**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI**

**College of Humanities and Social Science**

**School of Business**

# The effect of supply chain connectivity on eco supply chain: the mediating role of eco innovation in the mining industry of Ghana

by

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## DECLARATION

I hereby declare that this submission is my own work towards the Master of Science, Logistics and Supply Chain Management and that to the best of my knowledge, it contains no material previously published by another person nor material that has been accepted for the award of any other degree of the University, except where due acknowledgment has been made in the text.

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**(Head of Department, SCIS) Signature Date**

## DEDICATION

I dedicate this to myself, my entire family especially my parents, Mr. andMrs. Adjei, and to my wife and two lovely daughters

## ACKNOWLEDGEMENT

I would like to convey my deepest gratitude to the following people for inspiring me to embark on this study. My foremost thanks to my Supervisor, Prof. Kwame Owusu Kwateng, who has guided me through all phases of the study. His rigorous oversight and motivation have helped me to work to my maximum ability. I must also thank my formal boss, Mr.Joseph Darko Mantey, the Logistics manager of Olam Ghana Ltd without whose permission and goodwill, I would not have undertaken this study. I also appreciate the cooperation and support of my colleagues who have relentlessly provided and supported me during the whole time of my study. I would like to extend my appreciation to the Kwame Nkrumah University Science and Technology Graduate School of Business for availing such a flexible study program that could otherwise have been challenging for me to pursue my study. I wish to express my deepest gratitude to my instructors for their highly valuable knowledge transfer and deeply educational classroom. My parents, my wonderful and supportive wife, Emelia Martekor Akita, my sweet daughters, Nana Okyereaa Ayeyie Adjei and Adowa Pomaa Adjei are mentioned last only to emphasize the special nature of their extraordinary support during the course of my study and beyond

## ABSTRACT

The study aims to examine the role that eco-innovation in Ghana's mining industry plays as a mediator between supply chain connectivity and eco-supply chain. The quantitative data in the study were analysed using deductive reasoning, and the research design was a cross-sectional explanatory survey. The study's sampling processes, research equipment design, and analysis were all influenced by a quantitative methodology. The study's population referred to all of the permanent workers at the sampled Tarkwa Mining Enterprises. A total of 381 employees from mining and retail companies who have substantial first-hand knowledge of the issue under study filled out the survey. Using a method known as stratified sampling, the study chose the individuals who took part. The assumptions of the investigation were checked using Structural Equation Modeling (SmartPLS 4). Data were summarised using descriptive statistics in the study. The findings demonstrated the positive a significant effect of the supply-chain connectivity in the mining industry's eco supply chain. The research also showed that eco-innovation has a major effect on eco-supply chains, mediating the relationship between supply chain connectivity and eco-supply chain. Based on the results, managers in the mining industry may improve eco-supply chains by increasing connectedness and eco-innovation along supply chains.

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| | |
|---|---|
| TEM | Traditional Environmental Management |
| CEO | Chief Executive Officer |
| HR | Human Resources Managers |
| EFA | Exploratory Factor Analysis |
| CR | Composite Reliability |
| CA | Cronbach's Alpha |
| FL | Factor Loading |
| AVE | Average Variance Extracted |

**APPENDIX**

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the study

The ability of businesses to use expertise, technology, and resources to increase profits and reduce costs is now critical to supply chain management (Roscoe et al., 2020). A key function of any supply chain is to increase profits and reduce costs by optimizing processes (Engelseth and Wang, 2018). Therefore, supply chain connectivity becomes important in every business because it is important to monitor business performance (Anitha, et al., 2021). Moreover, it also affects the overall performance of the business effectively. The main purpose of this system is to increase the financial strength of the business (Wamba and Akter, 2019). It has become important for eco-development to be part of procurement activities and business worldwide (Malecki, 2018). The reason is that environmental issues can allow a person to decide in a split second (Kjekshus, 2020).

Supply chain connectivity is one of the most important ways to connect different communities economically(Roscoe et al., 2020). It is one of the most important and modern practices followed worldwide (Alsadi et al., 2021). The main purpose of developing and adopting a supply chain connectivity is to help the organisation find different resources around the world and to have the ability to supply these resources to any part of the world (Bahrami et al., 2022). In other words, supply chain management involves cooperation and coordination between customers, suppliers, and manufacturers, including third-party service providers (Lai et al., 2018). The purpose of supply chain connectivity is to improve supply chain performance in terms of reducing uncertainty, cost, and lead time for services and goods (Gumede and Nzama, 2019).

In modern times, the traditional supply chain has evolved from a straightforward, but highly dynamic process to an era of incredible engineering and incredibly complex and diverse global networks (Agrawal and Narain, 2018). Many supply chain managers who want to manage and improve the speed and accuracy of information flow (Aich, et al., 2019), it has proven to be a double-edged sword that results in results. The physical supply chain can be difficult to manage (Dwivedi et al., 2020). Whether it is to ensure supplier quality and performance or to meet environmental and regulatory requirements, supply chain managers must address these issues as necessary to achieve accurate forecasting and operational efficiency (Moretto et al., 2019).

Perhaps the most pressing challenge, arising from a fragmented supply chain and increasing awareness is to protect the supply chain from persistent disruption (Elphick-Darling and Gunasekera, 2017). While the risk of cyber threats applies to suppliers and third-party suppliers as the next organization, it is traditional problems such as theft, stock shortages a,nd fires, that continue to be long-term risks to reduce (San Andres, 2017).The technology was available to provide more efficiency and visibility, by being installed throughout the organization in the form of electronics, software, sensors and network connections to collect and exchange information during transactions (Hsu, 2017). But are companies using this information effectively? Especially considering how cheap technology and increased reliability enable Internet of Things (IoT) devices to be deployed in almost every retail environment (Manfred, 2018).

As every supply chain manager knows, there are a multitude of details to manage in any supply chain operation from picking, inventory, payment, scheduling and compliance, to name a few (Engelseth et al., 2018). To effectively protect the supply chain, companies need to understand what happens at any point in time, throughout production, storage and transportation (Dubey et al., 2018). They also need to move away from manually collecting data for back-end reporting,

instead using it to inform real-time analysis and decision-making (Kimura, and Chen, 2018). Connecting information across the system in real time is essential, giving systems and managers the ability to get a high-level, updated and accurate view of their supply chain at any time (Shibin et al., 2020). The supply chain and the connections between the system are important for the continuous efficiency of the supply chain (Tang et al., 2019).

Many industries such as mining are now experimenting with artificial intelligence as a means of making real-time decisions, by analyzing data patterns over time. The same method can identify trends that may indicate supply chain fraud, or that the efficiency of some transport routes is gradually declining (Macdonald et al., 2018). Regardless of its size or complexity, supply chain managers need to see how they can integrate these methods and improve information connections throughout their supply chains (Peng et al., 2022) if reductions are to be achieved and protect themselves from harm. A robust supply chain cannot be maintained if the system lacks the ability to maintain the threat (Seuring, 2013). To maintain supply chain connectivity, companies must review existing systems, information, and processes that companies see as key to protecting their supply chain (Chiang et al. , 2021). This will help identify where there are gaps in the company's information, and how to restore the system, or connect it (Bag et al., 2021), it can help you make the process more efficient and automated (Shibin et al . , 2020 ). When companies review their systems and processes, there will be an immediate opportunity to address important issues. The connection doesn't have to be accidental and renewable, but it is a step that gives the company the confidence to demonstrate real business value. The only question that remains is whether the company started this journey before the stakeholders want to know why the supply chain is unsafe (Budiman and Rau, 2019).

Eco Supply Chain is an important strategy to achieve sustainable development for companies (Badi and Murtagh, 2019). The concept of eco supply management related to environmental aspects (Sugandini et al., 2020). Environment-based supply management is important to implement because until now supply chain performance measurements have often not considered the impact on the environment (Liu et al., 2018). Yevu et al. (2021) revealed that the issue of environmental supply chains is seen as important for the successful implementation of the industrial environment and green environment programs. Waste and emissions from the supply chain have become major cacause of environmental problems including global warming and acid rain (Mousavi et al., 2021; Samad et al., 2021). Environmental performance is one of the company's activities that aims to improve or reduce the effects of environmental damage caused by the company (Benzidia et al., 2021). The more a company contributes to the environment, the better the company's image in the eyes of the public (De Giovanni, 2021). A company that has good environmental performance and discloses its environmental performance can affect the way investors view the company, which in turn can affect financial performance of the company (Kazancoglu et al., 2021).

Eco-innovation is an innovation that focuses on reducing the impact of environmental damage or pollution (Chistov, et al., 2021). Eco-innovation not only includes product methods (Ch'ng et al., 2021), but also marketing methods (Geng, et al., 2021), organizational methods (Loučanová, et al., 2021), and social and organizational methods. An approach that has a positive impact on the company's sustainable development process (Mavi and Mavi, 2021). In general, the use of eco-innovation is to replace more compatible products, processes and services of the company in order to achieve better results in terms of environmental protection (Chistov, et al., 2021). Companies that implement environmental improvements are expected to participate in the conservation of the environment (Acebo et al., 2021). Therefore, the implementation of ecological innovation in the

business system is very important to achieve the main performance goals related to society, economy, and environment (Kuo et al., 2022; Fernandez et al., 2021).

Ecological innovation is a management effort to create new products or processes that have environmental quality as the main consideration of the company in the production process (Geng, et al., 2021; Mavi and Mavi, 2021; Chistov, et al population, 2021;). Efforts to create new products or processes in the production process with environmental aspects such as factory management will affect the reduction of raw material use and energy use in the production process (Chien et al., 2021; Hizarci-Payne et al them, 2021; Pichlak and Szromek, 2021). The reduction in the use of raw materials and energy in the production process will have the effect of reducing the operating cost of the factory (Hizarci-Payne et al., 2021; Pichlak and Szromek, 2021). Research by Pan et al. (2021), Tao et al. (2021) and Ding et al. (2021) suggest that new ecological policies have the potential to reduce the pollution caused by the production process to reduce the burden and cost of following pollution. In addition, the benefits of an ecological innovation strategy include improving the company's reputation compared to its competitors (Biscione et al., 2021).

### 1.2 Statement of the problem

Organizations can be improved through the enhancement of supply chain management systems (Donkor et al., 2022). Because in this way, organizations will develop coordination and access more information to improve the provision of the environment (Agyei-Owusu et al., 2022). Which is important and beneficial for the organization (Opoku-Fofie et al., 2022). Experts have suggested that supply chain connectivity is about the firm's information technology resources of infrastructure (Roscoe et al., 2020; Engelseth and Wang, 2018; Anitha et al., 2021; Alsadi et al., 2021). In addition, it is a valuable and important tangible asset because it can develop all the supply chain processes for the organisation's operations (Manfred, 2018). Organizations improve the

ability to transport, combine, collect and access by using new methods to improve the supply chain (Engelseth et al., 2018). A number of experts provide supporting arguments regarding the management of supply chain networks to increase knowledge and innovation (Dubey et al., 2018; Kimura and Chen, 2018; Tang et al., 2021; De Giovanni, 2021; Chistov et al., 2021). Supply chain connectivity is a key factor in driving innovation. It provides the ability to create relationships among employees and organizations to use the latest technological advances to improve supply chain operations. It also helps improve one's analytical skills (Seyedghorban et al., 2020). Supply chain connectivity is about the integration of supply chain and related information of technologies (Roscoe et al., 2020). This means that supply chain connectivity is the firm's ability to use information and communication technology quickly to generate information to achieve desired goals (Dubey et al., 2018; Engelseth and Wang, 2018)

This is related to the study of Chistov, et al. (2021) in their research on the use of eco supply chain to improve company performance, they found that the eco supply chain such as purchase, production, delivery and return has an impact in practice Chien et al. (2021) found that environmental performance directly affects performance. Hizarci-Payne et al. (2021) eco-supply chain has impacts on environmental performance. Some studies related to environmental performance and operational performance are disclosed in Pichlak and Szromek (2021) and Geng et al. (2021) stated that environmental performance has an impact on financial performance. Mahdiraji et al. (2022); Caoet al. (2022); Ben Amara and Chen (2020); Kazancoglu et al. (2020) found that environmental performance has an impact on operational and financial performance. This argument is supported by Cao et al. (2022) who found strong evidence that in eco-innovation after products are produced is important to customers. Cao et al. (2022) stated that customer pressure is not important for adopting green practices in companies. This is because the company

does not communicate directly with customers. Many consumers feel the impact of their products on the environment, but consumers do not care or care about the environmental performance of product companies. Literature has shown how supply chain connectivity, eco supply chain and eco innovation has improve business and environment in the procurement setting. There has been gap in literature on the effect on supply chain connectivity on eco supply chain and the mediating effect of eco innovation in both developed and developing nation. Especially in developing countries like Ghana, the issue of eco supply chain connectivity, supply chain and eco innovation has not being tackle but the procurement setting continues to face the problem of unfriendly ecological progress. This current study seeks to add to literature by studying the effect of supply chain connectivity on eco supply chain and the mediating effect of eco innovation of the mining industry in Ghana.

**1.3 Objectivity of the study**

The main objective is to examine the effect of supply chain connectivity on eco supply chain and the mediating effect of eco innovation of mining industry in Ghana. The specific objectives are as follows;

1. To determine the effect of supply chain connectivity on eco supply chain of the mining industry in Ghana.
2. To evaluate the contribution of supply chain connectivity on eco innovation of the mining industry in Ghana.
3. To investigate the effect of eco innovation on eco supply chain of the mining industry in Ghana.
4. To evaluate the role of eco innovation in mediating supply chain connectivity and eco supply chain in Ghana.

## 1.4 Research question

1. What is the effect of supply chain connectivity on the eco supply chain of the mining industry in Ghana?
2. What is the contribution of supply chain connectivity to eco-innovation of the mining industry in Ghana?
3. Does eco innovation has any effect on eco supply chain of the mining industry in Ghana
4. Can eco innovation mediate the relationship between supply chain connectivity and eco supply chain of the mining industry in Ghana?

## 1.5 Significance of the study

The results of this study will provide positive evidence for the impact of supply chain connectivity, eco-innovations on the eco supply chain in the Ghanaian Mining industry. These relationships are partially mediated by eco innovation. Thus, while the differences between the supply chain connectivity and eco-innovation on eco supply chain, the direct impact on the mining industry remains to be identified. This work supports data delivery in two important ways. First, there are some empirical studies that have evaluated how supply chain affect the supply chain environment and environmental innovation, especially in the mining industry in developing economies such as Ghana, where environmental protection is at an early stage. Second, it contributes to the knowledge of the effects and conditions in the supply chain affecting the eco-supply chain through the mediation of eco-innovation in the Mining industry. The results will have important implications for public administration and managers of companies in the mining industry and other domestic and international industries. Therefore, the results will show the importance of promoting supply chain connectivity and the integration of eco-innovative practices in the company because this will have a significant impact on the eco supply chain.

## 1.6 Scope of the study

The study aims to examine the effect of supply chain connectivity on the eco supply chain and the mediating effect on eco-innovation in the mining industry in Ghana. In this context, the study focuses on mining companies and their ability to use supply chain connective co-innovation practices on eco supply chain within the setting of their industry. Geographically, mining companies in Ghana are the main target for this current study. This will cover all mining companies located across Ghana.

## 1.7 Limitations of the study

Although this study has many strengths, there are shortcomings that can only be resolved in future studies. The study will be conducted on the mining industry in Ghana, such as a developing country in Africa. Due to the limited data on their environment and ecological activities within the supply chain, gathering the data will come with caution and can be criticized by scholars in generalizing the research findings outside the context of Ghana. However, the findings of this study may apply to other countries with similar characteristics to Ghana.

## 1.8 Summary of Methodology

The study employed the descriptive research design and quantitative approaches in examine the effect of supply chain connectivity on eco supply chain and the mediating effect of eco innovation of mining industry in Ghana. Data will be collected through the administering of questionnaires. Close and open-ended questions will be categorized into sections. The study respondents will be employees and managers of the mining site. Three hundred and sixty-nine (369) respondents will be selected using purposive sampling technique with the help of Cochran's (1977) formula of sample size determination. For the data analysis, the data will be analysis in SPSS which will

include missing values, validity, explanatory statistics, and hypothesis testing for multi-dimensional analysis. Subsequently, the data will transfer to version 4 of SmartPLS (Sarstedt andCheah, 2019) to perform predictive calculations through multivariate data analysis. This will help in examining the effect of supply chain connectivity on eco supply chain and the mediating effect of eco innovation on the mining industry in Ghana. The results will be displayed using tables, graphs and charts.

### 1.9 Organisation of the study

The study will be structured in five chapters, the first chapter (chapter one) will introduce and describe the study, the problem statement, the objectives, and the research questions about the significance and scope of the study. the second section, reviews literature-related definitions and concepts, research theory and theoretical frameworks, and other authors' empirical evidence. The third part discusses the research design, descriptions of study sites, target populations, sampling and sampling methods, sample sizes, questions, and collection procedures, data sources, data analysis, reliability and validity from the source. The fourth section contains data analysis and discussion, and the fifth section finds a summary of the research, conclusions, and recommendations.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

Chapter two of this thesis was organised into four main sub-headings. The chapter provides information organised under conceptual review, theoretical review, empirical review, and finally the research model and hypotheses development. The Conceptual review section provided definitions, operationalisations, and how the constructs have been used in this study. The theoretical review section also provides the theoretical underpinnings of the study. The various prepositions proposed in this study were depicted using a conceptual framework and various relationships were well discussed. The Chapter ends with research gaps highlighted in the study.

## 2.2 Conceptual Review

### 2.2.1 Supply Chain Connectivity

In today's modern commercial climate, it is crucial to make possibilities, marketplaces, and supply chains simpler to reach businesses and individuals (Dolgui and Ivanov, 2022). Moreover, irrespective of its proximity inside a system, such as a gateway or a feeder, centralized or distant, interconnectivity covers necessary infrastructure, activities, and means to support the flow of commodities and persons inside and beyond boundaries (Kumar and Anbanandam, 2020). In addition, one economic growth connectedness is reliant on the connectivity of each of its counterparts. Moreover, knowledge of import prices and socioeconomic remoteness, which indicate the typical cost to reach markets as a buyer or provider, is essential to comprehend how well or how the restricted connection is (Roscoe et al., 2020). In addition, connections can be analysed at the worldwide, provincial, or sectorial levels. Commerce, public transit, innovation,

and territory expansion are all impacted by connectivity. Alternatively, supply chain connectivity makes sure that all of the different channels, processes, and techniques are integrated (Engelseth and Wang, 2018). In order to maintain accessibility and efficacy end-to-end throughout the distribution network, they must effectively interact with one another. Moreover, many businesses that wish to improve their processes have this as their ultimate objective. In addition, it consists of businesses, as well as their collaborators, providers, and clients (Alinaghian et al., 2020). Moreover, purchases, traceability, and stock levels, along with the modalities and endpoints engaged, are just a few examples of the data and physical flows across the supplier chain's components that are referred to as supply chain connectivity (Kimura and Chen, 2018). For the purpose of this study, the definition of supply chain connectivity by Kimura and Chen (2018) will be adopted by the study. It states that purchases, traceability and, stock levels, along with the modalities and endpoints engaged, are just a few examples of the data and physical flows across the supplier chain's components that are referred to as supply chain connectivity.

### 2.2.2 Eco-Innovation

In current times, academic evidence-based policy organisations have given the concept of eco-innovation more prominence. In addition, eco-innovations are a subcategory of economic advancements and are similar to them in numerous ways (Chistov et al., 2021). Furthermore, eco-innovations do, notwithstanding, also have distinctive, remarkable that imply a need for specific planning and governance measures to promote them. Understanding the factors that influence the creation and dissemination (pervasive acceptance) of eco-innovations is critical for understanding how firm leadership and the welfare of the economy may promote and steer them (Araújo and Franco 2021). In addition, since a variety of studies cannot agree on a single term, discussing eco-innovation is not an easy undertaking (Salim et al., 2019). Alternatively, eco-innovation, according

to the Eco-innovation research station, is the "initiation of just about any new or substantially enhanced items (good or service), procedure, strategic restructuring, or advertising remedy that declines the utilisation of environmental assets (which include components, power, steam, and ground) and lessens the discharge of pollutants throughout the entire existence (Geng et al., 2021)." In addition, ecological stresses are noticeably reduced through eco-innovations, which, per the Horbach et al. (2012), include "technology, production, advertising, and service development." Moreover, there are also sources are considered (Ahmad et al., 2021). Nevertheless, notwithstanding linguistic variations, all concepts incorporate the environmental dimension and represent the two primary impacts of eco-innovation: lesser harmful ecological outcomes and more optimized energy usage (Scarpellini et al., 2020). Although eco-innovation can take many different forms (such as products, processes, institutional arrangements, and/or business strategies), the impact of a potential for environmental burden is not the main driver for its use (Zaman et al., 2021). For the purpose of this study, the definition of eco-innovation by Geng et al. (2021) will be adopted by the study. It states that eco-innovation, according to the Eco-innovation research station, is the "initiation of just about any new or substantially enhanced items (good or service), procedure, strategic restructuring, or advertising remedy that declines the utilization of environmental assets (which include components, power, steam, and ground) and lessens the discharge of pollutants throughout the entire existence.

### 2.2.3 Eco Supply Chain

Agyabeng-Mensah et al. (2020) claim that during this period of industrialisation, people have a tendency to deplete and utilize the natural environment more quickly than they did in the past. Modernization simultaneously harms the environment greatly by the air quality it generates, which may then harm the ecosystem. When it is not quickly tackled, ecological contamination is a serious

issue that might result in the disappearance of all species on the planet (Permana and Soediantono, 2022). Factories operation, mobility, garbage, agriculture products, hydroelectric dams, land usage and bioenergy combustion, fossil fuel extraction, residential, tourist, and other industries are among those that keep on growing and worsen the sustainability of the globalized world, according to Weize et al. (2019). Every business must take responsibility for the garbage it produces in order to lessen harmful emissions, rather than merely ignoring this ecological crisis. According to Uddin et al. (2022), businesses that are environmentally conscious will have an influence on improving customer perception such that the industry's degree of competitiveness is now focused on ecological concerns instead of excellence, pricing, and distribution. In order to control the distribution network, the organisation must pay close consideration to this.

### 2.3 Theoretical Literature Review

An abundance of knowledge and information in the scope of innovation makes the research process to become challenging, difficult, and lengthy (Freudenreich et al., 2020). Thus, to focus on the research direction, three underpinning theories were used as a research foundation in supporting and addressing the gap, and as a guide to align this research into an appropriate direction. The researcher examined underlying ideas in this part, as well as the effect of supply chain connectivity on eco supply chain: a mediating role of eco-innovation. The Stakeholder theory and its extension to the Supply chain network theory serve as the foundational theories for this investigation. Theoretical frameworks provide a clear prism or context through which a subject is studied; it explains the context and the connections between the various factors and dimensions.

### 2.3.1 Stakeholder theory

Subsequent studies based on organizational and stakeholder theory contend that authoritarian, supply chain connectivity, and eco-supply chain influences inside a company's current network may influence the acceptance of eco-innovation (Freudenreich et al., 2020). Regulation and consumption patterns pressures, the desire to outperform the competition, peer collaboration, and regulatory requirements are all factors that might affect a company's decision to implement eco-innovations (Pinto, J., 2019). Acceptance of eco-innovation is significantly influenced by the form and character of the system of links to other interested parties and partnerships in that these constraints are entrenched (Freeman et al., 2020). Nevertheless, there's not any clear study examining how inter-firm networking embedded linkages affect the uptake of resource efficiency eco-innovation. Furthermore, there are no clear studies investigating whether inter-firm networks' embedding linkages affect the uptake of resource efficiency eco-innovation (Barney and Harrison, 2020). For networking of businesses and relevant parties to evaluate their eco-innovation practices, more experimental and theoretical methodologies are required (Rose et al., 2018). There is an absence of a close bond and general perception between many experts regarding a greater knowledge of how the political and social configuration of conversations within a system of business owners and other interested parties may affect the successful adoption and deployment of resource efficiency supply chain (Uribe et al., 2018). It has not yet been determined if hypotheses about the processes by which these eco-innovations are embraced and spread across online communities are relevant (Vitolla et al., 2019).

### 2.3.2 Supply chain network theory

In spite of the importance of connections for understanding predictive dynamic networks, there aren't many instances in the research of how the most recent advancements in network theory have

been applied explicitly to distribution channels. Research projects have, for the most part, preserved the simplistic dyadic/linear perspective or embraced a based social exchange perspective of a system (Tapia Ubeda, 2019; Ali et al., 2019). Instead, a distribution system may be represented as a channel by a collection of "nodes" that stand in for independent business units as companies with the ability to make their own decisions and a set of "interconnections" that bring these companies together to produce goods or services (Ojha et al., 2018). The fundamental agreement, if extant, and trading links among the enterprises are represented by interconnections. Several connectivity patterns can be taken into account when simulating trade interactions, but the most important linkage kinds are the existence of agreements and different flow types, notably production flow, information shared, and money flows (Yamamoto et al., 2021). In the context of the buyer and the seller, interconnections, communication channels, and capital inflows all relate to the transmission of tangible goods, coordination data, and economic ability, respectively (Queiroz and Wamba, 2019). A distinct network may form while simulating a supply chain for each examined link type. As a result, distinct network configurations should result from input data of a streaming server on the same set of companies but examine various connection kinds. In fact, Vandchali et al. (2021) recently conducted a study that involved the concurrent examination of several link types (resources flow and contractual) in diverse supply chain connectivity. For each sort of link, they looked at, they discovered that different characteristics of interconnections occurred over a short amount of time between the same groups of businesses. Previous studies of other networks based, including social (Ferretti et al., 2020), commercial (Treiblmaier, 2018), environmental, biophysical (Yu, Z. and Khan, S.A.R., 2022), biological (Valizadeh et al., 2021), and networking technologies (Carnovale et al., 2019), have revealed a number of important, apparently widespread dependencies

## 2.4 Empirical Literature Review

This section assessed the research on prior studies that addressed the study's objective. These include the effect of supply chain connectivity on eco supply chain: a mediating role of eco-innovation. Literature related to the study's goal of the effect of supply chain connectivity on eco supply chain: a mediating role of eco-innovation in previous and ongoing research projects was evaluated.

Pichlak and Szromek (2021) performed a study that examined the significant environmental impacts of innovation action conducted by businesses and, specifically, evaluated the tendency of maintainable corporate executives to produce eco-innovation. Moreover, researching organizations with notable accomplishments in implementing eco-innovation initiatives were necessary to evaluate corporate sustainability managers' tendency to produce eco-innovation. In addition, a selected sample (N = 54) of participants in the study, comprising pioneers in the creation of eco-innovative approaches, was examined in Poland in 2019. Furthermore, the firms included in the poll were those that had won the GreenEvo program's six iterations as well as those that the Professional Observation in Innovations for Environmental Quality had selected as pioneers in greener. Moreover, the findings also show that larger businesses with more than 50 employees are more likely than smaller ones those comparatively fewer resources to produce revolutionary and gradual eco-innovation. Furthermore, the research demonstrates that using an inclusive innovation process increases the likelihood of producing eco-innovations, truly extreme ones. Additionally, adopting a corporate strategy to advance distribution network partnerships that involves absorbing evidence and data obviously coming from the market is the dominant factor in generating such improvements. Moreover, the findings can serve as a framework for creating new job opportunities that include teamwork in eco-innovation initiatives, particularly in the context of an improving

economy following an outbreak. In addition, the research recommended that future studies should indeed be grounded in objective criteria that can be confirmed beforehand in light of the survey's shortcomings and conclusions. Moreover, the information is cross-sectional in nature. Additional research in this intriguing area may also focus on eco-innovations that are not strictly technical.

Ramkumar (2020) conducted research to look at how acceptance of corporate sustainability eco-innovations is influenced by entrenched connections within inter-firm systems. In addition, the research performed depth methodology to recreate the pattern and character of the interactions between Jaguar Land Rover and its vendors who used a previous situational analysis of the REALCAR shuttered rebate program of Jaguar Land Rover from 2013 to 2017. Moreover, a networking multiple regressions was added to this in order to ascertain the impact of these interactions on the contributors to Jaguar Land Rover's choices about the procurement and execution of the shuttered reprocessing. In addition, the findings indicate that the choice to implement and the timing of that acceptance of the REALCAR shuttered material recovery advancement were influenced by the crucial client engagement with Jaguar Land Rover, the promotion of information sharing between many interpersonal vendors, and opposition from vendors affected by the shifting partnership. Moreover, as a result, businesses and distribution networks may want to think about utilizing the business partnerships that are already present in their supply chain networks to speed up the acceptance of resource-efficiency eco-innovations. Based on the findings and the limitations of the study, there were no recommendations made for future studies.

Geng et al. (2021) undertook research to look at the impact of eco-innovation and how it helps Chinese small- and mid-sized multinational corporations operate better. Moreover, depending on the information from theories, the study created and experimentally tested a model predicated on

the contingency hypothesis there are various business groupings of SMMEs relying on their rates of eco-innovation deployment and the continuous monitoring connected to eco-innovation procedures depends on the businesses clusters and traditional environmental management (TEM) procedures. Alternatively, the clustering information and software, which were obtained using questionnaire information gathered from 382 SMMEs in China, show that there are two company groupings of SMMEs that are each defined by three different eco-innovation intervention strategies (advanced technologies, administration, and advertising). In addition, from the findings, we deduced that 225 SMMEs (58.9% of the cohort) were eco-innovation consumers. Moreover, the other 157 SMMEs are classified as eco-innovation strategists, making up 41.1% of the population. Furthermore, the findings of the T-test reveal that there are differences amongst eco-innovation coordinators and consumers in terms of the degree to which traditional environmental management practices are implemented, as well as in terms of gains to the ecology and people. Moreover, outcomes from multiple regression analysis further demonstrate the benefits of combining some eco-innovation strategies with traditional environmental management methods to enhance employees. In addition, depending on the literature review and shortcomings, the researcher hypothesized that more investigation is needed to explicate the existence of these relationships and how they have changed using a wide range of information sources, such as continuous dynamic panels and in-depth case analysis.

Afshari et al. (2020) carried out a study to explore how distribution channels may promote extra manufacturing by using eco-innovation principles. Moreover, the research explores the significance of eco-innovation forces in a procurement chain's adoption of innovative practices and technology. In addition, it develops a novel theoretical framework to investigate additional production as a professional standard of eco-innovation and offers suggestions for its low-cost

implementation. Furthermore, the findings offer managerial guidance on the best ways to implement eco-innovative destruction network initiatives. Concisely, this work seeks to add by offering the connectivity to look at how eco-innovation factors could affect eco-friendly supply chain procedures in addition to studying eco-innovation factors utilizing additive manufacturing. According to the author's interpretation of the data and research constraints, preservative manufacturing is less cost-effective than supply chain management when energy prices are high. Contrarily, high expenses for energy drive up the expense of conveyance and lessen the advantages of procurement over additive manufacturing. Because of this, the impact of energy costs depends on a number of other variables that merit additional research.

Manfred (2018) conducted a study that aims to look at the expenses of trade in Africa in an effort to provide responses to the issue, "Does global supply chain connectedness matter?" In this study, the effectiveness of global supply chain connectedness is evaluated in relation to import prices using a general equilibrium model. Over the years 2006 to 2015, 169 nations are included in the system. The results imply that lower transaction costs in the area arise from improved worldwide distribution network linkages in African nations. The finding suggests that a country's capacity to lower transaction costs and trade internationally relies on its connectedness to the worldwide supply chain when we assess intraspecific and extra-African trade costs independently. The findings also imply that colonial connections, close proximity, a common experience, and a monetary union all have a detrimental impact on trade costs. The researcher contends that the study's results and shortcomings have both positive and negative ramifications for African nations. The first is to affirm that additional research is required to determine if increasing a government's global supply chain connectedness with export promotion legislation lowers transaction costs and boosts commerce.

Sherif et al. (2019) did a study to determine whether to create a shuttered supply chain connectivity concept with an eco-friendly transmission system and to improve reprocessing to use recovered lead in the manufacture of new batteries. Replacement batteries used power packs, and metal ingots can all be kept in the consolidated warehouses that are being considered. The suggested study aims to dedicate infrastructure with highly centralised distribution centers utilising a multi-facility algorithm requires, evaluate possible positions for unified warehouses using the K-means clustering approach, and actually reduce path length by permitting the reversible flow of supplies and goods among amenities. The outcomes demonstrate that by contrasting the suggested effectiveness of the algorithm with that of the actual framework, its effectiveness is verified. The assessment demonstrates that the suggested model outperforms the current model. Varying rates of scrap battery returns, various amounts of recovered metals, and various vehicle types are used to show the risk assessment, which will aid executives in making wise choices with regard to cost reductions. The researcher recommends that subsequent multi-objective research include sustainability concerns in order to make the issue more thorough and authentic. This is predicated on the study's results and shortcomings. In order to produce near global optimum with acceptable computational time in the future, the meta-heuristic strategies can be employed as the optimization method for the massive scale examples.

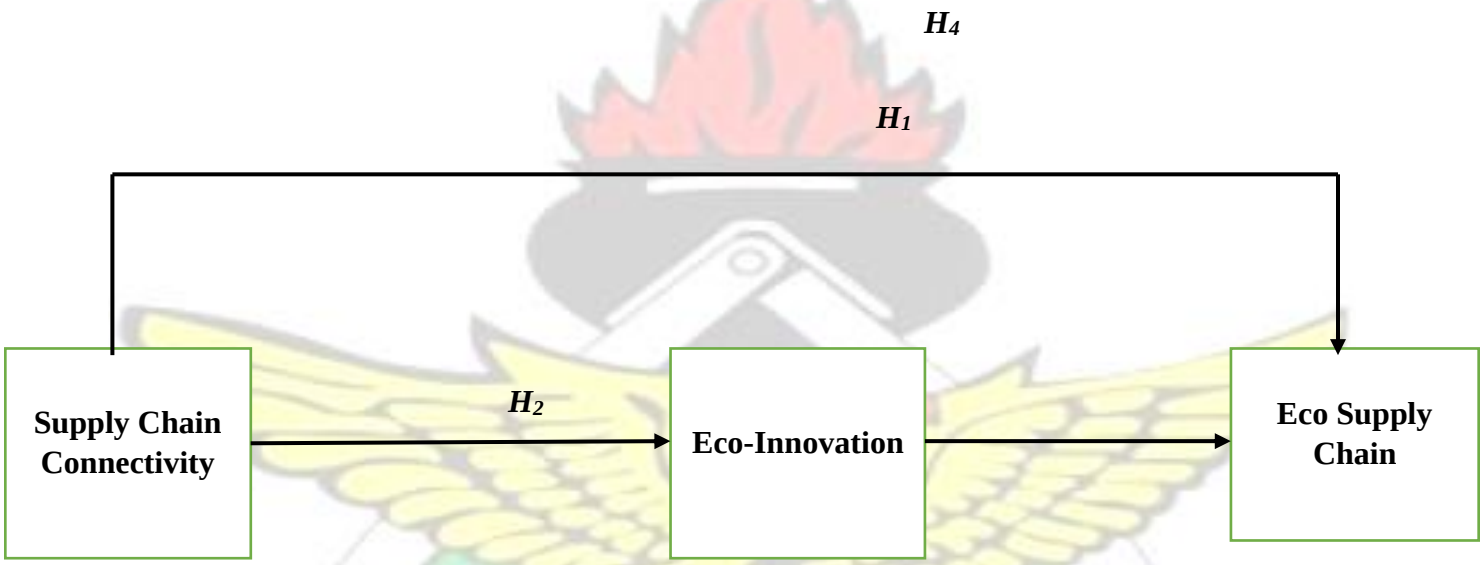
Costantini et al. (2017) carried out a study on sustainable development, distribution network management, and eco-innovation in the European industry. In a bid to encourage the implementation of particular measurements on sustainability reporting and eco-innovation, some prior implications are required to be provided in order to experimentally assess the existing theory here under consideration. Three elements, in particular, seem to be essential for the creation of the experimental approach. The breadth in terms of the geographic areas chosen for the study and the

quantitative format of the evaluation criteria employed are the first aspects that should be treated with respect. It focuses the study on environmental market failures in the form of exhaust emissions related to the supply and business activities with regard to the choice and assessment of ecological categories. The results of the research demonstrated that eco-innovations have both consequences that assist decrease environmental pressures. The severity of these consequences varies along the supply chain depending on the technique used and the kind of contaminant under consideration. The key conclusions are that both organisational and strategy democratic accountability techniques could perhaps explicitly mention the objective of increasing ecologic improvements that can be attained throughout the creation and application of cleaner production along the distribution network, and that both schemes should be organized in order to achieve efficiency of minimising stresses. It is important to conduct additional research on the additional creative business practices at the company level, which include non-technological management innovation such as corporate citizenship tools and inspection programs like the implementation of quality assurance procedures and labelling guidelines.

### 2.5 Conceptual Model/ Framework

The two major pillars of the theoretical model are the Stakeholder theory and its extension to the Supply chain network theory (see Figure 2.1). The robustness of the eco-supply chain is benefited from and supported by environmental technology, or "eco-innovation" (Mazzanti, 2018). Eco-innovation may enhance the effectiveness of industrial operations, marketing strategies, and the availability of products and services (Afshari et al., 2020; Puertas and Marti, 2021). In the Ghanaian economy, eco-innovation is defined by Gente and Pattanaro (2019) as "the manufacturing, integration, or commercialization of a product, manufacturing methods, provider, development system, or corporate technique that is innovative to the institution (going to develop

it) and that outcomes, during its life span, in an associated with green risk, greenhouse gas emissions, and other negative effects of commodity use (including energy use), especially in comparison to a similar understanding." Independent (Supply Chain Connectivity), dependent (Eco Supply Chain), and mediating variables are all included in the overall idea of (In Eco-Innovation). In this study, three types of variables were employed. It is anticipated that the effect of supply chain connectivity on eco supply chain: a mediating role of eco-innovation.




**`Figure 2.1 Conceptual framework**

This segment discusses the five key hypotheses as shown in Figure 2.1 above. Subsections have been created and discussed for each of the hypotheses as illustrated by the research model.

### 2.5.1 Hypothesis 1: Supply Chain Connectivity on Eco-Supply Chain

A buyer's demand is either explicitly or implicitly fulfilled through producers, distributors, transporters, shelf stackers, merchants, and customers who make up the supply chain. The effective flow of commerce via an eco-supply chain depends on the connectedness of the supply chain. Numerous types of research have been conducted research on supply chain connectedness and the

eco-supply chain. As per Yuliantoro et al. (2019), Zhang et al. (2007) found that supply chain connectedness among eco-friendly providers significantly enhances a company's effectiveness. Similar results were found in earlier studies that the installation of an eco-supply chain has an impact on supply chain connection, according to Younis et al. (2020); Yu et al. (2018); Yuliantoro et al. (2019); and Zhu et al. (2007). Hence, it is anticipated that a positive influence of Supply Chain Connectivity on the Eco-Supply Chain:

***$H_1$.*** *Supply Chain Connectivity has a positive and significant effect on Eco-Supply Chain*

### 2.5.2 Hypothesis 2: Supply Chain Connectivity on Eco-Innovation

Harland (2021) asserts that a number of variables may be distinguished as being crucial when structuring a Supply chain network or connectedness, including the choice of cooperating collaborators, the development of a strong competitiveness position, the observation of rivals, and the provision of appropriate relationships (Harland, 2021). Furthermore, according to Ramkumar (2020), a business is entrenched in connections with other companies and is therefore a component of a supply chain network if it can persuade other businesses to do trade with it and they have a similar passion and a particular within the eco-supply chain (Wang et al., 2022. Additionally, Cao et al., 2022) discovered that the supply chain (procurement, manufacturing, transportation, and recovery) has an effect on supply chain connectedness in their study on the implementation of eco supply chain boosting firm effectiveness. Hence, it is anticipated that supply chain connectivity will have positive influence on eco-innovation:

***$H_2$.*** *Supply Chain Connectivity has a positive and significant effect on Eco-Innovation*

### 2.5.3 Hypothesis 3: Eco-Innovation on Eco-Supply Chain

As a business response to green legislation and eco-Supply Chain, eco-innovation has been identified as one of the important variables determining ecological and financial effectiveness in companies and societies (John, 2018). Several research has been done in this respect to look at the significance and advantages, difficulties and limitations, as well as the financial and economic implications of eco-innovation. As a result, 35% of the literature examined for this investigation fell under this category. Takalo and Tooranloo (2021), investing in studies and eco-innovation (Homrich et al., 2018.), conducting eco-supply chain planning (Yang et al., 2020), achieving additional cash flow, and reducing costs by raising understanding of eco-innovation commitments were the most critical elements in the given publications (Sivarajah and Ragonga, 2020). The use of active eco-innovation in induced by environmental complexities, the establishment of a robust impact of eco-supply chain, green procurement advancement, and assistance utilisation of eco-innovation equipment and technologies, and the investment in environmental initiatives (Supriadi et al., 2022) were all positive effects of compelled and socially constructed undue stress on eco-supply chain implementation (Arijanto, 2022). Hence, it is anticipated that a positive influence of Eco-Innovation on the Eco-Supply Chain:

***$H_3$.*** *Eco-Innovation has a positive and significant effect on Eco-Supply Chain*

***$H_4$.*** *Eco-Innovation mediates the relationship between Supply Chain Connectivity and Eco Supply Chain*

**Table 2.1: Summary of Literature Review**

| Author/Year | Country | Purpose | Theory | Method | Findings | Future studies |
|---|---|---|---|---|---|---|
| Pichlak and Szromek (2021) | Switzerland | The goal of the research is to discuss the significant environmental impacts of innovation action conducted by businesses specifically, to evaluate the tendency of maintainable corporate executives to produce eco-innovation. | Not Clearly Stated | Qualitative | The findings also show that larger businesses, those with more than 50 employees, are more likely than smaller ones, those with comparatively fewer resources, to produce revolutionary and gradual eco-innovation. Furthermore, the research demonstrates that using an inclusive innovation process increases the likelihood of producing eco-innovations, truly extreme ones. Additionally, adopting a corporate strategy to advance distribution network partnership that involves absorbing evidenc | The research recommended that future studies should indeed be grounded in objective criteria that can be confirmed beforehand in light of the survey's shortcomings and conclusions. Moreover, the information is cross-sectional in nature. Additional researches in this intriguing area may also focus on eco-innovations that are not strictly technical. |

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| | | | | | e and data obviously coming from the market is the dominant factor in generating such improvements. The findings can serve as a framework for creating new job opportunities that include teamwork in eco-innovation initiatives, particularly in the context of an improving economy following an outbreak. | |
| Ramkumar (2020) | Italy | The study examines how acceptance of corporate sustainability eco-innovations is influenced by entrenched connections within inter-firm systems. | Institutional theory | Qualitative | The findings indicate that the choice to implement and the timing of that acceptance of the REALCAR shuttered material recovery advancement were influenced by the crucial client engagement with Jaguar Land Rover, the promotion of information sharing between many inter | Based on the findings and the limitations of the study, there were no recommendations made for future studies. |

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| | | | | | personal vendors, and opposition fro m vendors affecte d by shifting partn ership. As a result, businesses and di stribution network s may want to thin k about utilizing t he business partne rships that are alre ady present in thei r supply chain net works to speed up the acceptance of r esource efficiency eco-innovations. | |
| Geng et al. (2021) | China | The research looks at the impact of e co-innovation and ho w it helps Chinese small- and mid-sized multinationa l corporations oper ate better. | Contingency theory | Quantitative | The findings of the T-test reveal that there are differences amongst eco-innovation coordinators and consumers in terms of the degree to which traditional environmental management practices are implemented, as well as in terms of | Depending on the literature review a nd shortcomings, t he researcher hypo thesized that more investigation is ne eded to explicate t he existence of the se relationships an d how they have c hanged using a wi de range of inform ation sources, suc h as continuous dy namic panel and i n- |

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| | | | | | gains to the ecology and people. Outcomes from multiple regression analysis further demonstrate the benefits of combining some eco-innovation strategies with traditional environmental management methods to enhance employee. | depth case analysis. |
| Afshari et al. (2020) | Canada | The research looks at how distribution channels may promote extra manufacturing by using eco-innovation principles. | Grey theory) | Quantitative | The findings offer managerial guidance on the best ways to implement eco-innovative destruction network initiatives. This work seeks to add by offering the connectivity to look at how eco-innovation factors could affect eco-friendly supply | According to the author's interpretation of the data and research constraints, preservative manufacturing is less cost-effective than supply chain management when energy prices are high. Contrarily, high expenses for energy drive up the expense of conveyance and lessen the advantages of pr |

| | | | | | | |
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| | | | | | chain procedures in addition to studying eco-innovation factors utilizing additive manufacturing. | ocurement over additive manufacturing. Because of this, the impact of energy costs depends on a number of other variables that merit additional research. |
| Manfred (2018) | Cameroon | The researchers looked at the expenses of trade in Africa in an effort to provide responses to the issue, "Does global supply chain connectedness matter?" | Comparative advantage theory | Quantitative | The finding suggests that a country's capacity to lower transaction costs and trade internationally relies on its connectedness to the worldwide supply chain when we assess intraspecific and extra-African trade costs independently. The findings also imply that colonial connections, close proximity, a common experience, and a monetary union all have a detrimental | The researcher contends that the study's results and shortcomings have both positive and negative ramifications for African nations. The first is to affirm that additional research is required to determine if increasing a government's global supply chain connectedness with export promotion legislation lowers transactions costs and boosts commerce. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | impact on trade costs. | |
| Sherif et al. (2019) | India | The focus of this research is to create a shuttered supply chain connnectivity concept with an eco friendly transmission system and to improve reprocessing to use recovered lead in the manufacture of new batteries. | Not Clearly Stated | Quantitative | The outcomes demonstrate that by contrasting the suggested effectiveness of the algorithm with that of the actual framework, its effectiveness is verified. The assessment demonstrates that the suggested model outperforms the current model. Varying rates of scrap battery returns, various amounts of recovered metals, and various vehicle types are used to show the risk assessment, which will aid executives in making wise choices with regard to cost reductions. | The researcher recommends that subsequent multi-objective research include sustainability concerns in order to make the issue more thorough and authentic. This is predicated on the study's results and shortcomings. In order to produce near global optimum with acceptable computational time in the future, the meta-heuristic strategies can be employed as the optimization method for the massive scale examples. |
| Costantini et al. (2017) | Italy | The research examined sustainable development, distribution network management, and eco | Not Clearly Stated | Quantitative | The results of the research demonstrate that ecoinnovations have both consequences that assi | It is important to conduct additional research on the additional creative business practices at |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | - innovation in European industry. | | | st decrease environmental pressures. The severity of these consequences varies along the supply chain depending on the technique used and the kind of contaminant under consideration. The key conclusions are that both organisational and strategy democratic accountability techniques could perhaps explicitly mention the objective of increasing ecologic improvements that can be attained throughout the creation and application of cleaner production along the distribution network, and that both schemes should be organized in order to achieve efficiency of minimising stresses. | the company level, which include non-technological management innovation such corporate citizenship tools and inspection programs like the implementation of quality assurance procedures and labeling guidelines. |

# CHAPTER THREE

# RESEARCH METHODOLOGY AND ORGANISATIONAL PROFILE

## 3.1 Introduction

This study sought to examine the effect of supply chain connectivity on the eco supply chain and the mediating effect of eco innovation in the mining industry in Ghana. This chapter objectively presents the methodology of the research. The methods projected in this chapter, purpose to accomplish the study objectives and answer the research questions. The methodology chapter commenced by clearly explaining the research design. Secondly, research sampling procedures, and then the research instrument. The final stage in this section addresses the explanation of the proposed data analysis.

## 3.2 Research Design

Deductive and inductive research are two broad types of research approaches (Trochim, 2006). Trochim (2006) explains that inductive research makes its arguments based on observations and experiences and therefore concludes by moving from "specific to general". On the other hand, deductive research starts from established rules, laws, and principles about a particular phenomenon and draws conclusions by moving from "general to specific." In addition, Creswell and Clark (2017) propose that deductive research has its orientation from the positivist paradigm and employs a top-down approach where the researcher tests theories through the use of hypothesis to either confirm or disconfirm a theory. In contrast, inductive research, which has its orientation from the interpretivism paradigm, makes use of a bottom-up approach where the researcher utilizes the views of participants to build broader themes and then generates a theory by connecting the themes identified (Cohen, Mannion andMorrison, 2017).

The study adopted quantitative/deductive research approach as it was relevant in enabling the researcher to test theories deductively by searching for evidence to either support or refute the hypothesis (Creswell andPlano Clark, 2007). This study through the testing of theories deductively to either support or refute the effect of supply chain connectivity on eco supply chain and the mediating effect of eco innovation of the mining industry in Ghana.

The research design is the actual structure that indicates the time frame(s) in which data is collected, the type of study to be conducted, and how many groups are involved in the research study (Edmonds andKennedy, 2012). The research design, therefore, serves as the roadmap that guides the researcher to achieve the research objectives and provide answers to the study's research questions.

Research design according to Okesina (2020) has various components including the research purpose (descriptive, explanatory, exploratory, or a combination of two or more purposes), research methods (quantitative, qualitative, and mixed methods), and time horizon (cross-sectional or longitudinal). Considering the positivist approach used, the research design for the current study was explanatory as opposed to descriptive and exploratory. This is because the explanatory research design is characterised by hypotheses that predict the nature and direction of the relationship among the variables of the study. In addition, borrowing from Okesina (2020) the study is a cross-sectional one as opposed to a longitudinal design since data was collected in a short space of time spanning one month.

### 3.3 Population of the study

The population is the set of individual persons or objects in which an investigator is primarily interested during a research inquiry (Igwenagu, 2016). It describes the total number of people or items that one wishes to understand. In this study, the population describes all the permanent staff or employees of the selected mining companies in Tarkwa. A preliminary field survey revealed that the number of employees for the targeted retail firms was 4098 workers and that of the mining firms was 3902. This brings the total population to 8000 workers.

### 3.4 Sample Size and Sampling Technique

The sample size is a representation of the population utilized by the researcher and from whom inferences are made (Babbie, 2013). The study employed the stratified sampling procedure in selecting the sample size for the study. The stratified sample procedure is used when the population is divided into different heterogeneous units and there is the need to fairly represent each sub-unit in the study. The retail firms and the mining firms constituted the sub-units of the population. Thus, the study selected a proportionate number from each stratum. In doing so, the sample size formula proposed by Yamane (1967) was adopted. In the formula, as specified in equation (1), 'N' is the population size, 'n' is the sample size, and 'e' is the margin of error which was kept at 5%. From equation (1), the study obtained a minimum sample size of 381.

$$n = N / [1 + (N \times e^2)] = 8000 / [1 + (8000 \times 0.05^2)] = 381 \quad (1)$$

The study selected a proportionate number from each of the industries – retail, and mining. The procedure followed in choosing the exact sample size was that the population for each industry (mining – 3902; retail – 4098) was in each case divided by the overall population and the result was multiplied by the sample size of 381. Thus, the sample size selected for the mining industry was 186 (3902/8000 × 381) while that of the retail industry was 195 (4908/8000 × 381). It must

be noted that 381 (that is, 186 for mining and 195 for retail firms) is the minimum sample size needed. To meet this number and be cognizant of the possibility of non-responses and missing values, the study administered more questionnaires than the requirement for the minimum size. In this case, 50% more questionnaires were administered; bringing the total for the mining industry to 279 and that of the retail firms to 293. This resulted in a total questionnaire administration of 572. The notion was to ensure that the total number of answered questionnaires will more than adequately meet the minimum sample size requirement.

### 3.5 Data Collection

The two key sources of data for most research is primary and secondary. While primary data consists of first-hand materials that the researcher has gathered himself or herself mainly using questionnaires (Dubey et al., 2016), secondary data in contrast is the information that has been collected by other individuals for other purposes (Bryman and Bell, 2007). In this study the main source of data collection is primary. To support or reject the findings from this study, data from secondary sources were reviewed. The primary source of data includes information gathered through questionnaires that were administered to the respondents sampled from pharmaceutical firms in Ghana. In gathering the primary data required in this study, a cross-sectional survey design is utilized. A structured questionnaire with a mainly close-ended format was self-administered to the respondents. A team comprising the researcher and research assistants will visit the metropolitan and municipalities to administer the questionnaires in addition to the online survey. Before the questionnaires are administered, an introductory letter was obtained from Kwame Nkrumah University of Science and Technology, Department of Supply Chain and Information Systems, and presented to the selected establishment Human Resources Managers (HR)/ Chief

Executive Officer (CEO). The CEO or HR manager after being satisfied with the demands of the research then issued a letter introducing the team to the workers. After obtaining the approval, the researcher will seek the consent of the respondents before administering the questionnaire. To achieve this purpose the researcher will explain in detail the aim and importance of the study to the respondents before they decided to participate in the study. Also, part of the questionnaire preamble will reiterate the promise of confidentiality of the data. The team will distribute three hundred (300) questionnaires to compensate for non-response. For each randomly selected organisation, we identified a key informant, who typically had a title such as supply chain manager who was in charge of the company's internal and external processes. The study targeted these executives and other top and middle-level managers as they are most knowledgeable about organizational issues and their application in other business functions. The questionnaire was the main instrument used to collect primary data. A well-structured questionnaire containing measurement items validated in previous studies will be employed in the study. Each of the variables was measured based on a five (5) point Likert which ranged from 1 (strongly disagree) to 5 (strongly agree). The questionnaire will be structured to reflect the relevant objectives of the research. The questionnaire helped to solicit responses to test all the key variables in the conceptual framework of the study. Using a Five-point Likert scale point (1= "Strongly Disagree" to 5= "Strongly Agree"), each item was measured. The preliminary part consisted of demographic measures which included gender, educational background, work experience, and position within the firm of the participants, of the categorization questions included in the survey, captured the kind of company. The constructs and their respective measures are shown in the appendix.

One of the important steps in developing a questionnaire is to pre-test. It is to confirm that the questionnaire has been designed effectively for the proposed study before actual data is collected.

In research, a pre-test is done to validate the content and the question wording, format, and how relevant the questions are to the objectives. Although the proposed items to be used in this research are adopted from previous research, yet, a pre-test is very important to confirm that the questions are suited to the respondents (Kumar et al., 2013). The pre-test in this research was done through discussions with people academics who are authorities in the related study area. This included academic Professors and also experts from the industry. The pre-test process focused on reviewing the proposed questionnaire with its content validity, clarity, and timing for the respondents to answer the questionnaire. Respondents were engaged to answer the questionnaire and the feedback from the respondents within the pre-test period was used to improve the questionnaire. The experts in the field of the supply chain from Ghana were asked to point out items that are unclear to understand for rewording or elimination.

### 3.6 Method of Data Analysis

Data analysis is the process of using a systematic procedure to draw inferences from data gathered from the field as well as considering the various procedures that can be used to analyze the data (Churchill and Iacobucci, 2009). The researchers further suggest that the research design, the kind of data and assumptions made in the research, and concerns associated with the study will influence the suitability of a given technique. Data analysis may follow quantitative or qualitative procedures in scrutinising the large volume of information obtained from the field. In the quantitative context, the procedure includes the use of statistical techniques to describe and examine variation in the quantitative measures. The quantitative approach emphasizes the use of either inferential or descriptive statistics (statistical techniques), to understand and establish relationships between constructs.

In this study Statistical Package for Social Sciences (SPSS) version 23 and SmartPLS 3 software will be utilized to conduct descriptive statistics and inferential statistics respectively. The data collected will be coded, cleaned, and prepared for analysis. The data will first be coded in Microsoft excel. In excel the data will be thoroughly checked to avoid possible data entry errors. After cleaning the data will then be exported to SPSS. The data checks in SPSS include missing values, reliability, descriptive statistics, and test of assumptions for multivariate analysis. Subsequently, SmartPLS version 3 (Ringle et al., 2015) will be employed to conduct inferential statistics through multivariate data analysis.

### 3.7 Reliability and Validity

Evaluating the measurement model is very important in quantitative research, it confirms the validation and the result of the research. It is however important for researchers to concentrate on improving the quality of their work (Heale and Twycross, 2015). Again, there are two vital features to deal with in assessing the measurement model, they include the reliability and validity of the study instrument to be used (Saunders, Lewis, andThornhill, 2016). Khalid et al. (2012), defined reliability measurement as the degree to which the measurement is free from random error by giving a consistent result. Concurrently, it is known as internal consistency of measurement which mirrors the same underlying construct (Cooper and Schindler, 2003). To test how reliable an instrument is, Hair et al. (2012), came up with two tests of reliability and they are internal consistency and indicator of reliability. For internal consistency reliability, the researcher used Cronbach Alpha. According to Hair, Sarstedt, Ringle, andMena (2012), the indicator reliability is used to measure the indicator's variance to explain the latent construct where every indicator's absolute standardized loading should be more than 0.7 (Hair, Ringle, andSarstedt, 2011). The researchers claim that the indicator loading, between 0.4 to 0.7 should be removed from the scale

if deleting the said indicator will increase the composite reliability above the accepted threshold value. However, if the indicator loading is equal to or less than 0.7, it should be removed at all times from the reflective scale. Zikmund (2000), defined validity to be the accuracy of the measurement device and denotes the ability of a scale to measure what is proposed to measure. For quantitative research, the researcher has to certify that the three traditional forms of validity exist in the measurement device and they include face validity, content validity, and construct validity (Heale andTwycross, 2015).

The common method among others is content validity however, it is very needful to be conducted. It tests whether the items would measure all the content which is made to measure in the study (Creswell, 2009; Heale andTwycross, 2015). The content validity is mostly done through reviewing related literature, in this research, the instruments used were validated from past studies. Yet to make sure that it captures all the content of the research, the researcher explored face validity by involving experts to evaluate to ensure that the instruments are suitable in terms of their relevance, appearance, and properly representing the elements (Richard G. Netemeyer, William O. Bearden, 2003).

**3.8 Ethical Issues**

Ethics are the moral principles that a person must follow, irrespective of the place or time (Akaranga andMakau, 2016). Research ethics focuses on the moral principles that researchers must follow in their respective fields of research (Fouka andMantzorou, 2011). A consent form was presented to the authorities of all selected firms to inform them of all benefits and risks involved in the participation and further sought their consent for their inclusion in the study. Selected firms had the right to decline their participation in the study. The researcher indicated in the consent form that all forms of anonymity and confidentiality would be observed. Privacy of firms in terms

of freedom to define the time, extent, and conditions of sharing information were also observed. The researcher avoided any form of actions in their relation with participants that amounts to deception. All forms of plagiarism and falsification of data were also avoided by the researcher.

### 3.9 The Mining Industry in Ghana

The mining industry in Ghana predates the colonial era. In the past, Ghana was referred to as the Gold Coast. Ghana is Africa's greatest gold producer, having surpassed South Africa in 2019 with output of 4.8 million ounces. Gold is the greatest economically exploited mineral in Ghana, accounting for around 95% of mineral revenue. Manganese, bauxite, and diamonds are other commercially mined minerals in Ghana. The nation is also blessed with iron ore, limestone, columbite-tantalite, feldspar, quartz, and salt deposits, as well as minor ilmenite, magnetite, and rutile deposits. In 2018, Ghana discovered commercial quantities of lithium and is collaborating with international partners to mine and refine lithium. Historically, Ghanaian mining production was held by the state, but beginning in the 1980s, Ghana worked toward privatization and state divestment, in part by encouraging foreign investment. American Newmont Goldcorp, as well as Chinese, Canadian, South African, and Australian mining firms, are among the largest in Ghana. Mineral rights are granted to private parties, allowing them to extract minerals from the earth. Nonetheless, the Government of Ghana is entitled to a 10% equity stake in the mineral operations, even if it makes no financial contribution. The government can enhance its interest in mineral operations through an investor agreement. The small-scale mining industry is restricted to Ghanaian nationals alone. Current investors are concerned about the localisation requirements in Minerals and Mining Legislative Instrument 2431 (2020). (Local Content and Local Participation). It requires licensees to develop a localization program for the recruitment and training of Ghanaians and imposes quotas on expatriate employees (up to two in management with the

General Manager position reserved for Ghanaians). It imposes time limits on other expatriates and moves gradually toward Ghanaian participation at all senior levels. In addition, it defines procurement targets and standards for local goods and services that assist the mining industry (including R&D, technical and engineering services, insurance, accounting, legal, and financial services as well as security, transport, fuel provision, etc.). Lastly, licensees may be obliged to list at least 20 percent of their equity on the Ghana Stock Exchange.

# CHAPTER FOUR

# DATA ANALYSIS, PRESENTATION, AND DISCUSSION OF RESULT



## 4.1 Introduction

The analysed data is presented in this chapter. This study included descriptive statistics, exploratory factor analysis, and confirmatory factor analysis. The hypotheses were tested using SmartPLS 4. In the discussion, the researcher goes further into the importance of the results and draws links to related studies.

## 4.2 Exploratory Factor Analysis

Exploratory factor analysis was performed in the research to add some basic checks and balances to the accumulated data. SPSS was the tool of choice for this purpose. Non-response bias and common method bias are both explained by a distinct unique set of causes. Extensive study was done, and the results, including some preliminary observations on data quality, were reported in the literature.

## 4.2 Response Rate

A test for response rate was used to analyse the number of people who filled out the survey. The assessment is especially important for longer-term surveys. The duration of data collection was around three months. There was a total of 572 questionnaires sent out, however only 381 responses were received. The response rate was 67%, which is considered to be sufficient for statistical analysis by previous studies (Sun et al., 2022; López, 2022; Lavidas et al., 2022).

**Table 4.1 Response Rate**

| Distributed | Collected | Percentage of Usable |
|---|---|---|
| Response | 381 | 67% |
| Non-Response | 191 | 34% |
| Total | 572 | 100.0% |



### 4.2.2 Test for Common Method Bias and Sampling Adequacy

One of the most often used techniques to identify common method is Harman's single-factor test (Podsakoff et al., 2003). This test reveals whether or not there is a unique factor to which all variables load. This study is performed by doing an Exploratory Factor Analysis (EFA) using a single extraction factor instead of the usual three. As shows in the table 4.1, the variation was 70.144%, and the three retrieved components were responsible for it. In this case, there is no evidence of a common method bias since there was not a single component that emerged and the first factor explained 43.962% of the variation.

Table 4.2 displays the results of a KMO sample adequacy test. The adequacy of the sample, as measured by the KMO, is 0.952. This result demonstrates the strong relationship between values along this dimension, in contrast to the zero and identity matrices. Exploratory factor analysis might potentially provide credible estimates when working with a suitably limited sample size. If the p-value of the data in table 4.2 is less than 0.05, the data are considered to be statistically significant. We may infer that the observed internal correlations between the variables had causes other than chance. Most measuring techniques have substantially improved in order to evaluate the underlying idea.

**Table 4.1 Common Method Bias**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % Of Variance | Cumulative % | Total | % Of Variance | Cumulative % |
| 1 | 10.332 | 43.962 | 43.962 | 10.332 | 43.962 | 43.962 |
| 2 | 3.059 | 19.803 | 63.765 | 3.059 | 19.803 | 63.765 |
| 3 | 1.34 | 6.379 | 70.144 | 1.34 | 6.379 | 70.144 |
| 4 | 0.728 | 3.467 | 73.61 | | | |
| 5 | 0.618 | 2.942 | 76.552 | | | |
| 6 | 0.557 | 2.653 | 79.205 | | | |
| 7 | 0.493 | 2.346 | 81.551 | | | |
| 8 | 0.428 | 2.038 | 83.589 | | | |
| 9 | 0.411 | 1.955 | 85.544 | | | |
| 10 | 0.353 | 1.682 | 87.226 | | | |
| 11 | 0.34 | 1.617 | 88.843 | | | |
| 12 | 0.309 | 1.473 | 90.316 | | | |
| 13 | 0.291 | 1.387 | 91.703 | | | |
| 14 | 0.277 | 1.32 | 93.023 | | | |
| 15 | 0.256 | 1.22 | 94.243 | | | |
| 16 | 0.242 | 1.154 | 95.397 | | | |
| 17 | 0.233 | 1.111 | 96.508 | | | |
| 18 | 0.213 | 1.012 | 97.52 | | | |
| 19 | 0.196 | 0.932 | 98.452 | | | |
| 20 | 0.183 | 0.87 | 99.323 | | | |
| 21 | 0.142 | 0.677 | 100 | | | |
| Extraction Method: Principal Component Analysis. | | | | | | |

**Table 4.2 KMO and Bartlett's Test**

| **KMO and Bartlett's Test** | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | 0.952 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 6424.846 |
| | df | 210 |
| | Sig. | 0.000 |

### 4.2.3 Non-response Bias

The study gathered data from 195 retail businesses and 186 mining sector businesses through questionnaires. The t-test was used to see whether there were statistically significant differences between the mining industry and the retail industry. The data from this study is shown in Table

4.3, and it reveals that the mining industry and the retail industry are statistically insignificant. The p values for supply chain connectivity (p = 0.401), eco innovation (p = 0.124) and eco supply chain (p=0.343) all had significance levels greater than 0.05. (i.e., not significantly different) were all larger than 0.05. (i.e., not significantly different). In light of this finding, the research included information from the two sectors into its subsequent evaluations of the suggested model.

**Table 4.3 Non-response Bias**

| **Levene's Test for Equality of Variances** | | | | | |
|---|---|---|---|---|---|
| | **Industries** | **Mean** | **F** | **Sig.** | **T** |
| Supply Chain Connectivity | Mining | 20.8526 | 0.707 | 0.401 | 2.561 |
| | Retail | 20.0262 | | | |
| Eco Innovation | Mining | 24.8368 | 5.114 | 0.124 | 2.644 |
| | Retailing | 23.7435 | | | |
| Eco Supply Chain | Mining | 40.4579 | 8.348 | 0.343 | 2.429 |
| | Retailing | 38.7906 | | | |

### 4.3 Demographic Information

The following table outlines the participants as well as the organization with about their demographic information. The findings are summarised in the table 4.4 that can be seen below. From the result, 34.6% of the participants appeared to be females whiles 65.4% appeared to be males. The results also showed that 22.6% of the participants were around 18-30 years, 57.5% were around 31-40 years, 13.9% were around 41-50 years and 6.0% of the rest were above 50 years. From the results also, 38.6% of the participants had bachelor's degree, 23.4% had diploma, 14.2% master's/PhD, 8.9% had junior high school certificate, 4.7% hold other certificate and

10.2% of the remaining had senior high school certificate. The result again demonstrated that 24.1% of the participants were business owners, 48.6% were business owners and managers, 15.5% were managers, 9.4% were production managers and 2.4%% hold other position. For the number of years their firms have been in operation, 28.1% of the participants indicated 1-5 years, 22.6% indicated 11-15 years, 8.1% indicated 16 years and above and 41.2% indicated 6-10 years. For the number of employees in their firms, 5.8% of the participants indicated 30-99 employees, 54.1% indicated 6-29 employees, 35.2% indicated more than 100 employees and 5.0% also indicated less than 5 employees. For the type of ownership of their company, 69.6% of the participants indicated fully-locally owned, 10.8% indicated fully-foreign owned and 19.7% also indicated jointly Ghanaian and foreign owned.

**Table 4.4 Demographic Information**

| Variables | Frequency | Percent |
|---|---|---|
| ***Gender*** | | |
| Female | 132 | 34.6 |
| Male | 249 | 65.4 |
| ***Age*** | | |
| 18 - 30 Years | 86 | 22.6 |
| 31 - 40 Years | 219 | 57.5 |
| 41 - 50 Years | 53 | 13.9 |
| Above 50 Years | 23 | 6.0 |
| ***Level of Education*** | | |
| Bachelor Degree | 147 | 38.6 |
| Diploma | 89 | 23.4 |
| Graduate Studies (Master / Ph.D) | 54 | 14.2 |
| Junior High School | 34 | 8.9 |
| Others | 18 | 4.7 |
| Senior High School | 39 | 10.2 |
| ***Your Position in the Firm*** | | |
| Business Owner | 92 | 24.1 |
| Business Owner andManager | 185 | 48.6 |
| Manager | 59 | 15.5 |
| Production Manager | 36 | 9.4 |

| | | |
|---|---|---|
| Other | 9 | 2.4 |
| **How many years have your firm been in operation** | | |
| 1-5 Years | 107 | 28.1 |
| 11-15 Years | 86 | 22.6 |
| 16 Years and Above | 31 | 8.1 |
| 6-10 Years | 157 | 41.2 |
| ***How many employees are in the firm?*** | | |
| 30-99 employees | 22 | 5.8 |
| 6-29 employees | 206 | 54.1 |
| More than 100 employees | 134 | 35.2 |
| Less than 5 employees | 19 | 5.0 |
| ***Type of ownership*** | | |
| Fully locally owned | 265 | 69.6 |
| Fully foreign owned | 41 | 10.8 |
| Jointly Ghanaian andforeign owned | 75 | 19.7 |
| **Total** | **381** | **100.0** |



### 4.4 Measurement Model Assessment

The quality of the measurement model was evaluated using the criteria established by Hair et al. (2019). The PLS-SEM program SmartPLS version 4 was used to conduct the analysis (Ringle et al., 2015). The researcher checked that all indicator loadings were more than 0.70 before commencing the research. If the construct can explain over 50% of the variance in the indicator, it's a good sign that its components may be relied upon. According to Table 4.5, the researcher kept only the outer loading components that scored at least 0.700.

#### 4.4.1 Reliability

Two primary methods exist for testing a construct's internal consistency and making sure it's genuine. Examples of such measurements are composite reliability (CR) and Cronbach's alpha (CA). Cronbach's alpha is a reliability test based on correlations across apparent indicator constructs, in contrast to composite reliability (CR), which examines the accuracy with which one set of items predicts another set's latent variable. Constructs are considered to be reliable if their

corresponding Cronbach's alpha (CA) and composite reliability (CR) values are between 0.70 and 0.9. In Table 4.5. It is shown that the CR for eco innovation, eco supply chain and supply chain connectivity extend from 0.909 to 0.955, and the CA spans from 0.867 to 0.948, based on the results of the model's reliability tests. This finding indicates that the model is one-dimensional, yielding the same outcome each time it is executed.

### 4.4.2 Validity

When several different indicators provide similar results for a given construct, then state that the construct has strong convergent validity. It is argued that a test is convergently valid if it correlates well with other tests that use the same or similar criteria (Jensen, 2003). Measures of convergent validity might be empirical or theoretical. Multiple tests may be run on the same item to compare how well they measure the same attribute. Standardied tests are generally agreed upon to be quantitatively equivalent. An example of convergence is a correlation that is rather strong to not-too-weak. Factor loading (FL) and average variance extracted (AVE) are common indicators of convergent validity (AVE). Results of the convergent validity study are shown in Table 4.5. (Ave and FL) Values of loading over 0.7 are preferred, whereas those below 0.7 are not. If the CA, CR, or AVE values are over the threshold, then one should pay attention to the indicators with loadings between 0.4 and 0.7. Eliminating indicators known to reduce CA, CR, and AVE is unnecessary. On the AVE scale, a score of 0.5 or above is often considered good. All indicators had loadings over 0.7, as shown by the results. The AVE was also larger than 0.5, demonstrating that the model was accurate.

Finally, the measurement model's discriminant validity is analysed. Fornell and Larcker (1981) recommended doing this by examining the square root of the AVE for each construct's relationships with one another. As may be seen in table 4.6, the square roots of the AVEs make up

the diagonal components. The non-diagonal elements represent connections among the different constructs. All constructs have enough discriminant validity, since all diagonal elements are greater than their off-diagonal counterparts.

Due to lack of consistency on the Fornell-Larcker criterion, the HTMT ratio of correlations was developed (Hair et al., 2019; Henseler et al., 2015; Voorhees et al., 2016). Many of this research have shown that HTMT scores below 0.90 are preferable. One way to achieve this is to take the geometric mean of the average correlations for scales measuring the same variable and subtract the average value of the items' correlations across constructs (Henseler et al., 2015). According to Table 4.7, the maximum HTMT is 0.749, which is much lower than 0.9.

**4.5 Description of the Data**

The first step of SmartPLS is to provide a high-level overview of the data. The purpose of this analysis is to inform the researcher as to how thoroughly the respondents answered the survey questions. Descriptive statistics provide numerical values to each criterion (such as the mean, median, maximum, standard deviation, excess kurtosis, and skewness, among others). The standard deviation is a statistical measure of the dispersion of data. The average scores for the three categories are 4.05, 3.96, and 4.12 for eco innovation, eco supply chain, and supply chain connectivity respectively. Also, eco innovation, eco supply chain, and supply chain connectivity all had standard deviations of 0.801, 0.816 and 0.742, respectively. The results show that the computed or statistical mean represents the through value of all variables.

**Table 4.5 Reliability, Validity, and Descriptive Statistics**

| Confirmatory Factor Analysis | Factor Loadings | Descriptive Statistics | | VIF |
|---|---|---|---|---|
| **Scale** | **(t-value)** | **Mean** | **SD** | |
| ***Eco Innovation (CA=0.920; CR=0.937; AVE=0.714)*** | | | | |
| EI1 | 0.820(30.367) | 4.10 | 0.789 | 2.535 |
| EI2 | 0.826(26.869) | 4.09 | 0.787 | 2.496 |
| EI3 | 0.860(30.067) | 3.98 | 0.827 | 3.125 |
| EI4 | 0.874(33.154) | 4.07 | 0.803 | 3.108 |
| EI5 | 0.853(30.975) | 4.00 | 0.824 | 3.234 |
| EI6 | 0.836(26.873) | 4.05 | 0.776 | 2.551 |
| ***Eco Supply Chain (CA=0.948; CR=0.955; AVE=0.681)*** | | | | |
| ESC1 | 0.815(21.025) | 3.921 | 0.863 | 3.290 |
| ESC10 | 0.806(20.593) | 3.937 | 0.814 | 2.471 |
| ESC2 | 0.811(26.247) | 4.01 | 0.784 | 3.312 |
| ESC3 | 0.792(16.405) | 3.961 | 0.811 | 2.560 |
| ESC4 | 0.823(23.349) | 3.913 | 0.851 | 2.878 |
| ESC5 | 0.853(26.834) | 3.929 | 0.84 | 3.580 |
| ESC6 | 0.838(23.900) | 4.016 | 0.773 | 3.330 |
| ESC7 | 0.797(18.678) | 3.982 | 0.805 | 2.431 |
| ESC8 | 0.868(27.914) | 3.987 | 0.821 | 3.750 |
| ESC9 | 0.845(24.104) | 3.966 | 0.798 | 3.405 |
| ***Supply Chain Connectivity (CA=0.867; CR=0.909; AVE=0.714)*** | | | | |
| SCC2 | 0.863(27.500) | 4.07 | 0.739 | 2.181 |
| SCC3 | 0.856(24.695) | 4.11 | 0.753 | 2.172 |
| SCC4 | 0.841(25.551) | 4.16 | 0.735 | 2.107 |
| SCC5 | 0.820(24.158) | 4.12 | 0.741 | 1.855 |

**Table 4.6 Fornell-Larcker test**

| **Constructs** | **1** | **2** | **3** |
|---|---|---|---|
| Eco Innovation | **0.845** | | |
| Eco Supply Chain | 0.701 | **0.825** | |
| Supply Chain Connectivity | 0.660 | 0.573 | **0.845** |

**Table 4.7 HTMT Test results**

| Constructs | 1 | 2 | 3 |
|---|---|---|---|
| Eco Innovation | | | |
| Eco Supply Chain | 0.749 | | |
| Supply Chain Connectivity | 0.738 | 0.631 | |



### 4.6 Model Fit Summary

Fitness of Extracted-Index, SRMR, Root Mean Square of Approximation, and Chi-Square values and ranges are discussed (Table 4.8). Extracted and Rare both fall short of the allowed 0.9. Having a finite value means that the residual is not endlessly small if it has a square root or common root. Therefore, future studies must carefully analyse all important information and perspectives.

**Table 4.8 Fit Summary**

| Indices | Saturated model | Estimated model |
|---|---|---|
| SRMR | 0.048 | 0.048 |
| d_ULS | 0.478 | 0.478 |
| d_G | 0.342 | 0.342 |
| Chi-square | 757.304 | 757.304 |
| NFI | 0.877 | 0.877 |

### 4.7 Coefficient of Determination and Predictive Power of the PLs Model

The researcher checked the measurement model first, then assessed the reliability of the underlying structural model and predicted associations. The research eliminates the chance of false positives by first checking for collinearity and then assessing the structural correlations. In order to account for these unexplained elements, VIF were determined. Data from table 4.5 shows that VIF values

are much lower than the required 3.3 average (Hair et al., 2019). To evaluate how effectively the model captured the sample data, some researchers have looked at the R2 values of the endogenous variables. The R2 value between 0.75 and 0.50 suggests a strong and moderate correlation, whereas values below 0.25 indicate a weak connection (Hair et al., 2011). R2 values of 0.436 and 0.513 can be shown in Table 4.9 and Figure 4.1 for eco innovation and eco supply chain, respectively. The predictive potential of each of these numbers is greater.

Q2 is another metric that may be used to assess the PLS path model's prediction ability (Geisser, 1974; Stone, 1974). It's possible that an internally developed data-reliant structural model may be found to be significant when Q2 reaches a certain level (Hair et al., 2019). The model's predictive ability is seen in Table 4.9, where Q2 scores of 0.432 and 0.323 for eco innovation and eco supply chain respectively demonstrate the model's effectiveness.

**Table 4.9 Coefficient of Determination and Predictive Power of the PLs Model**

| Endogenous Constructs | R-square | $Q^2$predict |
|---|---|---|
| Eco Innovation | 0.436 | 0.432 |
| Eco Supply Chain | 0.513 | 0.323 |

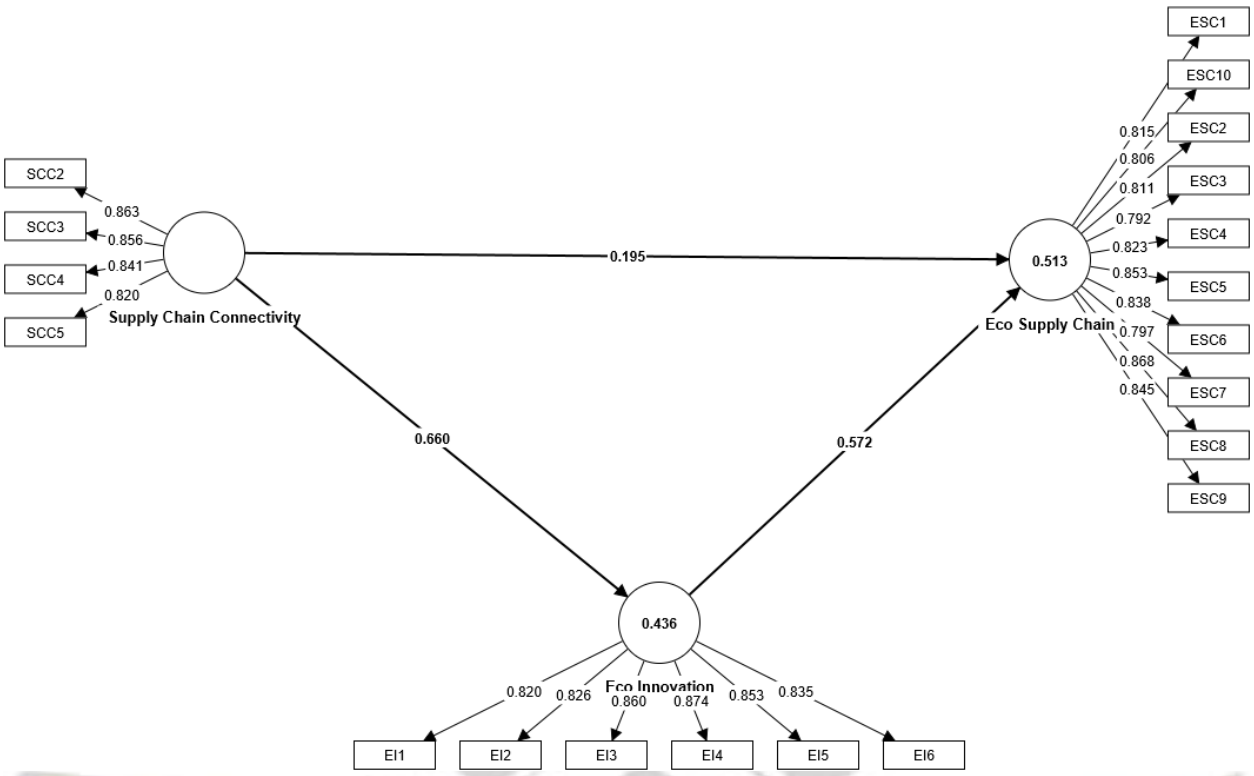


**Figure 4.1 Measurement Model Assessment**

### 4.7 Hypotheses for Direct and Indirect Relationship

SmartPLS 4 was used to examine the four hypotheses that were introduced to the research. The primary purpose of this research is to analyze the impact of supply chain connectivity on eco supply chain, with eco innovation in Ghana's mining sector serving as a mediator. Table 4.10 and Figure 4.2 below summarize the results.

This study set out to first examine the role that supply chain connectivity plays in the eco supply chain of the Ghanaian mining industry. The result in table 4.10 and figure 4.2 show a positive association between supply chain connectivity and eco supply chain in the Ghanaian mining industry (B=0.195; t=3.290; p-value=0.001 <0.05). This study's findings provide support to the researcher's assumption that there is a correlation between the variables studied. It also shows that supply chain connectivity may account for 19.5% of the variance in the eco supply chain of the

Ghanaian mining industry (assuming all other variables are equal). Findings from this study imply that a more fair and long-lasting improvement in the mining sector eco supply chain may be possible if leaders in Ghana's mining industry put a higher focus on supply chain connectivity.

The second objective of this study was to investigate the relationship between supply chain connectivity and eco-innovation in Ghana's mining industry. Eco innovation in the industry is shown to be significantly affected by the degree to which businesses in the sector use connected supply chains, as shown in Table 4.10 and Figure 4.2 (B=0.660; t=19.227; p-value=0.000 <0.05). The findings of this research provide support to the idea that the two factors are interconnected. These findings suggest that supply chain connectivity explains for 66.0% of the variation in eco-innovation, with other factors being held constant. To really advance eco-innovation, the mining industry must highlight its success in promoting supply chain connectedness.

Thirdly, the study set out to see whether the adoption of eco-innovation had an effect on the mining industry's capacity to improve its eco-supply chain. A positive and statistically significant correlation between eco innovation and eco supply chain in the mining industry is shown in table 4.10 and figure 4.2 (B=0.572; t=10.876; p-value=0.000 <0.05). The results support the idea that the two hypotheses are related. This adds weight to the argument that changes in the eco supply chain may underlie the mining industry's developing support for eco innovation. Accordingly, this accounts for 57.2% of the variability present in eco supply chains. These results point to the benefits that eco-innovation in the mining sector may bring to management.

The study's fourth goal was to determine whether or not eco-innovation mediates the connection between supply-chain connectivity and eco-supply-chain in the mining industry. The results in table 4.10 and figure 4.2 shows that eco innovation serves as a significant mediator between supply

chain connectivity and eco innovation in the mining industry (B=0.378; t=10.948; p-value=0.000 <0.05). In line with expectations, this study's findings provide credence to the hypothesized relationship between the factors. In addition, eco innovation may explain the observed association between supply chain connectivity and eco supply chains in the mining industry (37.8%). (When all other factors are held constant). This study's findings highlight the need of eco innovation at the highest levels of mining sector organizations for optimizing the beneficial effects of supply chain connectivity and eco supply chains.

**Table 4.10 Hypotheses for Direct and Indirect Relationship**

| **Hypotheses** | **Original sample (O)** | **Standard deviation (STDEV)** | **T statistics (\|O/STDEV\|)** | **P values** |
|---|---|---|---|---|
| Supply Chain Connectivity -> Eco Supply Chain | 0.195 | 0.059 | 3.290 | 0.001 |
| Supply Chain Connectivity -> Eco Innovation | 0.660 | 0.034 | 19.227 | 0.000 |
| Eco Innovation -> Eco Supply Chain | 0.572 | 0.053 | 10.876 | 0.000 |
| Supply Chain Connectivity -> Eco Innovation -> Eco Supply Chain | 0.378 | 0.035 | 10.948 | 0.000 |

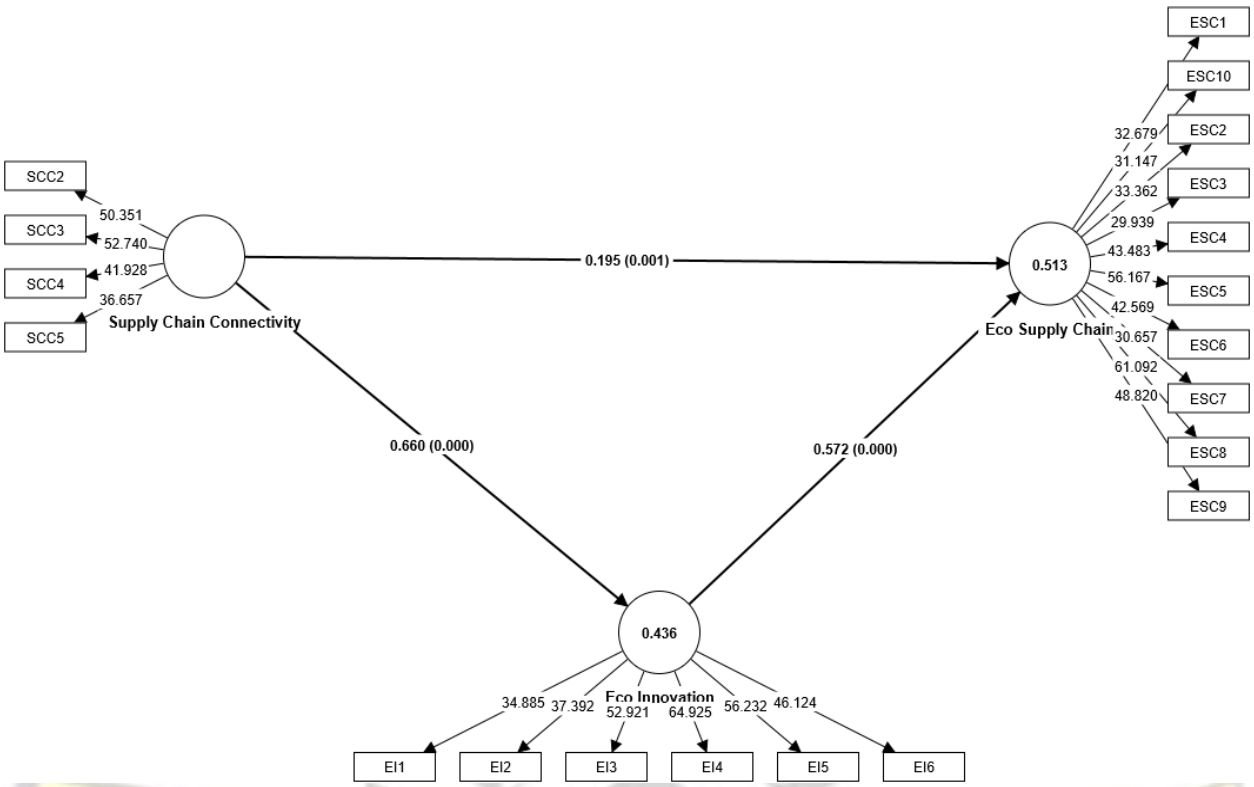


**Figure 4.2 Structure Model Evaluation**

## 4.8 Discussion of Results

This section will provide a brief summary of the relevant literature, with a focus on the study's most salient findings. The primary purpose of this research is to analyze the impact of supply chain connectivity on eco supply chain, with eco innovation in Ghana's mining sector serving as a mediator. The outcomes may be sorted into the groups described below.

This study set out to first examine the role that supply chain connectivity plays in the eco supply chain of the Ghanaian mining industry. The result showed a positive association between supply chain connectivity and eco supply chain in the Ghanaian mining industry (B=0.195; t=3.290; p-value=0.001 <0.05). This study's findings provide support to the researcher's assumption that there is a correlation between the variables studied. It also shows that supply chain connectivity may account for 19.5% of the variance in the eco supply chain of the Ghanaian mining industry

(assuming all other variables are equal). Findings from this study imply that a more fair and long-lasting improvement in the mining sector eco supply chain may be possible if leaders in Ghana's mining industry put a higher focus on supply chain connectivity. The result corroborates with Manfred (2018), who did research in an attempt to answer the question "Does global supply chain connectivity matter?" that accords with the findings presented in by looking at the costs of trade in Africa. When they evaluate intraspecific and extra-African trade costs separately, they discovered that a country's potential to reduce transactions costs and trade globally depends on its connection to the worldwide supply chain. The findings are consistent with those of Yuliantoro et al. (2019) and Zhang et al. (2007), who discovered that a company's efficiency is much improved by its supply chain's connectivity to environmentally friendly suppliers.

The second objective of this study was to investigate the relationship between supply chain connectivity and eco-innovation in Ghana's mining industry. The findings demonstrated that eco innovation in the industry is shown to be significantly affected by the degree to which businesses in the sector use connected supply chains (B=0.660; t=19.227; p-value=0.000 <0.05). The findings of this research provide support to the idea that the two factors are interconnected. These findings suggest that supply chain connectivity explains for 66.0% of the variation in eco-innovation, with other factors being held constant. To really advance eco-innovation, the mining industry must highlight its success in promoting supply chain connectedness. This conclusion agrees with Thamsatitdej et al. (2017), which prioritizes eco-design in sustainable supply chain management. Based on the findings, it is clear that introducing products into the market is a vital step in advancing eco-design methodology toward more sustainable supply chain management. These findings are consistent with those of Liu et al. (2021), who conducted an analysis of the upstream and downstream supply chain financial advantages and the factors underlying, and concluded that

supplier eco-design is beneficial to improving the overall financial gains for producers and suppliers.

Thirdly, the study set out to see whether the adoption of eco-innovation had an effect on the mining industry's capacity to improve its eco-supply chain. The results showed a positive and statistically significant correlation between eco innovation and eco supply chain in the mining industry (B=0.572; t=10.876; p-value=0.000 <0.05). The results support the idea that the two hypotheses are related. This adds weight to the argument that changes in the eco supply chain may underlie the mining industry's developing support for eco innovation. Accordingly, this accounts for 57.2% of the variability present in eco supply chains. The findings are consistent with the stakeholder's theory, which postulates that the structure and nature of the network of linkages to other interested parties and partnerships that these limitations are rooted in have a major impact on whether or not an eco-innovation is accepted (Freeman et al., 2020). These results point to the benefits that eco-innovation in the mining sector may bring to management. This finding is consistent with the findings of Geng et al. (2021), who studied the effects of eco-innovation on the performance of Chinese SMEs and MNCs. The findings support the idea that conventional environmental management techniques may be improved by including certain eco-innovation initiatives. Findings from research on eco-innovation, sustainable development, and distribution network management in European industry conducted by Costantini et al. (2017) are corroborated by the present study. The study's findings show that eco-innovations may have positive effects on the environment and also help mitigate some of the threats to it. The findings back up Bag et al. (2022), research on how eco-innovation influences environmentally friendly supply chain management, circular economy capacity, and the efficiency and effectiveness of SMEs. The research showed that eco-

innovation environmentally friendly supply chain management and SMEs' performance considerably.

The study's fourth goal was to determine whether or not eco-innovation mediates the connection between supply-chain connectivity and eco-supply-chain in the mining industry. The results in showed that eco innovation serves as a significant mediator between supply chain connectivity and eco innovation in the mining industry (B=0.378; t=10.948; p-value=0.000 <0.05). In line with expectations, this study's findings provide credence to the hypothesized relationship between the factors. In addition, eco innovation may explain the observed association between supply chain connectivity and eco supply chains in the mining industry (37.8%). (When all other factors are held constant). This study's findings highlight the need of eco innovation at the highest levels of mining sector organizations for optimizing the beneficial effects of supply chain connectivity and eco supply chains. The findings are consistent with the stakeholder theory's contention that factors inside an organization's existing network, such as authoritarian influences, supply chain connections, and eco-supply chain impacts, might affect the adoption of eco-innovation (Freudenreich et al., 2020). This finding lends credence to the work of Hojnik et al. (2018), which, via an examination of the mediating influence of eco-innovation, examines the connection between internationalization and firm economic success. The study's results demonstrated a positive and statistically significant relationship between internationalization and economic success at the business level, with eco-innovation serving as a partial mediator of this impact. The findings are consistent with those of Juniati et al. (2019), who investigate the function of eco innovation as a mediator between globalization and firm performance and competitive advantage among Malaysian MNCs. According to the findings, eco-innovation plays a pivotal role as a mediator between globalization and company success.

# CHAPTER FIVE

# SUMMARY, CONCLUSION, AND RECOMMENDATIONS

## 5.1 Introduction

This chapter concludes the study with a brief discussion of the study's findings and recommendations for further inquiry. The study's limitations as well as some suggestions for further research are discussed.

## 5.2 summary

The primary purpose of this research is to analyze the impact of supply chain connectivity on eco supply chain, with eco innovation in Ghana's mining sector serving as a mediator. Following this, the study provides a concise summary of the study's primary conclusions, which were drawn from the results of the research and the previously published literature. According to the stated goals of the study, the results are presented in a logical progression.

### 5.2.1 Effect of Supply Chain Connectivity on Eco Supply Chain

This study set out to first examine the role that supply chain connectivity plays in the eco supply chain of the Ghanaian mining industry. The result showed a positive association between supply chain connectivity and eco supply chain in the Ghanaian mining industry. This study's findings provide support to the researcher's assumption that there is a correlation between the variables studied. It also shows that supply chain connectivity may account for variance in the eco supply chain of the Ghanaian mining industry. Findings from this study imply that a more fair and long-lasting improvement in the mining sector eco supply chain may be possible if leaders in Ghana's mining industry put a higher focus on supply chain connectivity.

### 5.2.2 Effect of Supply Chain Connectivity on Eco Innovation

The second objective of this study was to investigate the relationship between supply chain connectivity and eco-innovation in Ghana's mining industry. The findings demonstrated that eco innovation in the industry is shown to be significantly affected by the degree to which businesses in the sector use connected supply chains. The findings of this research provide support to the idea that the two factors are interconnected. These findings suggest that supply chain connectivity explains for some variations in eco-innovation, with other factors being held constant. To really advance eco-innovation, the mining industry must highlight its success in promoting supply chain connectedness.

### 5.2.3 Effect of Eco Innovation on Eco Supply Chain

Thirdly, the study set out to see whether the adoption of eco-innovation had an effect on the mining industry's capacity to improve its eco-supply chain. The results showed a positive and statistically significant correlation between eco innovation and eco supply chain in the mining industry. The results support the idea that the two hypotheses are related. This adds weight to the argument that changes in the eco supply chain may underlie the mining industry's developing support for eco innovation. Accordingly, this accounts for variability present in eco supply chains.

### 5.2.4 The Mediating Effect of Eco Innovation on the link between Supply Chain Connectivity and Eco Supply Chain

The study's fourth goal was to determine whether or not eco-innovation mediates the connection between supply-chain connectivity and eco-supply-chain in the mining industry. The results in showed that eco innovation serves as a significant mediator between supply chain connectivity and eco innovation in the mining industry. In line with expectations, this study's findings provide credence to the hypothesized relationship between the factors. In addition, eco innovation may

explain the observed association between supply chain connectivity and eco supply chains in the mining industry. This study's findings highlight the need of eco innovation at the highest levels of mining sector organizations for optimizing the beneficial effects of supply chain connectivity and eco supply chains.



**5.3 Conclusion**

Specifically, this study aims to examine the role that eco-innovation in Ghana's mining industry plays as a mediator between supply chain connectivity and eco-supply chain. The quantitative data in the study were analyzed using deductive reasoning, and the research design was a cross-sectional explanatory survey. The study's sampling processes, research equipment design, and analysis were all influenced by a quantitative methodology. The study's population refered to all of the permanent workers at the sampled Tarkwa mining enterprises. A total of 381 employees from mining and retail companies who have substantial first-hand knowledge of the issue under study filled out the survey. Using a method known as stratified sampling, study chose the individuals who took part. The assumptions of the investigation were checked using Structural Equation Modeling (SmartPLS 4). Data was summarized using descriptive statistics in the study. The findings demonstrated the positive and significance effect of the supply-chain connectivity in the mining industry's eco supply chain. The research also showed that eco-innovation has a major effect on eco-supply chains, mediating the relationship between supply chain connectivity and eco-supply chain. Based on the results, managers in the mining industry may be able to improve eco supply chains by increasing connectedness and eco-innovation along supply chains.

**5.4 Recommendation**

The study aims to examine the role that eco-innovation in Ghana's mining industry plays as a mediator between supply chain connectivity and eco-supply chain. The findings demonstrated the

positive and significance effect of the supply-chain connectivity in the mining industry's eco supply chain. The research also showed that eco-innovation has a major effect on eco-supply chains, mediating the relationship between supply chain connectivity and eco-supply chain. Based on the results, managers in the mining industry may be able to improve eco supply chains by increasing connectedness and eco-innovation along supply chains. Following are some recommendations based on these findings.

- Supply chain connectivity significantly affects eco supply chain, as shown by the mining industry in Ghana. According to the findings, a stronger focus on supply chain connectedness is all that is needed to improve the effectiveness of eco supply chains across all mining sectors. Therefore, it is critical for the management of mining sector businesses to ensure that communication products are fully interconnected all through the supply chain, that knowledge implementations are fully embedded inside their company, that appropriate information system design interconnections exist with customers and suppliers, and that updated information systems fulfills distribution network cultural context.
- Ecological advancement seems to be assumed in light of the data presented herein. The mining industry's managers are tasked with fostering eco-innovation through a variety of means, including the introduction of new products that primarily involve adjustments to current technologies and/or products with reduced environmental consequences, the introduction of new items that have suddenly realized significant drop in the ecological impact of goods, the introduction of eco-innovations that led to the (near-)complete removal of harmful substances in manufacturing process, and the introduction of major changes in how our products are designed and manufactured.

- The results indicated that eco innovation played a mediating role between supply chain connectivity and eco supply chain. When eco innovation is emphasized by management at companies in the mining industry, the impact of supply chain connectivity on the eco supply chain will be greatly enhanced. Policymakers in the mining industry should encourage and promote the development of markets for eco-innovative solutions by adjusting the legislative environment.

### 5.5 Limitations and Future Research Directions

This research has many positive aspects, but it also has certain limitations. To begin, future investigations would benefit from a larger sample size than the one used in the current study. This study investigated the role that eco innovation had as a mediator between supply chain connectivity and eco supply chains. Moderating elements that may have an intervening role in the influence of supply chain connectivity and eco supply chain should be included in future studies of this connection. Second, since it was collected via a web-based questionnaire, the information is cross-sectional in nature. Given that the strength of links among variables in the research model may fluctuate over time, a longitudinal study involving the same participants may be conducted in the future to gain insight into what and how the linkages of supply chain connectivity and eco supply chain grow. The fact that the research was only applied to the mining industry is another possible drawback. Further research in other areas is needed to confirm the findings.

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## APPENDIX

### SURVEY QUESTIONNAIRE

Dear Sir/ Madam,

My name is ……..., 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 carry out research on the topic: **The effect of supply chain connectivity on eco supply chain: the mediating role of eco innovation in the mining industry of 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: RESPONDENT'S BIOGRAPHY AND COMPANY PROFILE

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

Please answer the following questions:

1. *Gender*: Male ☐ Female ☐
2. *Age*
   18-30 years ☐ 31-40 year's ☐ 41-50 years ☐ Above 50 years ☐
3. *Level of Education*
   Junior High School ☐ Senior High School ☐ Diploma ☐ Bachelor Degree ☐ Graduate Studies (Master / Ph.D.) ☐ Others ☐ For Others, Please specify:……
4. *Your Position in the Firm*
   Business Owner ☐ Business Owner and Manager ☐ Manager ☐ Production Manager ☐ Others ☐……
5. *How many years have your firm been in operation?*
   1 - 5 years ☐ 6 - 10 years ☐ 11 – 15 years ☐ 16 years and above ☐
6. *How many employees are in the firm?*
   Less than 5 employees ☐ 5 – 29 employees ☐ 30 – 99 employees ☐ More than 100 ☐
7. Type of ownership:

[ ] Fully locally owned [ ] Fully foreign owned [ ] Jointly Ghanaian andforeign owned

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**SECTION B: Supply Chain Connectivity**

To what extent do the following statements describe the level of adaptation made by your firm at the start of the relationship with this supplier by checking the appropriate number from 1 to 5 using the following scale: (1=Not at all – 5=A very great extent)

| **Supply Chain Connectivity (**Fawcett, S. E., Osterhaus, P., Magnan, G. M., Brau, J. C., andMcCarter) | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Information systems are highly integrated throughout the supply chain | | | | | |
| Information applications are highly integrated within the firm | | | | | |
| Adequate information systems linkages exist with customers | | | | | |
| Adequate information systems linkages exist with suppliers | | | | | |
| Current information systems satisfy supply chain communication requirements | | | | | |

**SECTION C: Eco Innovation (Hofman, P. S., Blome, C., Schleper, M. C., andSubramanian, N. (2020)**

To what extent do the following statements describe the level of adaptation made by your firm at the start of the relationship with this supplier by checking the appropriate number from 1 to 5 using the following scale: (1=Not at all – 5=A very great extent)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Our firm has introduced new or improved products or services that are more environmentally friendly than those already on the market. | | | | | | | |
| Our firm has made small changes in our products that mainly involve small adjustment in existing technologies and/or products with small reduction of environmental impacts. | | | | | | | |
| Our firm has made changes in our products that have realised substantial reductions in environmental impacts of our products. | | | | | | | |
| Our firm has made eco-innovations that led to (near to) complete removal of hazardous substances in our production process. | | | | | | | |
| Our firm has made big changes in our production processes that led to (close to) zero emission of waste. | | | | | | | |
| Our firm has made big changes in our production processes that led to (close to) zero emission of wastewater | | | | | | | |

**SECTION D: Eco Supply Chain (Ageron et al. (2012), Bag (2014), Murphy and Poist (2003), Stock (1998; Zeng, H., Chen, X., Xiao, X., andZhou, Z. (2017)**

To what extent do the following statements describe the level of adaptation made by your firm at the start of the relationship with this supplier by checking the appropriate number from 1 to 5 using the following scale: (1=Not at all – 5=A very great extent)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Clean energy such as solar or wind is used during production processes | | | | | | | |
| Environmentally friendly production technology and production processes are emphasised | | | | | | | |
| The firm attaches great importance to environmentally friendly product design (such as green design, product life cycle analysis, etc.) | | | | | | | |
| The firm sells waste and used materials to other firms | | | | | | | |
| The firm optimises logistics facility location to reduce the demand for logistics | | | | | | | |
| Efficient modes of transportation between logistics facilities are used | | | | | | | |
| The development and implementation of rules and regulations in environmental protection are evaluated when selecting dealers | | | | | | | |
| The firm considers its ability to provide environmentally conscious products and packaging when selecting dealers | | | | | | | |
| The firm designs/optimises ways to recycle waste materials and spare parts | | | | | | | |
| A waste product recycling, classification, and processing centre is established | | | | | | | |

***Thank you for participating in the survey.***