector in Ghana holds significant significance in the country's development process. This importance stems not only from the sector's inherent dynamism but also from the perceived positive externalities it generates for the broader economy. These externalities manifest in various ways, encompassing technology effects, human capital effects, learning effects, and the historical association between an expanding manufacturing sector and increasing income per capita.

- Technology effects refer to the utilisation and adaptation of technology by manufacturing firms, which can subsequently be applied in other sectors.
- Human capital effects pertain to the development of technical, organisational, and managerial skills within the manufacturing industry.
- Learning effects occur when one firm's investment in implementing a new production process reduces the learning costs for other entrants, known as "learning by doing."
- Lastly, the historical relationship between a growing manufacturing sector and rising income per capita is attributed to the relatively high returns on capital and labour, along with positive consumption and investment effects.

Research into the manufacturing sector is a valuable option due to its significant contribution to overall economic development.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND DISCUSSION OF RESULTS

4.1 Introduction

A summary of the information gathered regarding the study's research topics is provided in this chapter. It provides information about the respondents, descriptive analyses of the blockchain application, procurement effectiveness, supply chain performance, correlation analyses, and regression analyses on how the blockchain application affects supply chain performance by examining the role of procurement effectiveness as a mediator.

The study employed a quantitative research approach. Descriptive and cross-sectional research methods were used for this investigation. This quantitative study involved 136 purchasing and supply chain managers. The data were principally acquired through the utilisation of a standardised questionnaire that had been modified from previous research endeavours. The data was deciphered using SPSS and SmartPLS. The data was analysed using descriptive and inferential research methods. The correlations among the variables were determined using both descriptive and inferential statistics.

4.2 Respondents Profile

This section presents data about the study subjects and the participating companies, including demographic information. Key information collected from respondents includes gender, age, education, department, position, company age, number of workers, and ownership type.

Table 4.1: Respondents Profile

Variables	Items	Frequency	Per cent
Gender	Female	53	39
	Male	83	61
Age	23 years and below	5	3.7
	24–29 years	40	29.4
	30–35 years	46	33.8
	36–40 years	32	23.5
	41 years and above	13	9.6
Educational Background	Bachelor's Degree	66	48.5
	Master's Degree	66	48.5
	Ph.D./Doctorate	4	2.9
Please, indicate the department you belong	Accounting	2	1.5
	Actuarial	2	1.5
	Administration	1	0.7
	Education	1	0.7
	Finance	3	2.2
	Health	1	0.7
	Legal	2	1.5
	Management	44	32.4
	Marketing	23	16.9
	Mass media /communication	2	1.5
	Officer	1	0.7
	Procurement	47	34.6
	Supply chain	7	5.1
Please indicate your position	Junior level	26	19.1
	Middle level	83	61
	Top management	27	19.9
Number of years the firm has been in operation:	1-5 years	36	26.5
	11-15 years	19	14
	16-20 years	15	11
	21 years and above	17	12.5
	6-10 years	43	31.6
	Less than 1 year	6	4.4
Number of employees in the firm	10-29 employees	14	10.3
	30-50 employees	16	11.8
	6-9 employees	14	10.3
	Less than 6 employees	8	5.9
	More than 50 employees	84	61.8
Type of Ownership	Fully foreign-owned	13	9.6
	Fully locally owned	99	72.8
	Jointly Ghanaian and foreign-owned	24	17.6
	Total	**136**	**100**

Source: Field Data, 2022

A total of 136 replies were legitimate, with 53 (or 39%) coming from women and 83 (or 61%) coming from men. Even though the result information shows that males dominate the sector of study, the study used data that gives a fair representation of the studied population.

Out of the 136 respondents, 3.7 percent were within 23 years and below; 29.4 percent were also within 24 – 29 years; 33.8 percent were within 30 – 35 years old, 23.5 percent were within 36 – 40 years, and 9.6 percent were within 41 years and above. However, the result reveals that most of the respondents were between 30 to 35 years old and that firms having this youthful workforce could use technologies such as blockchain to improve their supply chains.

Out of the 136 respondents, 48.5 per cent had bachelor's degrees and master's degrees respectively, and 2.9 per cent had PhD/Doctorate. The result reveals that most of the respondents had bachelor's degrees and master's degrees, this implies that respondents are educated and could understand the issues investigated in the study.

Out of the 136 respondents, 1.5 per cent were in Accounting, Actuarial, Legal, and Mass media/communication departments, 0.7 per cent were in Administration, Education, Health, and Officer, 2.2 per cent were in the finance department, 32.4 per cent indicated Management department, 16.9 per cent indicated Marketing, 34.6 per cent indicated Procurement and 5.1 per cent indicated Supply chain. The result reveals that the majority of the respondents belong to the Procurement department. This implies the study focused on senior staff who make supply chain decisions.

Out of the 136 respondents, 19.1 per cent were junior level, 61.0 per cent were middle level, and 26.5 per cent indicated Top management. The findings reveal that most of the respondents were middle-level and that they were the key operational heads who used blockchain technologies of the firms.

Twenty-two per cent of the 136 logistics service firms have been around for a year or less; fourteen per cent have been around for 11–15 years; eleven per cent have been around for 16–20 years; twelve and a half per cent have been around for 21 years or more; thirty-one and a half per cent have been around for 6–10 years; and four and a half per

cent have been around for less than a year. According to the findings, the average age of the companies represented among the respondents is between 16 and 20 years. Thus, it is expected that firms that have been operational for a longer time would have the capability to invest in such technologies which can aid them in enhancing their supply chain and operational performance.

Out of the 136 logistics service firms, 10.3 per cent had employee size within 10 – 29 and 6 – 9; 11.8 per cent had employee size within 30 – 50; 5.9 per cent had employee size within less than 6; 61.8 per cent had employee size within 50 and more. The findings reveal that the majority of the respondent's firms had employee sizes within 50 and more.

Out of the 136, 9.6 of the respondents indicated fully foreign-owned; 72.8 indicated fully locally owned; and 17.6 per cent indicated jointly Ghanaian foreign-owned. The result reveals that most of the respondent's firm's type of ownership was fully locally owned. This study prioritized locally owned firms which aids in ascertaining whether local firms are also making technological investments required to drive their operations.

4.3 Reliability and Validity Test

The Cronbach alpha and composite reliability measure how reliable the measurements capture the variables. All these numbers should fall above the 0.7 threshold (Hair et al., 2013). The dependability of the variables was shown by the fact that the items and constructs used to measure the variables had their Cronbach's Alpha all higher than 0.7. The convergent validity, as measured by the AVE, was more than 0.5 as recommended by Hair et al. (2013). When determining discriminant validity, the Fornell-Larcker criteria are used. The validity of the variables is shown by the fact that each item correlated most highly with itself as shown in Table 4.3. This showed that the factors loaded more strongly in their designated variables than in the other variables, suggesting that the variables were appropriately evaluated using the relevant factors.

Table 4.2: Reliability and Validity Test

Construct	Number of items	Cronbach's alpha	Composite reliability	The average variance extracted (AVE)
Blockchain Applications	7	0.954	0.957	0.786
Procurement Effectiveness	14	0.976	0.978	0.767
Supply Chain Performance	5	0.943	0.944	0.816

Source: Field Data, 2022

The variables' scores for CA, CR, and AVE are provided in Table 4.2 above. Blockchain application, Procurement Effectiveness, and Supply Chain Performance each received a Cronbach alpha score of 0.954, 0.976, and 0.943, respectively. Supply Chain Performance received a score of 0.944, Procurement effectiveness received a score of 0.978, and Blockchain application received a score of 0.957 for Composite Reliability. A score of 0.7 is acceptable for each of these values, indicating the reliability of the variables. Blockchain application received a score of 0.786 for the Average Variance Extracted (AVE), Procurement effectiveness received a score of 0.767, and Supply Chain Performance received a score of 0.816. The variables are appropriate because they meet the 0.5 threshold.

Table 4.3: Fornell – Larcker Criteria

Construct	Blockchain Applications	Procurement Effectiveness	Supply Chain Performance
Blockchain Applications	**0.886**		
Procurement Effectiveness	0.773	**0.876**	
Supply Chain Performance	0.808	0.809	**0.903**

Source: Field Data, 2022

Fornell Larcker Criteria and cross-factor loadings were used for the discriminant validity. The discriminant validity assesses whether the latent factors accurately reflect the other variables in the research, in contrast to the convergent validity, which evaluates how well the latent variables capture the primary variable. The correlation of the squared variance of the variables among themselves must be bigger than the correlation of the squared

variances with other variables below it according to the Fornell Larcker criterion. As seen in Table 4.3 above, the correlation between the Blockchain application and itself was 0.886, while it had correlations with SC Performance and procurement effectiveness of 0.773 and 0.808, respectively. Correlation values between procurement effectiveness and SC Performance were 0.809 and 0.876, respectively. A correlation coefficient of 0.903 existed between SC Performance and itself as well. Each of the variables was therefore more correlated with itself than with the variables above it, proving the validity of each one.

Table 4.4: Cross – Factor Loadings

Factor	Code	Blockchain Applications	Procurement Effectiveness	Supply Chain Performance
1	BCA1	0.795	0.590	0.570
2	BCA2	0.891	0.734	0.729
3	BCA3	0.910	0.702	0.767
4	BCA4	0.910	0.687	0.722
5	BCA5	0.924	0.686	0.741
6	BCA6	0.858	0.713	0.751
7	BCA7	0.908	0.672	0.710
8	OP1	0.721	0.824	0.929
9	OP2	0.713	0.793	0.861
10	OP3	0.790	0.819	0.940
11	PE1	0.645	0.879	0.783
12	PE10	0.715	0.874	0.788
13	PE11	0.706	0.857	0.723
14	PE12	0.724	0.896	0.831
15	PE13	0.725	0.899	0.854
16	PE14	0.721	0.913	0.824
17	PE2	0.684	0.896	0.809
18	PE3	0.678	0.915	0.788
19	PE4	0.547	0.742	0.641
20	PE5	0.588	0.867	0.727
21	PE6	0.602	0.846	0.705
22	PE7	0.681	0.861	0.697
23	PE8	0.747	0.898	0.852
24	PE9	0.676	0.905	0.842
25	SCT1	0.716	0.791	0.883
26	SCT2	0.708	0.791	0.901

Source: Field Data, 2022

Cross-factor loadings are the most popular validity test since they evaluate the relationship between each latent variable and the principal variable or idea. Components

that strongly correlate with the dependent variable are given more weight. The items with the codes BCA1, BCA2, BCA3, BCA4, BCA5, BCA6, and BCA7 received scores of 0.795, 0.891, 0.910, 0.910, 0.924, 0.858, and 0.908 for the Blockchain application, accordingly. The BCA5 item received the highest mark, 0.924. Criteria 8 to 10 and 25 to 26 loaded the most heavily under SC Performance and are therefore appropriate factors to use when assessing SC performance. It was decided to employ the objects OP1, OP2, OP3, SCT1 and SCT2 since they loaded highly across all structures. The results are, correspondingly, 0.929, 0.861, 0.940, 0.883, and 0.901. Indicators 11 through 24 have the greatest procurement effectiveness loadings and are therefore appropriate factors for assessing supply chain responsiveness. Due to their large loading in all builds, the elements PE1, PE2, PE3, PE4, PE5, PE6, PE7, PE8, PE9, PE10, PE11, PE12, PE13, and PE14 were employed. The results are 0.879, 0.896, 0.915, 0.742, 0.867, 0.846, 0.861, 0.898, 0.905, 0.874, 0.857, 0.896, 0.899, and 0.913.

4.4 Descriptive Analysis

The average, standard deviation maximum and minimum were used as descriptive statistics to summarise the responses to the study's many questions. The following sections provide the designated details.

4.4.1 Procurement Effectiveness

14 valid and reliable items were used to quantify procurement effectiveness following the completion of the reliability and validity tests. This was done by administering a questionnaire with five-point Likert scale responses. Thus, the managers showed their agreement or disagreement levels with these items, and the results of their responses are presented in Table 4.5, where overall, the minimum response was 1, which corresponds to “strongly disagree”, and the maximum of 5 corresponding to “strongly agree” response. With the majority of the standard deviations above 1.0, it indicates that the variations in the responses for each of the items were highly dispersed from the central point (mean scores).

Table 4.5: Descriptive Statistics of Procurement Effectiveness

Variables	Min	Max	Mean	Standard deviation

1. There is a current manual on the works and products procurement procedure.	1	5	3.54	1.371
2. The procurement section employs competent personnel.	1	5	3.57	1.332
3. The department is equipped with enough computers, internet access, photocopying equipment, printers, etc. to carry out the anticipated procurement.	1	5	3.60	1.342
4. There are defined guidelines for receiving commodities.	1	5	4.02	1.263
5. There are templates for bid documents that are used.	1	5	3.70	1.245
6. The purchasing division keeps records of the warranty and latent fault liability periods.	1	5	3.92	1.131
7. A common structure for the Terms of Reference includes background information, tasks, inputs, objectives, and results.	1	5	4.07	1.062
8. A committee for choosing consultants has been established, and its members are qualified in terms of procurement and technical knowledge.	1	5	3.93	0.987
9. Exists a general code of ethics for instances of supervision.	1	5	3.94	1.187
10. In the case of supervision, there is a documented auditable record of the purchase choices.	1	5	4.00	1.078
11. For handling complaints, a formal non-judicial system exists.	1	5	3.93	1.116
12. The procurement files have a reference mechanism, right?	1	5	3.93	1.075
13. Original contracts are kept safe in a place that can withstand fire and theft.	1	5	3.93	1.132
14. Even decades later, documents of offers, bills, proposals, and complaints are still freely accessible.	1	5	3.89	1.122
Overall Mean			***3.85***	***1.175***

Source: Field Data, 2022

Mean and standard deviations were used in this phase of the analyses' descriptive technique to describe respondents' opinions on the efficiency of procurement. All of the items appear to evaluate the efficacy of the procurement process, according to the results shown in Table 4.5. “The terms of reference, on the other hand, are organised according to a standard structure, with background, tasks, inputs, objectives, and outputs” scored a mean of 4.07 and “there being established goods receiving processes” scored a mean of 4.02, respectively. “A documented auditable trail of procurement decisions in instances of oversight” has a mean score of 4.00. “The events of supervision” had a mean score of 3.94 on the question, "Is there a standard declaration of ethics?" “There is a formal non-judicial mechanism for handling complaints”, “there is a referencing system for procurement files”, “original contracts are secured in a fire and theft-proof location”, and

"there is a committee formed to select consultants that is composed of qualified individuals in terms of procurement and technical expertise." These factors received a mean score of 3.93 and 3.93, respectively. "The registration and tracking of warranty and latent fault liability periods in the procurement department" received a 3.92 rating. "Copies of proposals, invoices, bids, and complaints are quickly retrieved even years" rated 3.89. Standard bidding papers are now in use and have an average score of 3.70. "The unit has the necessary resources, including computers, internet access, photocopying equipment, printers, etc., to carry out the anticipated procurement", earning a 3.60. "The procurement division" received a score of 3.57 and has competent personnel. "There is a current guide to the works and commodities procurement procedure", which has a 3.54 rating. According to the findings, indicators of effective procurement had an overall mean below the aggregate mean of 3.85.

4.4.2 Supply Chain Performance (SCP)

Five reliable and valid items were used to assess SCP based on the perception of the participants. Hence, a five-point Likert scale response items were used to measure the agreement and disagreement levels of the managers regarding the company's supply chain performance. Throughout the responses recorded for the five items, the minimum was 1, being "strongly disagree" and the maximum of 5, relating to "strongly agree". With all the standard deviations above 1.0, it indicates that the variations in the responses for each of the items was highly dispersed from the central point (mean scores).

Table 4.6: Descriptive Analysis of Supply Chain Performance

Variables	Min	Max	Mean	Standard deviation
1. We give evidence that the materials used to make our goods were ethically and sustainably obtained or manufactured to our supply chain partners, as well as to our clients.	1	5	3.88	1.157
2. We have mapped our supply chain and given our customers and our supply chain partners the mapping data.	1	5	3.80	1.199
3. Our company predicts a rise in the performance of service and product quality growth.	1	5	3.77	1.289

4. Our business predicts a rise in the proportion of services and goods delivered on time.	1	5	3.75	1.265
5. In terms of service, product, and content diversity, our company predicts further growth.	1	5	3.98	1.088
Overall Mean			***3.84***	***1.200***

Source: Field Data, 2022

To characterise respondents' opinions on SCP in this area of the analysis, descriptive methodology (mean and standard deviations) was used. All of the items appear to assess SCP, according to the results shown in Table 4.6. Based on the responses, the item; "our company anticipates growth in the level of service, product, and content variety" scores a mean of 3.98, followed by "we offer our supply chain suppliers and our customers with information that demonstrates that the materials used to produce our products are ethically and sustainably sourced or produced" with a mean score of 3.88. Additionally, the average score obtained after mapping "our supply chain and sharing the mapping data with our consumers and supply chain partners" is 3.80. "Our company projects a rise in the performance" score mean of 3.77 for service and product quality. With a mean score of 3.75 for both services and products, our company predicts growth in on-time delivery. The outcomes demonstrated that indicators of supply chain performance were identified as having an overall mean below the aggregate mean of 3. 84.

4.4.3 Blockchain Application

Seven valid factors were utilised to evaluate the blockchain application once the validity and reliability tests were completed. Managers of the manufacturing firms were presented with a five-point Likert scale to measure the agreement and disagreement levels of the respondents regarding their firm's usage of blockchain technology. Field survey results in Table 4.7 indicated that some of the respondents strongly disagreed which recorded 1 as the minimum, while others strongly agreed with a score of 5 as the maximum response. With all the standard deviations below 1.0, it indicates that the variations in the responses for each of the items was less dispersed from the central point (mean scores).

Table 4.7: Descriptive Analysis of Blockchain Application

Variables	**Min**	**Max**	**Mean**	**Standard deviation**

1. As goods move through the supply chain, we securely capture transaction data using blockchain technology.	1	5	4.22	0.937
2. With our supply chain partners, we employ blockchain technology to speed up the completion of complicated transactions.	1	5	4.14	0.901
3. With our supply chain partners, we employ blockchain technology to lower the costs of settling complicated transactions.	1	5	4.16	0.949
4. We employ blockchain technology to increase privacy and to make sound more audible.	1	5	4.09	0.903
5. By utilising blockchain technology, we can improve operational effectiveness.	1	5	4.17	0.974
6. By utilising blockchain, we can increase the security of the information platforms that our supply chain partners utilise to exchange information.	1	5	4.03	0.985
7. As goods move through the supply chain, we securely capture transaction data using blockchain technology.	1	5	4.17	0.904
Overall Mean			***4.14***	***0.936***

Source: Field Data, 2022

To explain respondents' opinions on blockchain applications, this component of the analysis used a descriptive technique (mean and standard deviations). Nevertheless, Table 4.7 results showed that all the metrics measured the blockchain application. "Incorporating BT within the supply chain to reliably capture transaction data", however, receives a mean score of 4.22, followed by "the use of BT to enhance effectiveness" and "BT is being used to enhance the safety of our data sharing platforms across supply chain partners", both of which receive a mean score of 4.17. "Using blockchain technology to cut expenses associated with handling complicated transactions with our supply chain partners" also receives a mean score of 4.16. "We use blockchain technology to cut down on the 4.14 days needed to finish complicated transactions with our supply chain partners". "We employ BT to improve privacy and received a mean score of 4.09. By utilising blockchain technology, we can improve operational effectiveness" scored 4.03). The findings demonstrated that measures of blockchain application were found to have an overall mean below the aggregate mean of 4.14.

4.5 Structural Model Analysis and Hypotheses Testing

After confirming the reliability and validity of the latent variables, the next is to present the structural model. The structural model consists of direct and mediation tests to generate evidence in support of the hypotheses.

Table 4.8: Structural Equation Model Result

Construct	T value	Mean	S. D	R^2	P values
Direct effect					
Blockchain Applications -> Procurement Effectiveness	17.100	0.776	0.045	0.598	0.000
Blockchain Applications -> Supply Chain Performance	4.851	0.296	0.062	0.827	0.000
Procurement Effectiveness -> Supply Chain Performance	11.058	0.661	0.060	0.495	0.000
Total Indirect effect (mediation)					
Blockchain Applications -> Procurement Effectiveness -> Supply Chain Performance	8.990	0.513	0.057	0.447	0.000

Source: Field Survey (2022)

4.5.1 Direct Effect of Blockchain Application on SC Performance

The T-value of 4.851 suggests a statistically significant positive relationship between the use of Blockchain Applications and Supply Chain Performance. The mean effect size is 0.296, indicating a moderate positive effect. The R^2 value of 0.827 shows that approximately 82.7% of the variance in Supply Chain Performance is explained by Blockchain Applications. The p-value of 0.000 indicates the high statistical significance of this relationship. This signifies that as the use of Blockchain Applications increases or improves, Supply Chain Performance tends to improve as well. This also suggests that organizations or systems that utilize blockchain technology in their supply chain operations are more likely to experience positive outcomes in terms of supply chain performance metrics such as efficiency, reliability, and cost-effectiveness.

4.5.2 Direct Effect of Blockchain Application on Procurement Effectiveness

The T-value of 17.100 indicates a statistically significant positive relationship between the use of Blockchain Applications and Procurement Effectiveness. The mean effect size is 0.776, which suggests a strong positive effect. The R^2 value of 0.598 implies that approximately 59.8% of the variance in Procurement Effectiveness can be explained by Blockchain Applications. The p-value of 0.000 indicates the high statistical significance of this relationship. This signifies that as the use of Blockchain Applications increases or

becomes more prevalent, Procurement Effectiveness tends to improve as well. The result also suggests that organizations or systems that leverage blockchain technology in their procurement activities are more likely to experience positive outcomes, such as streamlined processes, reduced errors, enhanced transparency, or improved supplier relationships.

4.5.3 Effect of Procurement Effectiveness on SC Performance

The T-value of 11.058 indicates a statistically significant positive relationship between Procurement Effectiveness and Supply Chain Performance. The mean effect size is 0.661, indicating a strong positive effect. The R^2 value of 0.495 suggests that approximately 49.5% of the variance in Supply Chain Performance can be explained by Procurement Effectiveness. The p-value of 0.000 indicates the high statistical significance of this relationship. This signifies that as Procurement Effectiveness improves or becomes more efficient and effective, Supply Chain Performance tends to improve as well. This suggests that organizations that excel in procurement activities, such as supplier management, sourcing, and purchasing, are more likely to experience positive outcomes in their supply chain performance, including aspects like cost control, product quality, and delivery reliability.

4.5.4 Indirect Mediating Role of Procurement Effectiveness

The T-value of 8.990 indicates a highly statistically significant indirect effect involving Blockchain Applications, Procurement Effectiveness, and Supply Chain Performance. This implies that procurement effectiveness positively mediates the link between blockchain applications and SC performance. The mean effect size for this mediation effect is 0.513, suggesting a moderate positive effect. The R^2 value of 0.447 indicates that approximately 44.7% of the variance in Supply Chain Performance can be explained by this mediation path. The p-value of 0.000 underscores the high statistical significance of this mediation effect. This indicates that procurement effectiveness enhances or amplifies the positive impact of blockchain applications on supply chain performance. This also suggests that the benefits of blockchain applications in terms of supply chain performance are realized, at least in part, through their positive impact on procurement effectiveness. Therefore, organizations looking to maximize the advantages of blockchain in their supply chain should also focus on improving procurement practices.

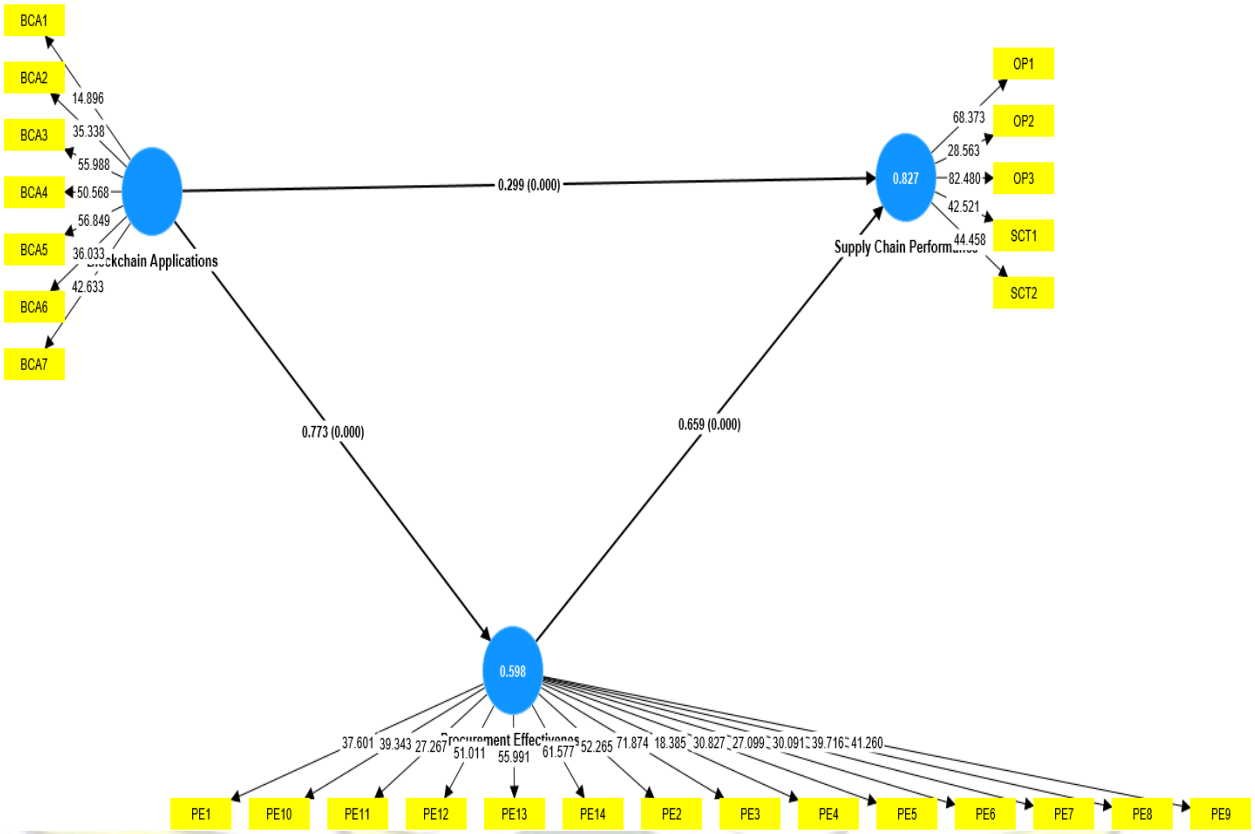

Figure 4.1: Structure Model Evaluation

4.6 Discussion of Findings

In this part, we compare and contrast the study's results with the current literature. It explains how blockchain application on SCP by analysing the purpose of procurement effectiveness as a mediator. The research goes on to explore the objectives of the connection between blockchain application, procurement effectiveness, and supply chain performance.

4.6.1 Effect of Blockchain Application on SC Performance

The study examined the impact of blockchain applications on SCP. The result demonstrated that there was a positive significant direct influence on the blockchain application to supply chain performance. With a positive path coefficient, this implies that supply chain performance will increase as blockchain application increases. It is noteworthy that although blockchain presents numerous benefits in enhancing supply chain efficiency, its adoption can present certain obstacles such as the connection with pre-existing systems, issues regarding scalability, and the necessity for the establishment

of industry-wide standards. Nevertheless, as this technology continues to develop and becomes more widely accepted, these obstacles are increasingly being resolved.

In general, blockchain technology possesses the capacity to fundamentally transform supply chain management and yield substantial enhancements in its operational efficiency across diverse sectors. The use of blockchain technology (BT) in logistics and supply chains has received a lot of interest. Although there has been overstated excitement, global supply chain/logistics deployment of continuous BT is expected to increase (Rawat et al., 2020). The technique has a number of advantages, including lower costs (Kshetri, 2019), improved sustainability (Saberi et al., 2019), and commercial viability. By encouraging customer and organisation engagement, BT helps businesses improve their sourcing and recycling procedures, which raises the bar for CSR (Franca et al., 2020). BT may significantly reduce costs by improving operational efficiency (Iansiti and Lakhani, 2017). Connecting companies involved in the supply chain encourages the integration of information, logistical, and commodity flows, which lowers operational costs. By using fewer suppliers, BT may achieve supply chain disintermediation and eradicate supply chain waste (Saberi et al., 2019).

Additionally, improvements in BT increase supply chain resilience by boosting visibility and enabling improved supply chain forecasts (Min, 2019). By providing cash incentives in the form of cryptocurrencies, BT is utilised to encourage clients. More people deposit recyclable materials like plastic, containers, and cans as a consequence, which boosts consumer perception of environmentally friendly products and procedures (Saberi et al., 2019). Businesses may utilise BT to improve consumer interactions, boost sustainability and corporate transparency, and reduce common mistakes along the supply chain (Bai and Sarkis, 2020). Information technology, like BT, enables information performance (Korpela et al., 2017). BT might be used to gather data. If shared among many firms, accumulated data may be utilised as a sort of feedback to enhance the functioning of and results achieved by an organisation (Fawcett et al., 2007). According to Babich and Hilary (2020), BT compiles data that may be handled in a closed-loop system regarding a product's lifecycle from conception through recycling (Sankaran, 2019).

This finding corroborates with the resource-based view theory, which posits that both internal and external resources such as employees and technology adoption of firms are

tools that can be used to spur sustainable competitive advantage. In the case of this study, blockchain applications are considered valuable resources that positively contribute to the supply chain performance of the firm. Thus, the theory shed light in terms of how firms can utilize their resources in the perspective of their capacity to innovate, to gain enhanced performance. Hence, with the positive link between blockchain and supply chain performance, it can be concluded that based on the RBV theory, blockchain applications are external resources that firms can leverage on to boost their supply chain processes. With this technology, firms can easily track and keep accurate record of their inventory and supply chain processes.

4.6.2 Effect of Blockchain Application on Procurement Effectiveness

The second objective of the research is to determine how blockchain technologies influence the efficiency of procurement processes. There was shown to be a direct and favourable effect of the blockchain application on the efficiency of procurement processes. The positive path coefficient means that the efficiency of procurement processes will increase as blockchain application increases. The integration of blockchain technology into procurement processes has been found to have a notable positive impact on their effectiveness. This influence yields several advantages, such as heightened transparency, diminished instances of fraudulent activities, financial savings, enhanced adherence to regulations, and bolstered faith in procurement procedures. Nevertheless, organisations must confront the obstacles associated with integration and carefully evaluate the ecological consequences of blockchain adoption in their procurement practices.

Blockchain technology has the ability to revolutionise the whole supply chain, from the acquisition of raw materials through delivery to customers (Goyat et al., 2019). This is because of its traits of openness, veracity, trustworthiness, security, cost-savings, competitive markets, efficient operations, and less waste (Philipp et al., 2019). Operational efficiency may be achieved by using blockchain technology for supply chain traceability in a variety of ways, including error reduction, process simplification, increased supply chain visibility, and better order fulfilment (Hastig and Sodhi, 2020). By facilitating the exchange of information, traceability can contribute to supply chain efficiency. Using blockchain in the supply chain improves efficiency since it lowers costs

associated with inventory management, supply network management, transportation, and procurement. Because a mediator or other third-party intermediary is not necessary in the blockchain-based supply chain system, transaction costs are reduced. Using blockchain technology in the logistics and supply chain has been recognised as being enabled by decreased transaction costs (Lines et al., 2017). The use of blockchain in supply chains not only boosts effectiveness and lowers costs, but also builds trust, streamlines associated business processes, enhances relationships between all stakeholders, lowers stock-out levels, speeds up responses, boosts competitiveness, and increases effectiveness (Queiroz et al., 2019; Madhani, 2021b).

This positive effect of blockchain applications on procurement performance is further supported by the dynamic capability theory. This theory as propounded by Teece, Pisano and Shuen (1997) refers to an organization's means of adapting to a dynamic and ever-changing business climate by combining and reorganising its internal and external talents. Additionally, among the dynamic talents is the ability to recognise and mould promising developments, seize opportunities and sustain competitive advantage via improving, safeguarding, combining, and reconfiguring the resources of the firm. Thus, with the highly competitive market, businesses have found solace in leveraging cutting-edge technologies to streamline their operations. One such operation is the procurement process. Thus, blockchain technology and procurement process efficiency have been cited as dynamic capabilities which result as a direct outcome of enterprises' innate configuration and redesign production and operations of the firm. Based on this theory, there should be a causal relationship between blockchain technology and procurement process efficiency through the lens of DCT. Therefore, the current study findings confirm the dynamic capability theory (1997). The positive relationship also implies that firms are beginning to adapt to technological changes. Thus, DCT emphasises the significance of projecting changes in the external environment and responding positively to those changes.

4.6.3 Effect of Procurement Effectiveness on SC Performance

The study's third objective determine the effect of procurement effectiveness on SCP. The finding disclosed that there was a positive significant direct influence on the

procurement effectiveness to SC performance. The positive path coefficient means that SC performance will increase as procurement effectiveness increases.

A positive and statistically significant direct influence on the effectiveness of procurement might result in a cascading effect that positively impacts the whole performance of the supply chain. The process of procurement holds significant importance within the supply chain, as its efficient and effective functioning can yield various advantageous outcomes for the entire supply chain. It is imperative to acknowledge that the impact of procurement on supply chain performance is not unidirectional. The effectiveness of procurement can be influenced by the performance of the supply chain. Instances such as variations in demand, delays in production, or disruptions in logistics might pose challenges to the procurement department's capability to efficiently obtain materials and goods.

In summary, the effectiveness of procurement plays a crucial role in determining the entire performance of the supply chain. When the procurement process operates at its highest level of efficiency, it has the potential to result in financial savings, greater product quality, strengthened supplier partnerships, and increased flexibility within the supply chain. These outcomes eventually have a positive impact on the whole supply chain, leading to its overall success. The numerous procurement systems that contribute to integrated information management provide rapid and simple access to integrated, consistent, and trustworthy data for procurement specialists (Gattiker and Goodhue, 2004). The accessible apps are available at every level of the purchase process. For instance, the deliver-to-pay and source-to-pay procedures are relatively common across a range of industries and may be carried out by a variety of applications. Enterprise resource planning (ERP), e-sourcing, order/delivery tracking, billing, and other such applications are a few examples of the kind utilised in operations management.

E-sourcing is the process of using the Internet to identify fresh suppliers to meet particular kinds of procurement demands. An e-tendering tool is also a component of an e-sourcing solution. It is used in the e-tendering process, in which a business seeks details from potential suppliers, such as product specs and price, and then electronically gets their reply (De Boer et al., 2002). Providers can compete for business in this fashion by submitting bids, with the lowest bidder or other variables frequently making the final

decision (Smart, 2010). To achieve a comprehensive digital transformation, supply chain management should encourage departmental collaboration, the management of outside resources, and the development of supply market knowledge rather than concentrating on specific applications (Srai and Lorentz, 2019).

4.6.4 Mediating Role of Procurement Effectiveness

The study's fourth objective tests the mediating influence of procurement effectiveness on the link between blockchain applications and SCP. The results revealed that procurement effectiveness positively mediates the link between blockchain applications to SC performance. The positive path coefficient means that procurement effectiveness plays an important mediating role in the link between blockchain applications to SC performance. Blockchain technologies provide the chance to simplify, digitalize, and streamline sluggish, lower-tier manual operations (Wang et al. 2019). They may also give managers better insight across supply chain processes, increased product traceability, and transparency throughout procurement, manufacturing, and fulfilment (Tian 2016; Bocek et al. 2017; Casey and Wong 2017). Early research by Kshetri (2018) shows a connection between supply chain operations using blockchain and increased cost, speed, reliability, risk reduction, sustainability, and flexibility.

The positive mediating role of procurement effectiveness implies that a positive effect of blockchain application on supply chain performance is contingent on the effectiveness of the procurement process. Thus, when the procurement processes are characterized by efficient human and capital resources, this will lay a good foundation for blockchain applications to have a significant influence on supply chain processes. Likewise, when management has total support for innovation, it propels the role of blockchain applications in the supply chain process. Theoretically, this study finding confirms the contingency theory, which emphasises that the effectiveness of blockchain applications may be contingent upon their alignment with specific supply chain characteristics. Also, the specific context in which the blockchain application is implemented has a significant influence on its effect in enhancing supply chain performance.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the summary of the key findings obtained in the previous chapter, the conclusions of the study, and recommendations for managers in the manufacturing industry. Some suggestions for future research are also discussed.

5.2 Summary of Findings

This study examined the role of procurement effectiveness as a mediator to examine the effect of blockchain applications on SCP. The study was guided by three objectives, the results are therefore summarised in line with the objectives below.

5.2.1 Effect of Blockchain Applications on Supply Chain Performance

The study's first objective examines the impact of blockchain applications on SCP. The result demonstrated that there was a positive significant direct influence on the blockchain application to supply chain performance. With a positive path coefficient, this implies that supply chain performance will increase as blockchain application increases.

5.2.2 Effect of Blockchain Applications on Procurement Effectiveness

The second objective of the research is to determine how blockchain technologies influence the efficiency of procurement processes. There was shown to be a direct and favourable effect of the blockchain application on procurement effectiveness. The positive path coefficient means that procurement effectiveness will increase as blockchain application increases.

5.2.3 Effect of Procurement Effectiveness on Supply Chain Performance

The study's third objective determine the effect of procurement effectiveness on SCP. The finding disclosed that there was a positive significant direct influence on the procurement effectiveness to SC performance. The positive path coefficient means that SC performance will increase as procurement effectiveness increases.

5.2.4 Mediating Effect of Procurement Effectiveness on the Relationship between Blockchain Applications and Supply Chain Performance

The study's fourth objective tests the mediating influence of procurement effectiveness on the link between blockchain applications and SCP. The results revealed that procurement effectiveness positively mediates the link between blockchain applications to SC performance. The positive path coefficient means that procurement effectiveness plays an important mediating role in the link between blockchain applications to SC performance.

5.3 Conclusion

This study examined the role of procurement effectiveness in the relationship between blockchain applications and supply chain performance. Cross-sectional survey data was gathered from 136 participants who were purposive sampled. A structured questionnaire was used in gathering data for the study. The Statistical Package for Social Sciences (SPSS) and SmartPLS were used to analyse the data. The outcome demonstrated that blockchain applications significantly enhance both procurement efficiency and supply chain performance. This implies that in practice when firms increase their usage of blockchain applications, it goes a long way to boost the efficiency of their procurement as well as improve the performance of their supply chain. The findings further showed that procurement effectiveness mediated the relationship between blockchain application and SC performance. This means that practically, the benefits firms gain in the application of blockchain are contingent on the effectiveness of procurement processes. Thus, for firms to attain the total benefits as they adopt blockchain applications, the effectiveness of their procurement processes which include providing sufficient resource allocation, efficient human capital supply and managerial support for the procurement processes should be enhanced. The current finding contributes to knowledge by pioneering this study on the mediating effect of procurement effectiveness on the link between supply chain and blockchain application. Thus, policymakers and industry players should emphasise the use of blockchain applications in the supply chain and procurement processes as a means to revolutionize the manufacturing industry. The study concludes that though blockchain applications enhance supply chain performance, optimal supply chain performance from blockchain applications can be achieved via an effective procurement process.

5.4 Recommendation

The researcher gives suggestions for management and future research based on findings and conclusions produced throughout the rest of the report.

5.4.1 Recommendation for Management

The result disclosed that there was a positive substantial direct influence of the blockchain application on procurement effectiveness. The study therefore recommends that before implementing BCT, managers should carefully consider the components of SC cooperation.

Also, managers should adopt blockchain applications, including those for software development, cryptography, and database technology, to increase SC performance and procurement effectiveness, as the study's findings showed that there was a positive significant direct influence on the blockchain application.

Furthermore, enterprises can keep track of the whereabouts and activities of all nodes in their supply chain with a blockchain-powered distributed ledger that updates in real time. Therefore, the study recommends that through evaluating their strategic plans, organisations should spend the necessary resources and energy to implement them.

5.4.2 Recommendations for Future Studies

Due to the cross-sectional nature of the data obtained, it is difficult to determine causation between the variables in this study. This flaw could be addressed in future studies by employing a longitudinal design. Furthermore, the research analyzed the influence of blockchain applications on SCP using quantitative approaches by examining the function of procurement effectiveness as a mediator. A qualitative technique may be used to carry out the same research and analyze the influence of blockchain applications on SCP by examining the function of procurement effectiveness as a mediator. According to the study, further statistical analysis approaches could be used in future research to investigate the impact of blockchain procurement on SCP by studying the role of procurement as a mediator.

REFERENCES

Abbas, K., Afaq, M., Ahmed Khan, T. and Song, W.C., (2020). A blockchain and machine learning-based drug supply chain management and recommendation system for the smart pharmaceutical industry. *Electronics*, *9*(5), p.852.

Abidi, M. H., Alkhalefah, H., Umer, U., and Mohammed, M. K. (2021). Blockchain-based secure information sharing for supply chain management: Optimization assisted data sanitization process. *International journal of intelligent systems*, *36*(1), 260-290.

Abou Maroun, E., Daniel, J., Zowghi, D., and Talaei-Khoei, A. (2018). Blockchain in supply chain management: Australian manufacturer case study. In *Service Research and Innovation* (pp. 93-107). Springer, Cham.

Afraz, M.F., Bhatti, S.H., Ferraris, A. and Couturier, J., (2021). The impact of supply chain innovation on competitive advantage in the construction industry: Evidence from a moderated multi-mediation model. *Technological Forecasting and Social Change*, *162*, p.120370.

Afriyie, S., Du, J. and Ibn Musah, A.A., (2019). Innovation and marketing performance of SME in an emerging economy: the moderating effect of transformational leadership. *Journal of Global Entrepreneurship Research*, *9*(1), pp.1-25.

Agi, M.A. and Nishant, R., (2017). Understanding influential factors on implementing green supply chain management practices: An interpretive structural modelling analysis. *Journal of environmental management*, *188*, pp.351-363.

Ahmad A. A. Khanfar;Mohammad Iranmanesh;Morteza Ghobakhloo;Madugoda Gunaratnege Senali;Masood Fathi (2021). Applications of Blockchain Technology in Sustainable Manufacturing and Supply Chain Management: A Systematic Review. Sustainability

Ahmad, S., Miskon, S., Alabdan, R., and Tlili, I. (2020). Towards sustainable textile and apparel industry: Exploring the role of business intelligence systems in the era of industry 4.0. *Sustainability*, *12*(7), 2632.

Akaranga, S.I. and Makau, B.K., (2016). Ethical considerations and their applications to research a case of the University of Nairobi.

Alegre, J., Sengupta, K. and Lapiedra, R., 2013. Knowledge management and innovation performance in a high-tech SMEs industry. *International small business journal*, *31*(4), pp.454-470.

Al-Shboul, M.D.A., (2017). Infrastructure framework and manufacturing supply chain agility: the role of delivery dependability and time to market. *Supply Chain Management: An International Journal*, *22*(2), pp.172-185.

Altay, N., Gunasekaran, A., Dubey, R. and Childe, S.J., (2018). Agility and resilience as antecedents of supply chain performance under moderating effects of organizational culture within the humanitarian setting: a dynamic capability view. *Production Planning and Control*, *29*(14), pp.1158-1174.

Ambekar, S.S., Deshmukh, U. and Hudnurkar, M., (2020). Impact of purchasing practices, supplier relationships and use of information technology on firm performance. *International Journal of Innovation Science*.

Ammous, S., (2016). Blockchain technology: What is it good for? *Available at SSRN 2832751*.

Angraal, S., Krumholz, H. M., and Schulz, W. L. (2017). Blockchain technology: applications in health care. *Circulation: Cardiovascular quality and outcomes*, *10*(9), e003800.

Arim Park; Huan Li; (2021). The Effect of Blockchain Technology on Supply Chain Sustainability Performances. Sustainability

Arntzen, B.C., Brown, G.G., Harrison, T.P. and Trafton, L.L., (1995). Global supply chain management at Digital Equipment Corporation. *Interfaces*, *25*(1), pp.69-93.

Arslanagic-Kalajdzic, M., Balboni, B., Kadic-Maglajlic, S. and Bortoluzzi, G., (2017). Product innovation capability, export scope and export experience: Quadratic and moderating effects in firms from developing countries. *European Business Review*, *29*(6), pp.680-696.

Babbie, E., (2015). *Observing ourselves: Essays in social research*. Waveland Press.

Babich, V., and Hilary, G. (2019). Blockchain and other distributed ledger technologies in operations. *Foundations and Trends® in Technology, Information and Operations Management*, *12*(2-3), 152-172.

Babich, V., and Hilary, G. (2020). OM Forum—Distributed ledgers and operations: What operations management researchers should know about blockchain technology. *Manufacturing and Service Operations Management*, *22*(2), 223-240.

Bag, S., Wood, L.C., Xu, L., Dhamija, P. and Kayikci, Y., (2020). Big data analytics as an operational excellence approach to enhance sustainable supply chain performance. *Resources, Conservation and Recycling*, *153*, p.104559.

Bai, C., and Sarkis, J. (2020). A supply chain transparency and sustainability technology appraisal model for blockchain technology. *International Journal of Production Research*, *58*(7), 2142-2162.

Baltacioglu, T., Ada, E., Kaplan, M.D., Yurt and, O. and Cem Kaplan, Y., (2007). A new framework for service supply chains. *The Service Industries Journal*, *27*(2), pp.105-124.

Banerjee, S., Walder, F., Büchi, L., Meyer, M., Held, A.Y., Gattinger, A., Keller, T., Charles, R. and van der Heijden, M.G., (2019). Agricultural intensification reduces microbial network complexity and the abundance of keystone taxa in roots. *The ISME journal*, *13*(7), pp.1722-1736.

Barclay, M.J. and Smith Jr, C.W., (1995). The maturity structure of corporate debt. *The Journal of Finance*, *50*(2), pp.609-631.

Barney, J., (1991). Firm resources and sustained competitive advantage. *Journal of management*, *17*(1), pp.99-120.

Barney, J.B., (2001). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of management*, *27*(6), pp.643-650.

Berkeley, S., Bender, W.N., Gregg Peaster, L. and Saunders, L., (2009). Implementation of response to intervention: A snapshot of progress. *Journal of learning disabilities*, *42*(1), pp.85-95.

Berneis, M., Bartsch, D. and Winkler, H., (2021). Applications of Blockchain Technology in Logistics and Supply Chain Management—Insights from a Systematic Literature Review. Logistics, 5(3), p.43.

Bhattacherjee, A., (2012). Social science research: Principles, methods, and practices.

Bhushan, B., Khamparia, A., Sagayam, K. M., Sharma, S. K., Ahad, M. A., and Debnath, N. C. (2020). Blockchain for smart cities: A review of architectures, integration trends and future research directions. *Sustainable Cities and Society*, *61*, 102360.

Bienhaus, F., and Haddud, A. (2018). Procurement 4.0: factors influencing the digitisation of procurement and supply chains. *Business Process Management Journal*.

Blome, C., Schoenherr, T. and Rexhausen, D., (2013). Antecedents and enablers of supply chain agility and its effect on performance: a dynamic capabilities perspective. *International Journal of Production Research*, *51*(4), pp.1295-1318.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. Guilford publications.

Busse, C. (2016). Doing well by doing good? The self-interest of buying firms and sustainable supply chain management. *Journal of Supply Chain Management*, *52*(2), 28-47.

Casey, M. J., and Wong, P. (2017). Global supply chains are about to get better, thanks to blockchain. *Harvard business review*, *13*, 1-6.

Casey, M.J. and Wong, P. (2017). Global supply chains are about to get better", Harvard Business Review, available at: https://hbr.org/2017/03/global-supply-chains-are-about-toget-better-thanks-to-blockchain/

Chin, W.W., 1998. Commentary: Issues and opinions on structural equation modeling. *MIS quarterly*, pp.7-16.

Cho, I. and Blaser, M.J., (2012). The human microbiome: at the interface of health and disease. *Nature Reviews Genetics*, *13*(4), pp.260-270.

Cole, R., Stevenson, M., and Aitken, J. (2019). Blockchain technology: implications for operations and supply chain management. *Supply Chain Management: An International Journal*.

Cooper, D.R., Schindler, P.S. and Sun, J., 2006. *Business research methods* (Vol. 9, pp. 1-744). New York: Mcgraw-hill.

Creswell, J.W., 2009. Mapping the field of mixed methods research. *Journal of mixed methods research*, *3*(2), pp.95-108.

Creswell, J.W., 2014. *A concise introduction to mixed methods research*. SAGE publications.

Cronbach, L.J., 1951. Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), pp.297-334.

Crosby, M., Pattanayak, P., Verma, S. and Kalyanaraman, V., 2016. Blockchain technology: Beyond bitcoin. *Applied Innovation*, *2*(6-10), p.71.

Danneels, E., 2002. The dynamics of product innovation and firm competences. *Strategic management journal*, *23*(12), pp.1095-1121.

Davidson, S., De Filippi, P. and Potts, J., 2016. Economics of blockchain. *Available at SSRN 2744751*.

Davis, P.J. and Simpson, E., 2017. Resource-based theory, competition and staff differentiation in Africa: Leveraging employees as a source of sustained competitive advantage. *American Journal of Management*, *17*(1), pp.19-33.

Dey, P.K., Malesios, C., De, D., Budhwar, P., Chowdhury, S. and Cheffi, W., 2020. Circular economy to enhance sustainability of small and medium-sized enterprises. *Business Strategy and the Environment*, *29*(6), pp.2145-2169.

Di Vaio, A., and Varriale, L. (2020). Blockchain technology in supply chain management for sustainable performance: Evidence from the airport industry. *International Journal of Information Management*, *52*, 102014.

Dikko, M., 2016. Establishing construct validity and reliability: Pilot testing of a qualitative interview for research in Takaful (Islamic insurance). *The qualitative report*, *21*(3), pp.521-529.

Dolgui, A., Ivanov, D. and Sokolov, B., 2018. Ripple effect in the supply chain: an analysis and recent literature. *International Journal of Production Research*, *56*(1-2), pp.414-430.

Donkor, J., Donkor, G.N.A. and Kwarteng, C.K., 2018. Strategic planning and performance of SMEs in Ghana: The moderating effect of market dynamism. *Asia Pacific Journal of Innovation and Entrepreneurship*.

Eckstein, D., Goellner, M., Blome, C. and Henke, M., 2015. The performance impact of supply chain agility and supply chain adaptability: the moderating effect of product complexity. *International Journal of Production Research*, *53*(10), pp.3028-3046.

Falih Chichan, H. and Alabdullah, T.T.Y., 2021. Does environmental management accounting matter in promoting sustainable development? A study in Iraq. *Journal of Accounting Science*, *5*(2), pp.110-122.

Fawcett, S. E., Osterhaus, P., Magnan, G. M., Brau, J. C., and McCarter, M. W. (2007). Information sharing and supply chain performance: the role of connectivity and willingness. *Supply Chain Management: An International Journal*.

Fiati, H. M. (2019). *Sustainable Procurement Practices and Operational Performance of Manufacturing Firms in Ghana* (Doctoral dissertation, UCC).

Fornell, C. and Larcker, D.F., 1981. Structural equation models with unobservable variables and measurement error: Algebra and statistics

Fouka, G. and Mantzorou, M., 2011. What are the ethical issues in conducting research?

França, A. S. L., Neto, J. A., Gonçalves, R. F., and Almeida, C. M. V. B. (2020). Proposing the use of blockchain to improve the solid waste management in small municipalities. *Journal of Cleaner Production*, *244*, 118529.

Frederico, G.F., Garza-Reyes, J.A., Kumar, A. and Kumar, V., 2020. Performance measurement for supply chains in the Industry 4.0 era: a balanced scorecard approach. *International Journal of Productivity and Performance Management*, *70*(4), pp.789-807.

Froystad, P. and Holm, J., 2016. Blockchain: powering the internet of value. *Evry Labs*.

Giannakis, M. and Louis, M., 2011. A multi-agent based framework for supply chain risk management. *Journal of Purchasing and Supply Management*, *17*(1), pp.23-31.

Gohil, D., and Thakker, S. V. (2021). Blockchain-integrated technologies for solving supply chain challenges. *Modern Supply Chain Research and Applications*, *3*(2), 78-97.

Gong, D., Li, W., Hu, L.D., Luo, J.M., Shen, J.L., Fang, M.Y., Yang, Q.M., Wang, H.X., Ke, X.Y., Chen, H.R. and Wang, Z., 2017. Clinical features and prognosis of t (8; 21) AML patients in China: a multicenter retrospective study. *Zhongguo shi yan xue ye xue za zhi*, *25*(4), pp.980-986.

Goyat, R., Kumar, G., Rai, M. K., and Saha, R. (2019). Implications of blockchain technology in supply chain management. *Journal of System and Management Sciences*, *9*(3), 92-103.

Grant, A., Townend, M., Mulhern, R. and Short, N., 2010. *Cognitive behavioural therapy in mental health care*. Sage.

Graue, C., 2015. Qualitative data analysis. *International Journal of Sales, Retailing and Marketing*, *4*(9), pp.5-14.

Gu, C., Zhan, Y., Wang, J., Cai, Y., Cao, Z. and Zhang, Q., 2020. Resilient and permanent deformation of unsaturated unbound granular materials under cyclic loading by the large-scale triaxial tests. *Acta Geotechnica*, *15*(12), pp.3343-3356.

Gurtu, A., and Johny, J. (2019). Potential of blockchain technology in supply chain management: a literature review. *International Journal of Physical Distribution and Logistics Management*.

Habib, M.K., Magruder-Habib, K.M. and Kupper, L.L., 1987. A review of sample size determination in comparative studies.

Hair Jr, J.F., Sarstedt, M., Hopkins, L. and Kuppelwieser, V.G., 2014. Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European business review*.

Hair Jr, J.F., Sarstedt, M., Matthews, L.M. and Ringle, C.M., 2016. Identifying and treating unobserved heterogeneity with FIMIX-PLS: part I–method. *European Business Review*.

Hair, J. F., Ringle, C. M., and Sarstedt, M. (2013). Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long range planning*, *46*(1-2), 1-12.

Hair, J.F., 2009. Multivariate data analysis.

Hair, J.F., Ortinau, D.J. and Harrison, D.E., 2010. *Essentials of marketing research* (Vol. 2). New York, NY: McGraw-Hill/Irwin.

Hastig, G. M., and Sodhi, M. S. (2020). Blockchain for supply chain traceability: Business requirements and critical success factors. *Production and Operations Management*, *29*(4), 935-954.

Henseler, J., Ringle, C.M. and Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science*, *43*(1), pp.115-135.

Henseler, J., Ringle, C.M. and Sinkovics, R.R., 2009. The use of partial least squares path modeling in international marketing. In *New challenges to international marketing*. Emerald Group Publishing Limited.

Hofbauer, G. and Sangl, A., 2019, December. Blockchain Technology and Application Possibilities in the Digital Transformation of Transaction Processes. In Forum Scientiae Oeconomia (Vol. 7, No. 4, pp. 25-40).

Hofmann, E., Strewe, U.M. and Bosia, N., 2018. Discussion—how does the full potential of blockchain technology in supply chain finance look like?. In *Supply chain finance and blockchain technology* (pp. 77-87). Springer, Cham.

Hult, G.T.M., Hair Jr, J.F., Proksch, D., Sarstedt, M., Pinkwart, A. and Ringle, C.M., 2018. Addressing endogeneity in international marketing applications of partial least squares structural equation modeling. *Journal of International Marketing*, *26*(3), pp.1-21.

Iansiti, M. and Lakhani, K.R. (2017). "The truth about blockchain", Harvard Business Review, Vol. 95 No. 1, pp. 118-127.

Ighalo, J.O. and Adeniyi, A.G., 2020. A comprehensive review of water quality monitoring and assessment in Nigeria. Chemosphere, 260, p.127569.

Javidan, M., Dorfman, P.W., De Luque, M.S. and House, R.J., 2016. In the eye of the beholder: Cross-cultural lessons in leadership from Project GLOBE. In *Readings and Cases in International Human Resource Management* (pp. 119-154). Routledge

Jones, K. and Kaluarachchi, Y., 2008. Performance measurement and benchmarking of a major innovation programme. *Benchmarking: An International Journal*.

Joshi, A.P., Han, M. and Wang, Y., 2018. A survey on security and privacy issues of blockchain technology. *Mathematical foundations of computing*, *1*(2), p.121.

Kamble, S.S., Gunasekaran, A. and Gawankar, S.A., 2020. Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *International Journal of Production Economics*, *219*, pp.179-194.

Kamble, S.S., Gunasekaran, A. and Sharma, R., 2020. Modeling the blockchain enabled traceability in agriculture supply chain. *International Journal of Information Management*, *52*, p.101967.

Kamble, S.S., Gunasekaran, A., Subramanian, N., Ghadge, A., Belhadi, A. and Venkatesh, M., 2021. Blockchain technology's impact on supply chain integration and sustainable supply chain performance: Evidence from the automotive industry. Annals of Operations Research, pp.1-26.

Katiyar, R., Meena, P.L., Barua, M.K., Tibrewala, R. and Kumar, G., 2018. Impact of sustainability and manufacturing practices on supply chain performance: Findings from an emerging economy. *International Journal of Production Economics*, *197*, pp.303-316.

Kim, Joon-Seok; Shin, Nina (2019). The Impact of Blockchain Technology Application on Supply Chain Partnership and Performance. Sustainability

Kline, R. B. (2005). Principles and practice of structural equation modeling 2nd ed. *New York: Guilford*, *3*.

Korpela, K., Hallikas, J. and Dahlberg, T. (2017). Digital supply chain transformation toward blockchain integration, *Proceedings from the 50th HI International Conference on System Sciences*, Waikola, HI, available at: https://scholarspace.manoa.hawaii.edu/bitstream/10125/41666/paper0517.pdf/

Korpela, K., Hallikas, J. and Dahlberg, T., 2017, January. Digital supply chain transformation toward blockchain integration. In *proceedings of the 50th Hawaii international conference on system sciences*.

Kotrlik, J.W.K.J.W. and Higgins, C.C.H.C.C., 2001. Organizational research: Determining the appropriate sample size in survey research. *Information technology, learning, and performance journal*, *19*(1), p.43.

Krejcie, R.V. and Morgan, D.W., 1970. Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), pp.607-610.

Kshetri, N. (2018). 1 Blockchain's roles in meeting key supply chain management objectives. *International Journal of information management*, *39*, 80-89.

Kshetri, N. (2019). Blockchain and the economics of food safety. *It Professional*, *21*(3), 63-66.

Kshetri, N., 2018. 1 Blockchain's roles in meeting key supply chain management objectives. *International Journal of information management*, *39*, pp.80-89.

Kurpjuweit, S., Schmidt, C. G., Klöckner, M., and Wagner, S. M. (2021). Blockchain in additive manufacturing and its impact on supply chains. *Journal of Business Logistics*, *42*(1), 46-70.

Laskowski, M. and Kim, H.M., 2016, July. Rapid prototyping of a text mining application for cryptocurrency market intelligence. In *2016 IEEE 17th International Conference on Information Reuse and Integration (IRI)* (pp. 448-453). IEEE.

Leng, J., Ruan, G., Jiang, P., Xu, K., Liu, Q., Zhou, X., and Liu, C. (2020). Blockchain-empowered sustainable manufacturing and product lifecycle management in industry 4.0: A survey. *Renewable and sustainable energy reviews*, *132*, 110112.

Liao, Y. and Barnes, J., 2015. Knowledge acquisition and product innovation flexibility in SMEs. *Business Process Management Journal*.

Lillrank, P. and Särkkä, M., 2011. The service machine as a service operation framework. *Strategic Outsourcing: An International Journal*, *4*(3), pp.274-293.

Ling-Yee, L., 2007. Marketing resources and performance of exhibitor firms in trade shows: A contingent resource perspective. *Industrial Marketing Management*, *36*(3), pp.360-370.

Lonial, S.C. and Carter, R.E., 2015. The impact of organizational orientations on medium and small firm performance: A resource-based perspective. *Journal of Small Business Management*, *53*(1), pp.94-113.

Lysons, K. and Farrington, B., 2020. *Procurement and supply chain management*. Pearson UK.

Madhani, P. M. (2021). Supply chain transformation with blockchain deployment: enhancing efficiency and effectiveness. *IUP Journal of Supply Chain Management*, *18*(4), 7-32.

Maglio, P.P. and Spohrer, J., 2008. Fundamentals of service science. *Journal of the academy of marketing science*, *36*(1), pp.18-20.

Malhotra, N. and Birks, D.F., 2007. An applied approach. *Marketing research. London: Prentice Hall*.

Mani, V., Gunasekaran, A. and Delgado, C., 2018. Enhancing supply chain performance through supplier social sustainability: An emerging economy perspective. *International Journal of Production Economics*, *195*, pp.259-272.

Maull, E.A., Ahsan, H., Edwards, J., Longnecker, M.P., Navas-Acien, A., Pi, J., Silbergeld, E.K., Styblo, M., Tseng, C.H., Thayer, K.A. and Loomis, D., 2012. Evaluation of the association between arsenic and diabetes: a National Toxicology Program workshop review. *Environmental health perspectives*, *120*(12), pp.1658-1670.

Melville, N., Kraemer, K., and Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS quarterly*, 283-322.

Mensah, P. and Merkuryev, Y., 2014. Developing a resilient supply chain. *Procedia-Social and behavioral sciences*, *110*, pp.309-319.

Min, H. (2019). Blockchain technology for enhancing supply chain resilience. *Business Horizons*, *62*(1), 35-45.

Mondol, E. P. (2021). The Impact of Block Chain and Smart Inventory System on Supply Chain Performance at Retail Industry. *International Journal of Computations, Information and Manufacturing (IJCIM)*, *1*(1).

Mougayar, W., 2016. *The business blockchain: promise, practice, and application of the next Internet technology*. John Wiley and Sons.

Nandi, M.L., Nandi, S., Moya, H. and Kaynak, H., 2020. Blockchain technology-enabled supply chain systems and supply chain performance: a resource-based view", Supply Chain Management, *25*(6), pp. 841-862.

Ndiaye, N., Razak, L.A., Nagayev, R. and Ng, A., 2018. Demystifying small and medium enterprises' (SMEs) performance in emerging and developing economies. *Borsa Istanbul Review*, *18*(4), pp.269-281.

Ndolo, J. and Njagi, E., 2014. Role of ethics in procurement process effectiveness in the water sector in Kenya :(A Case Study of EWASCO, Embu County).

Newbert, S.L., 2007. Empirical research on the resource-based view of the firm: an assessment and suggestions for future research. *Strategic management journal*, *28*(2), pp.121-146.

Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., Mullany, E.C., Biryukov, S., Abbafati, C., Abera, S.F. and Abraham, J.P., 2014. Global, regional, and national prevalence of overweight and obesity in children and adults

during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The lancet*, *384*(9945), pp.766-781.

Njagi, L. and Kombo, H., 2014. Effect of strategy implementation on performance of commercial banks in Kenya. *European Journal of business and management*, *6*(13), pp.62-67.

Opoku, R. K., Fiati, H. M., Kaku, G., Ankomah, J., and Opoku-Agyemang, F. (2020). Inventory management practices and operational performance of manufacturing firms in Ghana. *Advances in Research*, *21*(10), 1-18.

Osei Sekyere, J., 2016. Current state of resistance to antibiotics of last-resort in South Africa: a review from a public health perspective. *Frontiers in public health*, *4*, p.209.

Panayides, P.M. and Lun, Y.V., 2009. The impact of trust on innovativeness and supply chain performance. *International journal of production Economics*, *122*(1), pp.35-46.

Park, A., and Li, H. (2021). The effect of blockchain technology on supply chain sustainability performances. *Sustainability*, *13*(4), 1726.

Paul, T., Mondal, S., Islam, N., and Rakshit, S. (2021). The impact of blockchain technology on the tea supply chain and its sustainable performance. *Technological Forecasting and Social Change*, *173*, 121163.

Peck, H., 2005. Drivers of supply chain vulnerability: an integrated framework. *International journal of physical distribution and logistics management*.

Peters, G.W. and Panayi, E., 2016. Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money. In *Banking beyond banks and money* (pp. 239-278). Springer, Cham.

Petersson, E. and Baur, K., 2018. Impacts of blockchain technology on supply chain collaboration: A study on the use of blockchain technology in supply chains and how it influences supply chain collaboration.

Philipp, R., Prause, G., and Gerlitz, L. (2019). Blockchain and smart contracts for entrepreneurial collaboration in maritime supply chains. *Transport and Telecommunication*, *20*(4), 365-378.

Pyke, D.F. and Cohen, M.A., 1994. Multiproduct integrated production—distribution systems. *European Journal of Operational Research*, *74*(1), pp.18-49.

Quaye, D.M. and Mensah, I., 2019. Entrepreneurial leadership and performance of female-owned small and medium-sized enterprises in Ghana. *International Journal of Entrepreneurship and Small Business*, *38*(1-2), pp.19-44.

Queiroz, M. M., Telles, R., and Bonilla, S. H. (2019). Blockchain and supply chain management integration: a systematic review of the literature. *Supply Chain Management: An International Journal*.

Raj, A., Dwivedi, G., Sharma, A., de Sousa Jabbour, A.B.L. and Rajak, S., 2020. Barriers to the adoption of industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective. *International Journal of Production Economics*, *224*, p.107546.

Raja Santhi, A., and Muthuswamy, P. (2022). Influence of blockchain technology in manufacturing supply chain and logistics. *Logistics*, *6*(1), 15.

Rawat, B., Chaudhary, D. V., and Doku, R. (2020). Blockchain technology: Emerging applications and use cases for secure and trustworthy smart systems. *Journal of Cybersecurity and Privacy*, *1*(1), 4-18.

Reijers, W. and Coeckelbergh, M., 2018. The blockchain as a narrative technology: Investigating the social ontology and normative configurations of cryptocurrencies. *Philosophy & Technology*, *31*, pp.103-130.

Rejeb, A., Keogh, J. G., and Treiblmaier, H. (2019). Leveraging the internet of things and blockchain technology in supply chain management. *Future Internet*, *11*(7), 161.

Ren, Z.J. and Zhou, Y.P., 2008. Call center outsourcing: Coordinating staffing level and service quality. *Management Science*, *54*(2), pp.369-383.

Saberi, S., Kouhizadeh, M., Sarkis, J., and Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research*, *57*(7), 2117-2135.

Saif, M.R., 2020. The effect of organizational culture on knowledge management and managerial performance of government department in Dubai. *European Journal of Multidisciplinary Studies*, *5*(1), pp.47-53.

Saini, S. and Singh, D., 2020. Impact of implementing lean practices on firm performance: a study of Northern India SMEs. *International Journal of Lean Six Sigma*, *11*(6), pp.1005-1034.

Saji, K.B. and Mishra, S.S., 2013. Investigating the role of firm resources and environmental variables in new product commercialization. *Journal of Product and Brand Management*.

Sankaran, K. (2019). Carbon emission and plastic pollution: how circular economy, blockchain, and artificial intelligence support energy transition? *Journal of Innovation Management*, *7*(4), 7-13.

Sarmiento, R., Sarkis, J. and Byrne, M., 2010. Manufacturing capabilities and performance: a critical analysis and review. *International Journal of Production Research*, *48*(5), pp.1267-1286.

Saunders, M.N. and Rojon, C., 2011. On the attributes of a critical literature review. *Coaching: An International Journal of Theory, Research, and Practice*, *4*(2), pp.156-162.

Sedgwick, P. (2015). Multistage sampling. *Bmj*, *351*.

Sezen, B., 2008. Relative effects of design, integration and information sharing on supply chain performance. *Supply chain management: An international journal*.

Sikorski, J.J., Haughton, J. and Kraft, M., 2017. Blockchain technology in the chemical industry: Machine-to-machine electricity market. *Applied energy*, *195*, pp.234-246.

Singh, K.P., Gupta, S. and Rai, P., 2013. Identifying pollution sources and predicting urban air quality using ensemble learning methods. *Atmospheric Environment*, *80*, pp.426-437.

Sirmon, D.G., Gove, S. and Hitt, M.A., 2008. Resource management in dyadic competitive rivalry: The effects of resource bundling and deployment. *Academy of management journal*, *51*(5), pp.919-935.

Sirmon, D.G., Hitt, M.A., Arregle, J.L. and Campbell, J.T., 2010. The dynamic interplay of capability strengths and weaknesses: investigating the bases of temporary competitive advantage. *Strategic Management Journal*, *31*(13), pp.1386-1409.

Smith, S.M. and Albaum, G.S., 2005. *Fundamentals of marketing research*. Sage.
Song, J. M., Sung, J., and Park, T. (2019). Applications of blockchain to improve supply chain traceability. *Procedia Computer Science, 162*, 119-122
Sönnichsen, S.D. and Clement, J., 2020. Review of green and sustainable public procurement: Towards circular public procurement. *Journal of cleaner production*, *245*, p.118901.
Sundram, V.P.K., Chandran, V.G.R. and Bhatti, M.A., 2016. Supply chain practices and performance: the indirect effects of supply chain integration. *Benchmarking: An International Journal*.
Taherdoost, H., 2016. Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in research. *How to test the validation of a questionnaire/survey in research (August 10, 2016)*.
Taouab, O. and Issor, Z., 2019. Firm performance: Definition and measurement models. *European Scientific Journal*, *15*(1), pp.93-106.
Tapscott, D. and Tapscott, A., 2017. How blockchain will change organizations. *MIT Sloan Management Review*, *58*(2), p.10.
Teece, D.J., Pisano, G. and Shuen, A., 1997. Dynamic capabilities and strategic management. *Strategic management journal*, *18*(7), pp.509-533.
Thio-ac, A., Serut, A. K., Torrejos, R. L., Rivo, K. D., and Velasco, J. (2019). Blockchain-based system evaluation: The effectiveness of blockchain on E-procurements. *arXiv preprint arXiv:1911.05399*.
Waithaka, R. K., and Kimani, J. G. (2021). Effect Of E-Procurement Practices On Supply Chain Performance. *Global Journal of Purchasing and Procurement Management*, *1*(1), 32-42.
Wang, M, Wang, B, and Abareshi, A. 2020. Blockchain Technology and Its Role in Enhancing Supply Chain Integration Capability and Reducing Carbon Emission: A Conceptual Framework. Sustainability, 12(24), 10550
Wang, X, & Cheng, Z. 2020. Cross-Sectional Studies. Chest, 158(1), S65–S71. doi: 10.1016/j.chest.2020.03.012
Wei, L.Q. and Lau, C.M., 2010. High-performance work systems and performance: The role of adaptive capability. *Human Relations*, *63*(10), pp.1487-1511.
West, J. and Bogers, M., 2014. Leveraging external sources of innovation: a review of research on open innovation. *Journal of product innovation management*, *31*(4), pp.814-831.
Wimmer, R.D. and Dominick, J.R., 2011. Mass media research: An introduction, international edition. *United Kingdom: Wadsworth Cengage Learning*.
Wu, H. J., and Dunn, S. C. 1995. Environmentally responsible logistics systems. *International journal of physical distribution and logistics management*.
Xu, M., Wang, Z., Wang, F., Hong, P., Wang, C., Ouyang, X., Zhu, C., Wei, Y., Hun, Y. and Fang, W., 2016. Fabrication of cerium doped Ti/nanoTiO2/PbO2 electrode with improved electrocatalytic activity and its application in organic degradation. *Electrochimica Acta*, *201*, pp.240-250.
Yamoah, E.E. and Arthur, S., 2014. The Three Leadership Models: Implications for 21st Century Leadership. *Singaporean Journal of Business Economics, and Management Studies*, *2*(10), pp.4-14.
Yaqoob, I., Salah, K., Jayaraman, R., and Al-Hammadi, Y. (2021). Blockchain for healthcare data management: opportunities, challenges, and future recommendations. *Neural Computing and Applications*, 1-16.

Yermack, D., 2017. Corporate governance and blockchains. *Review of finance*, *21*(1), pp.7-31.

Yeşil, S., Koska, A. and Büyükbeşe, T., 2013. Knowledge sharing process, innovation capability and innovation performance: An empirical study. *Procedia-Social and Behavioral Sciences*, *75*, pp.217-225.]

Yin, R.K., 2009. *Case study research: Design and methods* (Vol. 5). Sage.

Yousefi, S., and Tosarkani, B. M. (2022). An analytical approach for evaluating the impact of blockchain technology on sustainable supply chain performance. *International Journal of Production Economics*, *246*, 108429.

Zailani, S., Govindan, K., Iranmanesh, M., Shaharudin, M.R. and Chong, Y.S., 2015. Green innovation adoption in automotive supply chain: the Malaysian case. *Journal of Cleaner Production*, *108*, pp.1115-1122.

Zhu, J. and Mostafavi, A., 2017. Discovering complexity and emergent properties in project systems: A new approach to understanding project performance. *International journal of project management*, *35*(1), pp.1-12.

Zhu, Z., Zhao, J., and Bush, A. A. (2020). The effects of e-business processes in supply chain operations: Process component and value creation mechanisms. *International Journal of Information Management*, *50*, 273-285.

Zuhair, M., Smit, G.S.A., Wallis, G., Jabbar, F., Smith, C., Devleesschauwer, B. and Griffiths, P., 2019. Estimation of the worldwide seroprevalence of cytomegalovirus: A systematic review and meta-analysis. *Reviews in medical virology*, *29*(3), p.e2034.

APPENDIX

QUESTIONNAIRE

My name is Ampratwum Hubert Addo King, a postgraduate student at the Kwame Nkrumah University of Science and Technology, Kumasi, Department of Supply Chain and Information Systems. This survey instrument has been designed to enable me to research the topic: **"IMPACT OF BLOCKCHAIN APPLICATION ON PROCUREMENT PROCESS EFFECTIVENESS AND SUPPLY CHAIN PERFORMANCE. (A CASE STUDY OF MANUFACTURING FIRMS IN GHANA)**. Any information provided will be used for academic purposes ONLY. There are no risks associated with your participation, and your responses will remain confidential and anonymous.

Section A: Background Information

When completing this questionnaire, please tick **[√]** in the applicable box or provide an answer as applicable.

1. Gender: [ ] Male [ ] Female

2. Age: [ ] 23 years and below [ ] 24–29 years

   [ ] 30–35 years [ ] 36–40 years

   [ ] 41 years and above

3. Educational Background:

   [ ] No formal education [ ] Basic/Primary [ ] Secondary

   [ ] Bachelor's Degree [ ] Master's Degree [ ] Ph.D./Doctorate

4. Please, indicate the department you belong

   [ ] Procurement [ ] Marketing [ ] Supply chain [ ] Management [ ] others specify_____

5. Please indicate your position [ ] Top management [ ] Middle-level[ ] Junior level

6. Number of years the firm has been in operation:

   [ ] Less than 1 year [ ] 1-5 years [ ] 6-10 years

   [ ] 11-15 years [ ] 16-20 years [ ] 21 years & above

7. Number of years the firm has been in operation:

   [ ] Less than 1 year [ ] 1-5 years [ ] 6-10 years

   [ ] 11-15 years [ ] 16-20 years [ ] 21 years & above

8. Number of employees in the firm:

   [ ] Less than 6 employees [ ] 6-9 employees [ ] 10-29 employees

   [ ] 30-50 employees [ ] More than 50 employees

9. Type of ownership:

   [ ] Fully locally owned [ ] fully foreign-owned

   [ ] jointly Ghanaian & foreign-owned

Section B: Procurement Processing Effectiveness

These items measure your firm's procurement activities using a five-point Likert-type scale to indicate the extent to which you agree or disagree with each statement as applicable to your firm: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, and 5 = *Strongly Agree*.

Code	Statement	1	2	3	4	5
	Part A.General Resource Assessment					
PE1	There is an up-to-date procurement process manual for goods and works.					
PE2	There is qualified staff in the procurement department.					
PE3	The unit has adequate facilities such as PCs, internet connections, photocopy facilities, printers, etc. to undertake the expected procurement process.					
	Procurement Processes: Goods and Works					
PE4	There are established goods-receiving procedures.					
PE5	There are standard bidding documents in use.					
PE6	The procurement department registers and tracks warranty and latent defects liability periods.					

	Procurement Processes: Consulting Services					
PE7	The Terms of Reference follow a standard format such as background, tasks, inputs, objectives, and outputs.					
PE8	There is a consultants' selection committee formed with appropriate individuals in terms of procurement and technical expertise.					
	Process Oversight and Control					
PE9	There is a standard statement of ethics in the event of an oversight.					
PE10	There is a written auditable trail of procurement decisions in the event of an oversight.					
PE11	There is a formal non-judicial mechanism for dealing with complaints.					
	Records Keeping					
PE12	There is a referencing system for procurement files.					
PE13	Original contracts are secured in a fire and theft-proof location.					
PE14	Copies of bids, invoices, proposals, and complaints are easily retrievable even after years.					

Section C: Supply Chain Performance

These items measure your firm's supply chain performance using a five-point Likert-type scale to indicate the extent to which you agree or disagree with each statement as applicable to your firm: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, and 5 = *Strongly Agree*.

Code	Statement	1	2	3	4	5
	Supply Chain Transparency					
SCT1	We provide our supply chain partners and our customers with information that proves that the materials used to produce our products are responsibly and sustainably sourced and produced.					
SCT2	We have mapped our supply chain and provided the mapping information to our supply chain partners and our customers.					
OP1	**Operational Performance**					
OP2	There is an increase in the growth of service and product quality performance.					

OP3	There is an increase in the growth of on-time delivery of services and products.					
OP4	There is an increase in growth in the degree of service, product, and content variety.					

Section D: Blockchain Applications

These items measure your firm's blockchain applications using a five-point Likert-type scale to indicate the extent to which you agree or disagree with each statement as applicable to your firm: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, and 5 = *Strongly Agree*.

Code	Statement	1	2	3	4	5
BCA1	We use blockchain technology to securely record transaction data as products move through the supply chain.					
BCA2	We use blockchain technology to reduce the amount of time required to complete complex transactions with our supply chain partners.					
BCA3	We use blockchain technology to reduce the costs associated with resolving complex transactions with our supply chain partners.					
BCA4	We use blockchain technology to enhance privacy.					
BCA5	We use blockchain technology to improve audibility.					
BCA6	We use blockchain technology to increase operational efficiency.					
BCA7	We use blockchain to improve the security of our information systems used to share information among our supply chain partners.					

Thank you for participating in the survey.

Sample Table

Population	Service and manufacturing SMEs in Ghana
Sample Size	100 service and manufacturing firms
Sampling Technique(s)	Purposive and Convenient Sampling Techniques
Unit of Analysis	Firm Level
Respondent types	Line Managers in Logistics, Supply Chain department.
Respondent types	One respondent from one firm