

**E-procurement and supply chain performance
in emerging economies: A study of
manufacturing sector in Ghana**

**A Thesis Submitted for the
Degree of Doctor of Philosophy**

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ABSTRACT

Electronic procurement has become one of the leading methods for purchasing goods and services in today's competitive environment. Research indicates that e-procurement influences business outcomes, including the output of the supply chain. However, factors that affect the relationship between e-procurement and supply chain performance have not received significant attention in the procurement literature. Based on this the current research aimed at investigating the effects of e-procurement on supply chain performance, as well as the mediating role of supplier efficiency and quality of information. The study further tested the interaction effects of perceived ease of use, perceived usefulness and top management support on the link between e-procurement and supply chain performance. Structured questionnaire was used to obtain data from a sample of 439 employees from the manufacturing sector in Ghana. The study was guided by the Technology Acceptance Model theory. Structural equation modelling was used to test the direct effects, mediation and moderation effects of the intervening variables. The findings indicate that, statistically, e-procurement exerts positive and significant influence on supply chain performance and drives supplier efficiency and quality of information. However, the effect of supplier efficiency on supply chain performance proved otherwise. Quality of information exerts a significant positive effect on supply chain performance. Furthermore, supplier efficiency and quality of information were found to be significant mediators between e-procurement and supply chain performance. Regarding the moderating effects, the interaction effect of perceived ease of use is statistically significant on the link between e-procurement and supply chain performance, but perceived usefulness and top management support are statistically insignificant. Theoretically, the study deepens the understanding of the mediating and moderating mechanisms that influence the relationship between e-procurement and supply chain performance in the manufacturing sector in a developing economy. The study has valuable implications for industry players, particularly procurement and supply chain management professionals and policy makers seeking to improve procurement and enhance the performance of their supply chains.

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LISTS OF ABBREVIATIONS

EP	Electronic procurement
SCP	Supply chain performance
SEM	Structural equation modelling
CB-SEM	Covariance based structural equation modelling
AVE	Average variance extracted
CFA	Confirmatory factor analysis
HTMT	Heterotrait-monotrait
KMO	Kaiser-Meyer-Olkin
MCAR	Missing completely at random
PLS-SEM	Partial Least Squares Structural Equation Modelling
SPSS	Statistical Package for the Social Sciences
CFI	Comparative fit index
GFI	Goodness of fit index
TLI	Tucker-Lewis index
RMR	Root Mean-Square Residual
RMSEA	Root Mean-Square Error of Approximation
RMR	Root Mean-Square Residual
VIF	Variance inflation factor
PEU	Perceived ease of use
PU	Perceived usefulness
TM	Top management support
SE	Supplier efficiency
QI	Quality of information

DEDICATION

To my cherished parents, Mr. Alexander Boampong Gyabaah and Ms. Comfort Gyau.

*To my lovely wife and children, Abigail Adomako Gyabaah (Mrs.), Nana A. S. Gyabaah,
Yaw D. B. Gyabaah and Afia B. O. Adomako.*

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DECLARATION

I declare that this thesis does not have any material that has been previously submitted, in whole or in part, for a degree at Brunel University of London or any other institution. I further affirm that this thesis represents my independent work. All ideas, information, and conclusions presented in this thesis are the result of my effort, except where specific acknowledgements have been made to the contributions of others.

CHAPTER 1

INTRODUCTION

1.1 Research Background

Purchasing can account for the majority of a company's spending and as a result the introduction of internet-based electronic procurement has been recognised as major transformation because of its potential to minimise total acquisition costs (Brandon-Jones and Kauppi, 2018; Piotrowicz and Irani, 2010; Trkman and McCormack, 2010; Gunasekaran et al., 2009; Croom, 2000). To ensure optimal business functionality, firms must ensure cost control and cost reduction of their operations while meeting organisational goals and objectives (Musau, 2018). As a result, the extant procurement literature asserts that applying the right procurement practices is crucial for business success, survival and overall performance (Rotchanakitumnuai, 2013; Bayazit, 2014; Vaidyanathan et al., 2012; Tatsis et al., 2006).

From a general perspective, procurement means acquiring goods and services from suppliers; either individuals or organisations (Mishra et al., 2007; Sun and Sadeh, 2009; Hope et al., 2021) while e-procurement is defined as business to business purchasing practice that utilises electronic commerce to identify potential sources of supply to purchase goods and services, to transfer payment, and to interact with suppliers (Pearcy and Giunipero, 2008). Organisations across the globe are showing higher interest in its implementation and it has been hailed as a panacea for increasing delivery speed, reducing errors, and many other managerial lapses (e.g. unethical practice) associated with traditional procurement system (Essig and Arnold, 2001; Gunasekaran et al., 2009). Furthermore, existing studies advocate that automating procurement transactions can lower purchasing costs by 42% (Chen et al., 2022) and contribute to diverse business outcomes (Gonzalez et al., 2019; Masudin et al., 2021) including within the supply chain (Chang et al., 2013; Halikas et al., 2021). Supply chain performance is the outcome of several processes involved in the organisation's supply chain function (Madzimure et al., 2020), thus businesses are highly interested in understanding how their supply chain performs for effective management of the firm (Saleheen et al., 2018).

Although the study of e-procurement and its effect on supply chain performance is gradually taking centre stage in the procurement literature (Chang et al., 2013; Kim et al., 2015; Hellen and Mwangangi, 2015), the existing literature indicates that knowledge about mechanisms that influence the relationship between e-procurement and supply chain performance in the manufacturing sector have not yet received significant attention (Smart, 2010; Chang et al., 2013; Croom and Brandon-Jones, 2007; Puschmann and Alt, 2005).

1.2 Problem statement

E-procurement has gained significant attention in manufacturing and has been used to streamline the procurement process to augment the activities of the supply chain (Andreas and Kleemann, 2016; Mishra et al., 2013; Tiwari et al., 2019). However, it is interesting to note that the overall adoption rate of the e-procurement technique is low, and its impact on businesses has not been fully realised or established, and organisations are in the process of incorporating it into their operations (Sarpong et al., 2017; Quesada et al., 2010; Yu et al., 2015). Moreover, generally, the prior literature demonstrate that the implementation of e-procurement has recorded marginal success (Tatsis et al., 2006; Gunasekaran and Ngai, 2008; Angeles and Nath, 2007; Gunasekaran et al., 2009; Opoku-Fofie et al., 2022). The inconclusive contribution of e-procurement to organisations has raised curiosity among scholars to better understand how it influences the performance of the supply chains across diverse business contexts (Harju et al., 2023; Chang et al., 2013).

Past studies have confirmed that the electronic purchasing technique influences the supply chain of many different types of businesses (Chang et al., 2013; Yornu, 2019). Beside the direct link between e-procurement and supply chain performance, the prior literature demonstrates that their link would be influenced by certain factors including quality of information (Chang et al., 2013), supplier efficiency (Smart's, 2010; Puschmann and Alt, 2005), perceived ease of use (Gamal, 2010), perceived usefulness (Daud et al., 2013; Gamal, 2010) and top management support (Kagande et al., 2022; Wu et al., 2007). However, to date, empirical examination of these relationships is largely absent,

and this represents the primary gap addressed in the present research. Furthermore, most of the studies on e-procurement and supply chain performance have focused on Western, European and Asian countries, with few in the context of African countries whose business orientation may be different. Accordingly, the existing evidence indicates that most research in this field of study has not offered the required attention to how these factors influence the relationship between e-procurement and supply chain performance in the Ghanaian manufacturing. In Ghana, studies that examined the effects of such factors in the manufacturing sector have not focused on their intervening influence on the nexus between e-procurement and supply chain performance (Dadzie et al., 2024; Grace et al., 2024; Awuah-Gyawu et al., 2025; Agyabeng-Mensah et al., 2025; Owusu, 2025; Armoh et al., 2023; Danquah et al., 2025)

The aforementioned observations about the extant lines of enquiry in the prior research in this area of study makes it extremely challenging for practitioners of supply chain management to assess the contribution of e-procurement to supply chain performance and the factors that affect their relationship, thus highlighting the need for urgent attention. To address this gap, the current study seeks to examine the mediating role of suppliers' efficiency, quality of information and the moderating role of perceived ease of use, perceived usefulness and top management support on the relationship between e-procurement and supply chain performance in the private manufacturing in Ghana.

1.3 Research questions

The gaps in the literature summarised above highlighted and pointed to the following research questions that this study seeks to answer:

RQ1. What is the mediating role of supplier efficiency on the link between e-procurement and supply chain performances in the manufacturing sector in Ghana?

RQ2. What is the mediating effect of quality of information on the link between e-procurement and supply chain performance in the manufacturing sector in Ghana?

RQ3. What moderating role does top management play to support the influence of e-procurement on supply chain performance in the manufacturing sector in Ghana?

RQ4. What is the moderating role of perceived ease of use on the link between e-procurement and supply chain performance in the manufacturing sector in Ghana?

RQ5. What is the moderating role of perceived usefulness on the link between e-procurement and supply chain performance in the manufacturing sector in Ghana?

1.4 Research aim and objectives

Based on the problem under investigation, the main aim of this study was to assess the impact of e-procurement on supply chain performance in the manufacturing sector in Ghana as well as the mediating role of supplier efficiency, quality of information and the moderating effect of perceived ease of use, perceived usefulness and top management support. To achieve the stated aim, the following specific research objectives were defined and carried out:

1. To conduct a critical examination of the literature on e-procurement and supply chain performance to identify specific current gaps in the extant research.
2. To identify the different factors that could influence the relationship between electronic procurement and supply chain performance.
3. To develop a conceptual framework describing the expected relationships between electronic procurement, supply chain performance, and key proposed influencing factors in the manufacturing sector in Ghana.
4. To empirically test the proposed conceptual model in the context of the Ghanaian manufacturing sector.
5. To provide a new theoretical contribution to the e-procurement and supply chain performance literature and recommendations for further research in this area of study.
6. To provide practical implications and recommendations to improve the implementation of electronic procurement in the manufacturing sector in Ghana.

1.5 Rationale for using Technology acceptance model

The Technology Acceptance Model (TAM) was employed as a theoretical lens to guide the study. The study posits that e-procurement has a direct influence on supply chain performance. This direct link is mediated by quality of information and supplier efficiency,

and is moderated by perceived ease of use, perceived usefulness and top management support. TAM addresses the application of technologies in the organisational context and posits that the acceptance of technology is influenced by a person's willingness to use it (Ma and Liu, 2005). The model predicts acceptance behaviour which involves some specific variables namely perceived ease of use, perceived usefulness, attitude towards use, behavioural intention to use and system usage (Tang and Hsiao, 2016).

TAM is consistent with the aim of the research which seeks to determine how using electronic technology for procurement influences supply chain performance. E-procurement is primarily a technology-based activity within organisations' purchasing transactions (Tatsis et al., 2006; Garrido et al., 2008; Kothari et al., 2005; Hung et al., 2014; Chang and Wang, 2010). Thus, to perform purchases electronically, a certain technology must be employed (Soares-Aguiar and Palma-Dos-Resis, 2008; Chang et al., 2004; Rajkumar, 2001; Raghavan and Prabhu, 2004). The literature demonstrates that acceptance of technology by users in organisational settings is important and their willingness to use the technology drives its usage (Ma and Liu, 2005). The prior procurement literature has applied TAM to explain factors that influence e-procurement usage (Purchase and Dooley, 2010) and linked the acceptance factors with perceived value of e-procurement services to influence continuance intentions to use (Ramkumar (2019). TAM's core theoretical understanding and insight from the procurement literature make it highly appropriate to use as the theoretical lens to explain how e-procurement technologies acceptance and usage influences the business output of the manufacturing sector. The extant literature shows that when organisations adopt and implement e-procurement it leads to positive organisational outcomes (Piotrowicz and Iran, 2010; Trkman and McCormack, 2010; Gunasekaran et al., 2009; Croom, 2000) including supply chain performance (Chang et al., 2013; Halikas et al., 2021; Madzimore et al., 2020; Pattanayak and Punyatoya, 2019; Smart 2010).

The study further posits that the acceptance factors (perceived ease of use and perceived usefulness) moderate the relationship between e-procurement supply chain performance. The TAM model emphasises a link between users' emotions and the use of technology and mainly centers on acceptance of information technology as its core theoretical

foundation (Huang and Huang, 2017). When users perceive that using information technology for purchases will be easy and useful, it motivates them to accept the electronic purchasing technique (Gamal, 2010). The user acceptance of the system is based on perceived usefulness and this promotes a stronger network of activities and equitable distribution of resources, enhances ability to share supply chain related information (Mas'adeh, 2016). Based on this insight, theoretically, perceived ease of use and perceived usefulness can influence the relationship between e-procurement and supply chain performance.

The study also posits that top management support facilitates the relationship between e-procurement and supply chain performance. Top management support is important for e-procurement and supply chain performance (Rotchanakitumnuai, 2013; Young and Poon, 2013; Hsu et al., 2019) (Xiao and Khan, 2024), and it has been shown that top management influences information technology usage (Darmasaputra et al., 2020). In terms of technology adoption, top management demonstrate its support in providing the needed resources (Jiménez et al., 2022). TAM argues that one of the main elements of adopting information systems is resources, which when provided is a source of motivation to use the information system (Sivo et al., 2018). Accordingly, when top management provide support in terms of time, money and equipment it encourages system usage and acceptance (Sivo et al., 2018). Therefore, TAM provides the basis to understand that top management support has a key role for adopting e-procurement technologies to enhance performance of the manufacturing supply chain.

The study also postulates that quality of information mediates the relationship between e-procurement and supply chain performance. Access to the right information is indispensable to procurement (Teo et al., 2010; Bayazit, 2014; Chang, 2013; Ragowsky et al., 1996; Hassandoust et al., 2024) and therefore is important for e-procurement implementation and output of the supply chain (Chang et al., 2013; Chirchir et al., 2015; Xiao and Khan, 2024; Kankam et al., 2023; Marinagi et al., 2015). One of the mechanisms of enhancing supply chain performance by adopting e-procurement is the information technology infrastructure (Croom and BrandonJones, 2005).

Access to the right information promotes system usage and success, thus, it can be anticipated from the TAM perspective that the parties involved in e-procurement transactions driven by right information can improve e-procurement technologies usage to influence supply chain performance of private manufacturing companies.

In conclusion, as e-procurement emerges as technology centered purchasing transaction activity, TAM stands as the appropriate framework for explaining how private manufacturing companies implement e-procurement to improve the performance of the supply chain of the sector.

1.6 Research methodology: Overview

The study examined the effects of electronic procurement on supply chain performance, the mediating effects of supplier efficiency, quality of information and the interaction effects of perceived ease of use, perceived usefulness and top management support. To answer the research questions and achieve the study's objectives, purposive sampling was used to obtain a sample of 600 employees from manufacturing companies located in Greater Accra and Ashanti regions in Ghana. These manufacturing companies produce goods in the electronic/electrical, pharmaceutical, food and beverages/drinks, metals and metal products, chemicals, rubber, plastics, non-metallic product, and machinery, equipment, and furniture manufacturing sectors.

A survey was used to collect data after an extensive literature review was conducted to obtain validated and previously used questions from the previous studies to measure the study constructs (e-procurement, supplier efficiency, quality of information, perceived ease of use, perceived usefulness, top management support and supply chain performance). Specifically, closed questions were used after refining it through face and content validity which led to slight changes in the wording. Before distribution of the questionnaire, letters were sent to the gate-keepers of the manufacturing companies explaining the aim of the current study and its importance and twenty employees were selected from each company. The survey was hosted on the Jisc online survey platform under the control of Brunel University, London. The software generates a link which

allows respondents to have ease of access through their emails to complete the survey. The questions were distributed to the president / managing director / CEO, operations/production manager/senior officers, manufacturing manager/senior officers, procurement manager/senior officers, supply chain/logistics managers/senior officers, information technology manager/senior officers and other senior managers/deputy managers.

The measurement model comprised of reflective constructs and data was analysed through covariance based structural equation modelling (CB-SEM). Before validity and reliability analysis the data was subjected to rigorous data cleansing approaches: missing data evaluation, identification of outliers, non-response bias test, common method bias, test for normality univariate, test for linearity, multicollinearity test, Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity. Exploratory factor analysis was conducted to examine the factor structure of the constructs. The reliability of the constructs was established through indicator reliability, composite reliability and Cronbach's alpha test based on Hair et al. (2021).

The study tested convergent and discriminant validity to help ensure a valid result (Hair et al., 2021; Khuzaine et al., 2020), including the Fornell-Larker (1981) criterion and the Heterotrait-monotrait (HTMT) ratio recommended by (Hair et al., 2021). The final stage of the assessment of the measurement model was confirmatory factor analysis (CFA) intending to test how appropriately the data fitted the proposed structural model (Tavakol and Wetzel, 2020).

The final aspect of the data analysis focused on the structural models which began with testing the direct effects, followed by the mediation analysis and the final stage was the moderation analysis. In summary, ten (10) hypotheses were tested: five direct effects, two mediation effects and three interaction effects.

1.7 Scope and limitations of the study

The study examines the effects of electronic procurement on supply chain performance and further explores the mediating role of supplier efficiency and quality of information as

well as the moderating role of perceived ease of use, perceived usefulness and top management support. The study is confined to these constructs after an extensive literature review in this field of study (including the work of Chang et al. (2013), Croom (2000), Hallikas et al. (2021), Kim et al. (2015), Khan et al. (2022), Masudin et al. (2021), Pattanayak and Punyatoya (2019) and Teo and Lai (2009)). The foundation theory is limited to Technology Acceptance Model theory. Moreover, the research is geographically limited to Ghana and focused on the manufacturing sector. From the methodological perspective, the study employs a quantitative research method. Therefore, the weaknesses associated with quantitative study is the main limitation of this research but valid results have been achieved to enhance theory and practice by using valid and reliable data analysis procedures.

1.8 Significance and contribution of the study

The thesis investigated the effects of e-procurement on supply chain performance using Technology acceptance model (TAM) as theoretical lens to demonstrate how some mechanisms influence their link in the manufacturing sector in Ghana. The current research is important for scholars, managers, practitioners and policymakers in diverse ways.

First, anchored in TAM the study provides the basis for explaining how the users of the e-procurement technologies perform purchasing functions to enhance the supply chain of the private manufacturing companies. Theoretically, the thesis reveals knowledge on the acceptance factors that affect employee behavioural intention to patronize the e-procurement technique (Purchase and Dooley, 2010). When buyers value the e-procurement services, it influences their continuance intentions to use the system (Ramkumar, 2019). User positive attitudes towards e-procurement system assist suppliers to gain strategic benefits when the e-procurement system is utilised (Gamal, 2010). Contextually, e-procurement and supply chain management are regarded as critical for the success and survival of manufacturing companies in Ghana (Ofori and Fuseini, 2020; Sarpong et al., 2017; Musah et al., 2025; Dadzie et al., 2024; Charnor and Quartey, 2024; Ofori et al., 2023). However, little attention has been paid to this sector

regarding e-procurement and how it influences supply chain performance by the research community. Given this, filling this research gap extends knowledge on the influence of e-procurement on supply chain performance in an emerging economy.

Second, the study offers knowledge about the mediating role of supplier efficiency on the link between electronic procurement and supply chain performance. Based on TAM, the e-procurement technology self-efficacy can be enhanced by managers to improve the adoption rate of suppliers (Alaweti et al., 2014). Therefore, external characteristics such as self-efficacy and conditions of technology use (Sholikhah and Sutirman, 2020) influences supplier to use the e-procurement system to perform better to improve delivery. User emotions are linked to use of technology and mainly based upon acceptance of information technology (Huang and Huang, 2017). Thus, supplier intention to use the e-procurement technology influences their overall attitude towards the system. Further, the unique context of the research allows the research community to gain a deeper knowledge about the role of suppliers between e-procurement and supply chain performance in manufacturing sector in a developing economy.

Third, the study offers knowledge about the mediating role of quality of information on the link between e-procurement and supply chain performance. TAM reveals that behavioural intention to use the technology is the driving force of real behaviour because the level at which the user values certain behaviours contribute to the occurrence of the behaviour (Almulla, 2021). TAM postulates the link between user's emotion and information technology (Huang and Huang, 2017). A user's acceptance of the system is the intention to use the system, thus enhances the ability to distribute information about the supply chain (Mas'adeh, 2016). Furthermore, different from the previous literature, the present study exclusively provides an understanding of the critical role of quality of information in bridging the gap between electronic procurement and supply chain performance in the Ghanaian environment, rather than to the usual advanced economy context. The findings of the study enhance the understanding of scholars by revealing the power of information quality in achieving the aim of implementing the internet-based procurement method and supply chain management.

Fourth, the findings of the study reveal the interaction effects of perceived ease of use, perceived usefulness and top management support on the relationship between electronic procurement and supply chain performance. Perceived ease of use motivates users' acceptance of technology in organisations (Ma and Liu, 2005). Their interest to patronise the e-procurement system increases when users perceive that it can be used without any extreme or extra effort to achieve the intended purpose. Thus, when the e-procurement system comes with challenges and become difficult to use, it may discourage the parties of the transaction to utilise the e-procurement technology. Therefore, perceived ease of use is a driving force between e-procurement and supply chain performance. Further, the findings of the study deepen the understanding of the academic community about the perceived ease of use of the electronic procurement system and how this perception influences the user to utilise the procurement technologies to assist the performance of the supply chain, and in a developing nation where limited studies on this subject have been conducted.

Fifth, the study tested the interaction effects of perceived usefulness on the link between e-procurement and supply chain performance. TAM postulates that perceived usefulness influence person's intention to use a technology (Ma and Liu, 2005). The perceived usefulness of the e-procurement system encourages parties of a business transaction to use the system when they perceive that using it will contribute to the success of the transaction. Contrary to this theoretical understanding, the findings of the current thesis indicate that perceived usefulness statistically did not exert any influence on the link between e-procurement and supply chain performance. Furthermore, a comprehensive understanding is offered about the role of perceived usefulness in facilitating the link between e-procurement and supply chain performance in the manufacturing sector where this area of research has received limited attention.

Sixth, the role of top management in supporting the adoption and implementation of electronic procurement to influence the performance of the supply chain has been a central theme in the advanced countries but the emerging economies lack empirical understanding of this subject matter. TAM reveal that behavioural intention to use is the

driving force behind real behaviour because it is the degree at which someone value certain behaviour influences the occurrence of the behaviour (Almulla, 2021), and thus, willingness to perform an action is based on one's intention (Nguyen et al., 2022). Top management's intention to adopt e-procurement technologies encourages its usage to improve supply chain performance. Contrary to this theoretical insight, the effects of top management support was not statistically significant on the relationship between e-procurement and supply chain performance. Therefore, the study extends the understanding of this area of research, giving a novel theoretical and empirical view of top management support as it relates to facilitating the relationship between the e-procurement and supply chain performance.

Seventh, practically, the outcome of the study contributes to helping the efficient management of the supply chain, allowing managers and practitioners to make efficient strategic decisions about e-procurement implementation and supply chain management. Managers are informed through the findings of the current study that a key factor that offers a positive contribution to the supply chain of the manufacturing sector is the implementation of electronic procurement. The online purchasing system helps companies to manage costs and enhance the swift delivery of products and services in the supply chain of manufacturing companies. Furthermore, the findings emphasise the relevance of information with qualities such as accuracy, clarity, and timeliness and its positive contribution to the management of the supply chain of the manufacturing sector. Moreover, suppliers are one of the key partners in the supply chain and users/beneficiaries of such electronic technologies, and hence managers are informed that due to the important role of suppliers, top managers should collaborate with them to ensure successful business transactions.

Eighth, the study reveals that user perception of the internet-based purchasing system affects their willingness to utilise the system. User-perceived ease of use determine their enthusiasm to develop a positive attitude towards the electronic procurement system and the practices of enhancing the effectiveness of the supply chain. Given this, managers are recommended to carefully train the users of the procurement system for optimal gains.

Furthermore, top management are the decision makers of the implementation of the electronic procurement system but may not automatically support for lack of resources, expertise and enthusiasm to recognise the online buying system as a priority. Practitioners are given a valuable insight that top management should be provided with proper information on the need to use electronic procurement as a strategic business practice for enhancing operational effectiveness, increasing profitability and even eradicating fraud.

Ninth, finally, policymakers can use the outcome of the present research as a basis for formulating policies to assist manufacturing companies by providing support in terms of funds and favourable business regulations to boost the use of the online procurement system for enhanced performance. The nations in developing economies can use the findings as a motivating factor to build a stronger communication infrastructure. This will improve the availability of an efficient communication network to help the manufacturing sector to increase the country's Gross domestic product (GDP).

1.9 Thesis structure

The thesis is organised into six (6) chapters:

Chapter One has highlighted the background of the subject matter under study and has elaborated the problem of investigation. The research objectives and questions have been presented, followed by an overview of the methodology, scope and limitations of the study and the significance of the study.

Chapter 2 presents the review of the e-procurement and supply chain performance literature, specifically its background, overview and definitions, e-procurement and wider systems and status of e-procurement in Ghana. The chapter proceeds with an outline of the review methodology, leading to a descriptive analysis and a thematic analysis of the e-procurement and supply chain performance literature. The thematic analysis identified eleven themes, which are (1) adoption of e-procurement (2), drivers of e-procurement, (3) e-procurement systems, (4) implementing e-procurement, (5) benefits of e-procurement, (6) barriers, challenges and risks of e-procurement, (7) effect of e-

procurement practices, (8) usage of e-procurement applications, (9) factors affecting (Including antecedents/enablers) of e-procurement systems, (10) e-procurement and supply chain performance, and (11) overview of theories relating to e-procurement and supply chain performance. Finally, the chapter identifies gaps in the electronic procurement and supply chain performance literature.

Chapter 3 presents the research model. A detailed discussion of the underpinning theory of Technology Acceptance model (TAM) is provided. The study's ten hypotheses, of which five reflect the direct effects of e-procurement on supply chain performance and the relationship between the other variables, two capture the mediating role of supplier efficiency and quality of information, and three capture the moderating role of top management support, perceived ease of use and perceived usefulness, are presented.

Chapter 4 details the research methodology: research paradigm, approach, design, sampling and sampling procedure, and method for data collection, and sets out the procedure for data analysis. Detailed information on sources used to construct the survey questionnaire and justification for their use is provided. The procedure for ensuring the validity and reliability of the measurement instrument is provided. It further describes structural equation modelling (SEM) and provides valuable information on reasons for choosing the method of analysis and parameters for assessing the measurement and structural models. Discussions on direct effect, mediation, and moderation analysis and research ethics are provided.

Chapter 5 presents the data analyses, which includes descriptive statistics of the sample (demographic information of the respondents) and the constructs. This is followed by results obtained from data cleansing techniques which comprise of missing data evaluation, identification of outliers, non-response bias test, common method bias, test for normality univariate, test for linearity, multicollinearity test, Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of Sphericity. The results of validation approaches: exploratory factor analysis (EFA), Cronbach's alpha testing, composite reliability, inter-construct correlation, average variance extracted, confirmatory factor analysis (CFA) and other methods are presented and interpreted. The chapter then presents the results of

hypotheses testing: direct effects, indirect effects (mediation analysis) and interaction effects (moderation effects).

Chapter 6 presents discussion of the main results of the analysis. The results are compared with the previous literature to determine if the current results are in line with or differ from the outcome of the previous research. Accordingly, a detailed discussion is provided to allow scholars and practitioners to acquire knowledge from the results. The chapter further provides the conclusion of the main results and elaborates the theoretical and managerial implications and direction for future research. Conclusions are drawn based on the findings of the study and the direction for future research focuses on important areas that the current thesis could not capture and that the findings indicate are necessary for knowledge enhancement for both scholars and practitioners.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter examines the extant literature to assess the concepts that are applied in the present study in order to guide the research focus and design. The chapter begins by providing the background on electronic procurement in terms of its definition, emergence, adoption and implementation. This is followed by a semi-systematic review. The procedure for the review is discussed, followed by presentation of a descriptive and a thematic analysis of the electronic procurement and supply chain performance literature. The chapter closes by establishing the gaps in the electronic procurement and supply chain performance literature and presents concluding remarks.

2.2 Background

Electronic procurement and supply chain performance respectively have emerged prominently in recent decades, and both have been the subject of many empirical studies over some time (e.g. Kim et al., 2015; Mishra et al., 2007; Purchase and Dooley, 2010; Teo et al., 2009; Charnor and Quartey, 2024; Raghul et al., 2024; Maulidevi et al., 2024). Sections 2.2.1 through 2.2.6 that follow elaborate important aspects of the previous literature relating to electronic procurement and supply chain performance, focusing on their theoretical meaning, their emergence, adoption, application, and wider systems and benefits to organisations.

2.2.1 Electronic procurement (e-procurement): Overview and definitions

Electronic procurement is an internet-based business technique that organisations use to obtain goods and services through electronic systems (Kameshwaran et al., 2007). E-procurement uses the Internet or information communication technology to procure goods and services, and to manage supply chain relationships with contractors for contract of works, for example using the web technology to execute contract payments with an individual or with an organisation (Smart, 2010; Yu et al., 2015).

In e-procurement, the buyer software allows consumers to conduct transactions through electronic technologies and focus on activities such as order placement, catalogue management, payment and reporting (Gunasekaran and Ngai, 2008). Organisations variously implement online purchase systems to increase transparency in business transactions, increase their chances of market accessibility and market competition, and to support and monitor auditing processes to obtain current information on the market (Masudin et al., 2021). Table 1 presents prominent definitions of e-procurement provided in the literature.

Table 1: Definitions of e-procurement

Definition	Source
E-Procurement is the integration, management, automation, optimisation and enablement of a company's purchasing process, employing electronic tools and technologies, and internet applications.	Tatsis et al., (2006).
The use of web technologies in the buying process using network communications technology to engage in a wide range of activities up and down the value-added chain both within and outside the organisation.	Garrido et al. (2008)
E-Procurement is buying goods and services over the internet via web-based technology.	Kothari et al. (2005)
An information technology (IT)-based business model that facilitates the necessary processes conducted between business parties in a purchasing transaction.	Hung et al. (2014)
Using technology for searching, quoting, and acquiring goods or resources through the Internet.	Chang and Wong (2010).
A technology designed to facilitate the acquisition of goods by a commercial or a government organisation over the internet.	Khorana et al. (2014)
Business to business purchasing practice that utilises electronic commerce to identify potential source of supply to purchase goods and services, to transfer payment, and to interact with suppliers	Pearcy and Giunipero, (2008)

2.2.2 Procurement and supply chain management

Before discussing the emergence of e-procurement and its application in wider systems, this section briefly outlines the wider context of procurement and supply chain management.

Procurement refers to all activities that involve a purchasing activity (leasing, renting, acquiring goods, acquiring services) and also generally includes related management tasks associated with managing the external resource inputs of the organisation (Soares-Aguiar and Palma-dos-Reis, 2008; Tai et al., 2010). The extant literature demonstrates a clear association between procurement and supply chain management (Harland et al., 2019; Smart, 2010; Wisner and Tan, 2000; Tripathi and Gupta, 2021), not least because both have become a strategic tool and perform integral function in business strategies (Ogden et al., 2005; Zacharia et al., 2014). Procurement remains one of the valuable techniques of obtaining a sustainable outcome through effective management, production and maintenance of an organisation's supply chain (Singh et al., 2020) whereas supply chain management starts from acquisition of raw materials to delivery of end finished goods and services to the end user (Rossetti and Dooley, 2010; Han and Huang, 2025)

For the manufacturing sector, procurement is an indispensable activity for cost control and reduction and for the efficient delivery of raw materials to feed production (Das and Narasimhan, 2000; Kull et al., 2018). The procurement and supply chain management literature encourage companies to automate their procurement process to enjoy cost benefits and many other associated advantages (Cox, 2001; Gundlach et al., 2019; Meehan and Bryde, 2011; Yustika and Tan, 2021; Dou et al., 2024).

2.2.3 Emergence and adoption e-procurement

The idea of introducing electronic procurement was informed by the advent of web technologies (Goffman, 2004; Walker and Harland, 2008; Yu et al., 2015). The extensive and rigorous usage of information technology in the operations of manufacturing companies can be traced back to the 1960's with the application of electronic data interchange (EDI) protocols then followed by speedy diffusion of electronic funds transfer

(EFT), telemarketing and telebanking systems for commercial relations and cost reduction in the logistics chains (Caridi et al., 2004). EDI and EFT, as early forms of electronic procurement have evolved over time. Nevertheless, as observed by Datta (2011), Khorana et al. (2014), Chan and Owusu (2022) and Walker and Harland (2008) amongst others, many companies are struggling to adjust themselves to the continuous development, and others have in fact made no or minimum attempt to embrace the new procurement approach. Moreover, the adoption of e-procurement systems has been most prevalent in large companies, with the aim of restructuring the traditional procurement process (Ntaganda and Kengere, 2023) as illustrated in figure 1 which depicts e-procurement's evolution pathway.

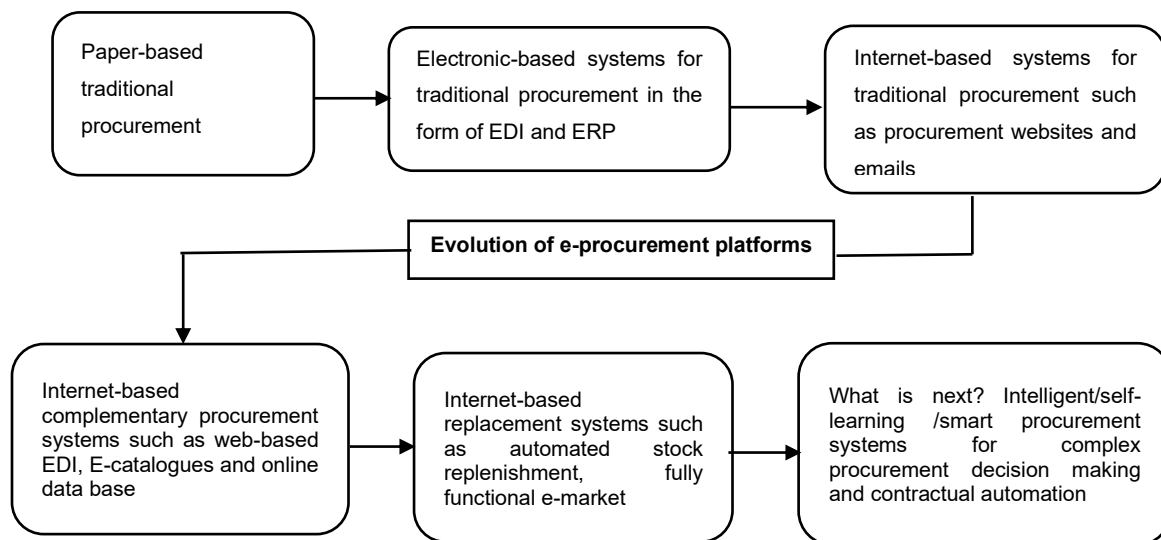


Figure 1: Evolution of e-procurement (Sa'adah, 2020)

2.2.4 E-procurement and wider systems

Electronic procurement systems enable suppliers to place their products on the World Wide Web (www.com) to attract customers, then manage the transaction process, managing orders and receiving payment through the internet (Sarpong et al., 2017). Some of the e-procurement systems are modules in enterprise resource planning (ERP) packages and other groups of information technology (IT) artefacts (Longva, 2019). ERP is a concept, and a system: conceptually, ERP integrates business activities in the organisation with advanced management control, perfect information on inventory,

enhanced workflow, supply chain management and good corporate practices; from a system perspective, ERP is a technological infrastructure organised to deliver the abilities necessary to bring the ERP concept into reality (Al-Mashari, 2001; Matolcsy et al., 2005; Supramaniam and Kuppusamy, 2011). ERP, accordingly, as illustrated in Figure 2 is therefore an enterprise-wide software system based on an integrated database that contains several elements such as financial reporting, accounting, human resource management, and sales just to mention but a few (Katu, 2020).

With regards to procurement, ERP provides internal information about materials available that inform a supplier to meet the demand of the organisation (Tarigan et al., 2021). The integration of all the functional elements in ERP enables the supplier to provide accurate information about the daily status of operations, for marketing, procurement and production departments, aiding them to meet schedules (Tarigan et al., 2021). Using ERP for inventory management facilitates a swift flow of revenue to enable manufacturing firms to manage the cost of operations effectively (Naveed et al., 2016). While e-procurement can be standalone system, as part of an ERP system, ERP enables the distribution of relevant transaction information across the entire organisation.

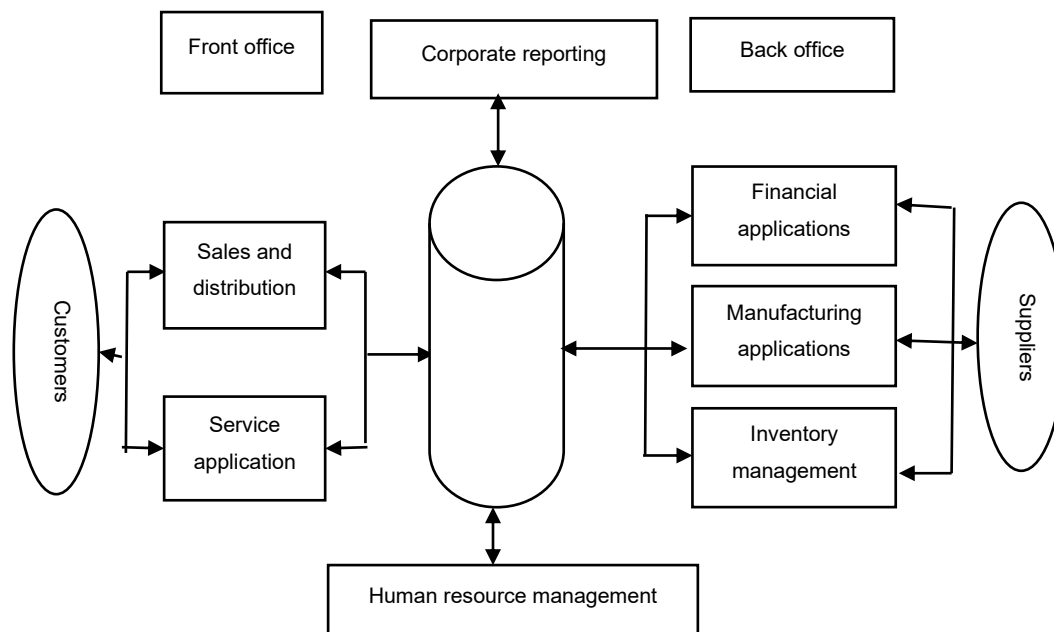


Figure 2: The basic concept of ERP (Andrianto, 2019)

To effectively use ERP, three main stages have been proposed, namely top management planning, operations management planning and execution of plans (Madanhire and Mbohwa, 2016), as illustrated in Figure 3. The ERP uses information technology to accommodate data within a database. The essence of ERP is the management practice of enterprise by data input, analysis and output of information to assist in the decision-making of workers at every part of the organisation (Zhao and Tu, 2021).

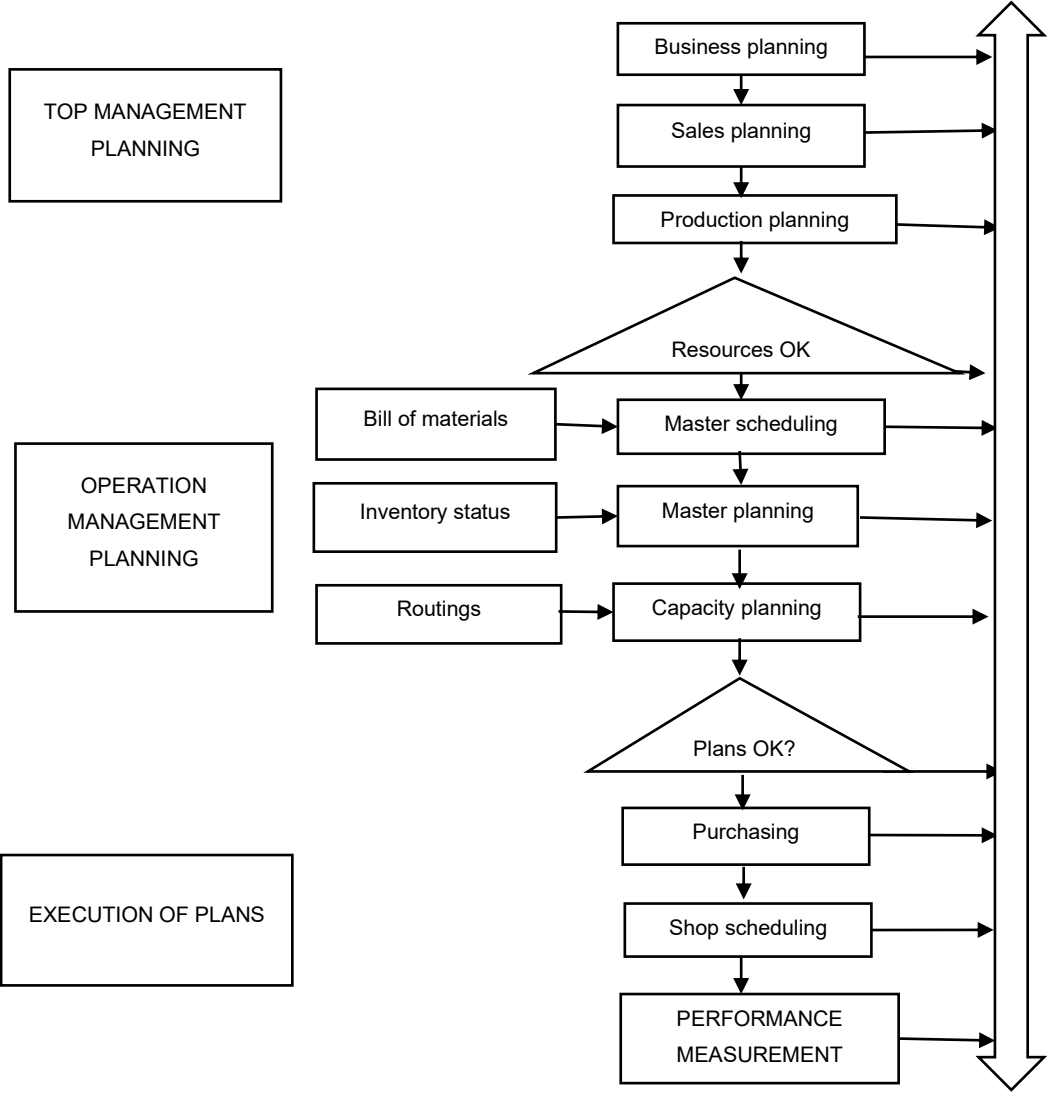


Figure 3: Standard ERP flow chart (Madanhire and Mbohwa, 2016)

Through e-procurement, organisational purchases can be managed through an efficient process that ensures smooth purchasing operations. Accordingly, e-procurement is purely an online business activity that facilitates the entire procurement process whether raw materials or service, enabling organisations to enjoy a low cost of operations, minimise the time of the procurement process and enhance inventory management (Piera et al., 2014). With regards to the e-procurement element within an ERP system, departments such as purchasing, production and risk prediction play a critical role based on supplier and price information in the database for better plans, determine prices and make proper financial projections as demonstrated in Figure 4.

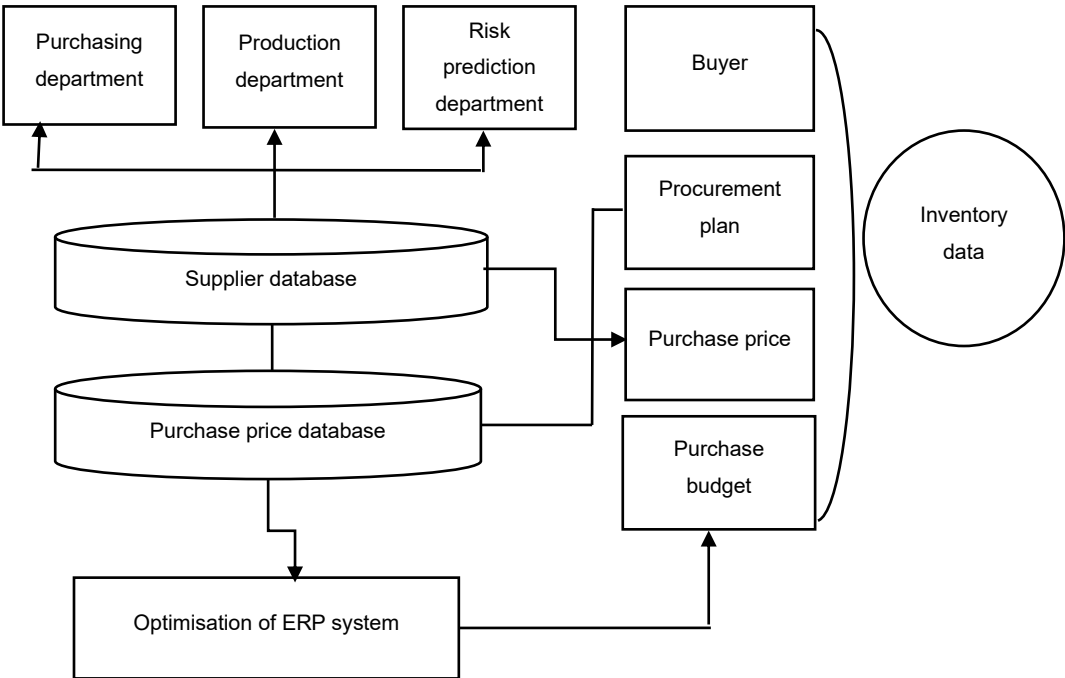


Figure 4: Illustration of a company ERP-based procurement and payment process (Zhao and Tu, 2021).

Although not considered a core aspect of e-procurement, it is important to note that some authors have regarded e-procurement and Electronic Maintenance, Repair and Overhaul (E-MRO) as being closely associated with and in some cases a part of e-procurement

(Basak, 2015; Croom, 2000; Gunasekaran et al., 2009; Rajkumar, 2001; Puschmann and Alt, 2005; Piotrowicz and Irani, 2010; Knudsen, 2003).

E-MRO specifically focuses on services such as procurement of maintenance, repairs and operating materials through a software system, unlike e-procurement and ERP which deal much more widely with products and services (Mutangili, 2014). Generally, the traditional MRO is a complex system that accommodates numerous regulatory policies, and diverse customer data and requires efficient human effort, (Efthymiou et al., 2022). The MRO can be either a manual system or facilitated through a digital platform that helps to reduce errors (Ucler and Gok, 2015).

Rodrigues and Lavorato (2016) noted that a firm's MRO strategy should be properly connected to the main strategy of the company and should be a long-term business operation. Like e-procurement, e-MRO has a central data storage that captures information needed for the MRO activities for departments such as logistics, engineering and planning, making information accessible through a user interface, often in the form of a layered style architecture (ElSaid et al., 2018). The huge amount of information demands a strong digitalised system to process (Guida et al., 2025), for example manufacturing data through real-time production status monitoring and data collection (Esposito et al., 2019).

2.2.5 E-procurement in manufacturing – Benefits and Industry 4.0

Industry 4.0 concept represents digitalisation in the industrial sector that combines internet technologies with other technologies such as machines and products (Nandankar and Sachan, 2020). Some of its components are smart products, smart factory and manufacturing, smart city, new systems for developing products, new systems for procurement, self-organisation in manufacturing and supply chain adaptation to human needs (Simetinger and Zhang, 2020). In procurement, industry 4.0 technologies offer organisations the opportunity to digitalise their operations through platforms such as e-design, e-inform, e-sourcing, e-evaluation and e-contract (Mojaki et al., 2024). Industry 4.0 digitises and automates transactions, transferring various value creation processes to digital platforms (Veile et al., 2021) and provides strategic interfaces that enhance

efficiency and facilitate the development of innovative business models (Jahan and Habib, 2025).

E-procurement in firms encapsulates all the activities that incorporate electronic technologies into buying tasks undertaken within the supply chain when executing business operations (Kusi et al., 2016). E-ordering, for example, has been observed to improve transparency, reduce work-related mistakes, reduce cost, increase work speed, increase efficiency, and enhance customer service and overall productivity (Muthoni and Mutuku, 2021; Mojaki et al., 2024).

Generally, online purchasing simplifies company procedures and at the same time improves productivity, synchronises payment methods, contributes to supplier engagement, and creates a convenient business atmosphere for consumers (Naim, 2022; Sarkar et al., 2024; Holloway et al., 2005; Boyer and Olson, 2002). In this era (industry 4.0), oil and gas companies, for example, use electronic procurement to attain a satisfactory procurement performance and utilise company resources effectively to reduce material waste and financial losses to avoid low profitability due to poor procurement practices (AlQubaisi et al., 2021). In manufacturing, industry 4.0 technologies can transform the procurement and the manufacturing process (Andreas and Kleemann, 2016) and enable them to develop more sophisticated procurement competences (Mishra et al., 2013). Manufacturing companies also use e-procurement to manage contracts through e-tendering to augment the operations of their supply chains (Tiwari et al., 2019).

2.2.6 E-procurement in Ghana

Research indicates that encouraging high-quality standards in procurement in Ghana is one of the most efficient means of maximizing profit and productivity (Baah, 2021). Ghana has made a substantial progress in adoption and implementation of the e-procurement technique for business transactions (Abdulatif et al., 2022; Musah et al., 2025; Dadzie et al., 2024; Charnor and Quartey, 2024; Ofori et al., 2023). E-procurement is considered to have the potential to be one of the efficient practices for the enhancement of operational transparency in Ghana for both public and private institutions (Sarpong et al., 2017).

Accordingly, the government of Ghana has instituted a public procurement authority (PPA) to implement the e-Ghana project which seek to use technology to carry out procurement activities in the public sector (Sarpong et al., 2017). It is a project that heavily depends on the use of advanced IT infrastructure to ensure transparency, accountability, competition and security in the procurement process (Desmond et al., 2019). Further, the central government has demonstrated its commitment to make e-procurement a main procurement tool in the public sector, thus all transactions will eventually be carried out electronically (Ofori and Fuseini, 2020).

It has been reported that e-procurement is used by majority of the companies in Ghana and many of the users have a good understanding of e-procurement and are comfortable with its dynamics (Dadzie et al., 2024). It has also been reported that the adoption and implementation of e-procurement in Ghana is considered by some to still be at a tender stage, though nevertheless making a valuable contribution to Ghana's Gross Domestic Product (GDP) (Ofori and Fuseini, 2020).

2.2.7 Supply chain performance and its measurement

Supply chain performance refers to the output of all the activities that are performed in a company's supply chain function (Madzimore et al., 2020). It is a multidimensional construct with many authors proposing diverse frameworks to measure it across different fields of study (Chang, 2013; Kameshwaran et al., 2006; Chang et al., 2004). Bigliardi and Bottani (2014) identified metrics involving customer service assessment, supplier performance, delivery performance evaluation, customer satisfaction, logistics costs and number of stock-out as the most applied metrics in the manufacturing sector. Saleheen et al. (2018) grouped the metrics under two broad headings: financial performance measurement system and non-financial performance measurement system, each involving several dimensions. Chang (2013) suggested tangible and intangible metrics for measuring supply chain performance: the tangible dimensions included supply chain factors such as costs, profits and cash turnover; the intangible dimensions involve supply chain management factors which reflect capacity utilisation, customer satisfaction and lead time.

2.3 Review methodology (Semi-systematic review)

For a comprehensive understanding of scientific research in the e-procurement and supply chain management literature, including the theories, methods, and main findings, and to help identify gaps in the literature, it is appropriate to conduct a semi-systematic review. Semi-systematic review is a research method that employs a specified procedure to ascertain and analyse the dispersed empirical knowledge (Harmelink et al., 2024; Snyder, 2019). A semi-systematic review in this field of study, in itself, can enhance the knowledge of managers, scholars and practitioners.

To gather knowledge in this area of research through semi-systematic review, the procedure adopted from Tranfield et al. (2003) was followed. The procedure follows three key steps:

Step 1: planning the review of electronic procurement and supply chain performance research: defining the review objectives and preparing the protocol.

Step 2: conduct the review by identifying, selecting, evaluating and synthesizing the important electronic procurement research.

Step 3: reporting and presenting the findings of the review by providing a descriptive analysis, a thematic analysis, and identifying gaps in the literature and hence salient avenues for research.

Semi-systematic review was important for the purpose of the current study and makes a significant contribution to knowledge because systematic review of the field is lacking, and thus the review itself fills a research gap that, for example, can help other researchers to identify appropriate methodology for their studies and, in turn, enhance the quality and impact of future work (Kraus et al., 2023). Furthermore, semi-systematic review, by bringing dispersed knowledge in the field together and analysing it, can provide the basis for better decisions by policy makers and users alike (Kraus et al., 2020). It is a tool that can assist in keeping up with the state-of-art, sharing empirical knowledge in the specific area of focus (Snyder, 2019). The semi-systematic approach to literature review, helps to minimise bias and ensure transparency, offers a deeper understanding of literature about

research questions, and hence logically synthesises past research to reinforce knowledge foundation of a topic (Williams et al., 2021).

The detailed semi-systematic review protocol is elaborated in subsections 2.3.1 and 2.3.2. Figure 5 below summarises the implementation of the review protocol and screening process, to arrive at the specific literature which forms the review ‘data’ of this review.

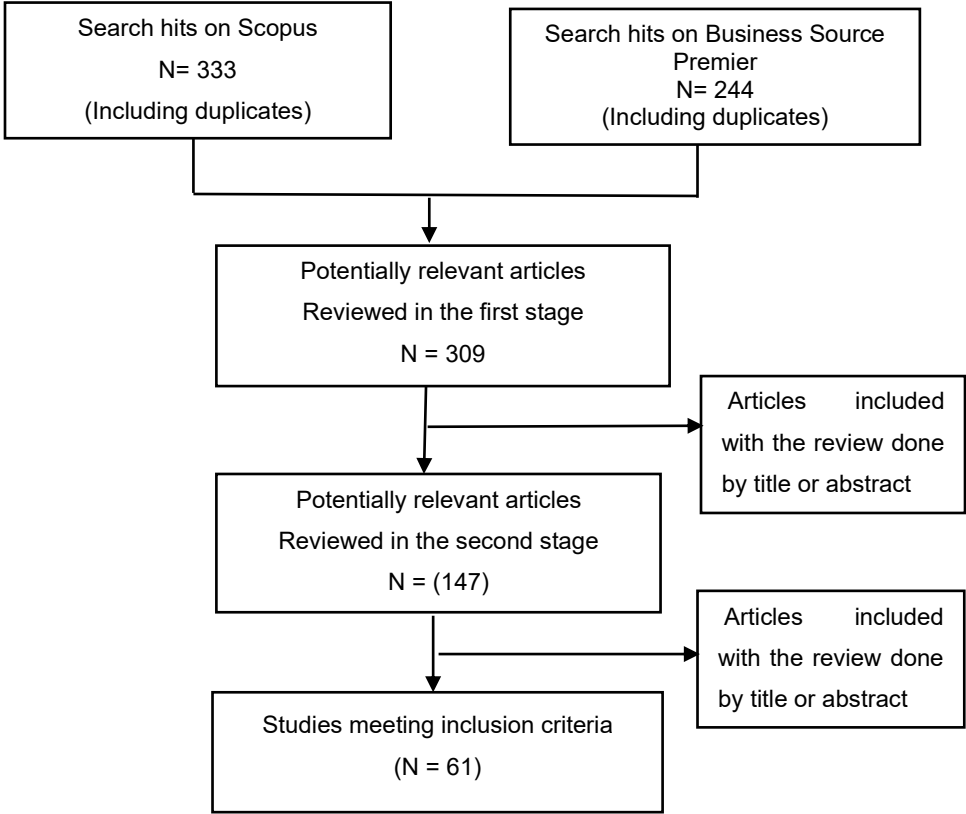


Figure 5: Databases and paper screening process

2.3.1 E-procurement research review protocol

The systematic review of the current research aimed at uncovering the current status of the e-procurement and supply chain performance literature. The review covered empirical work (qualitative and quantitative) and other existing systematic literature review based on articles.

A rigorous selection criterion of the papers was followed to ensure that the appropriate papers were obtained. The key elements of the SLR protocol were as follows:

1. The search was done in Scopus and Business Source Premier (BSP) databases to solicit papers eligible for the review. The rationale behind the choice of Scopus and BSP was that the former contains approximately 21,000 titles across different fields of research and the latter is one of the most used business research database and hosts more than 2,300 journals including full text for over 1,100 peer-reviewed titles in different fields of research.
2. The review was limited to papers published in peer-reviewed journals; thus editorials, conference papers, book chapters, books and unpublished theses were excluded in the review. Articles in the field of business management, particularly procurement and supply chain management and published in the English language were included. This helps to uncover all empirical evidence that is in alignment with the already specified inclusion criteria to fulfil the objective of the review (Snyder, 2019).

Table 2: Key words used for the literature search

Scopus search	Business Source Premier search
'electronic procurement' or 'e-procurement' (no filters)	'electronic procurement' or 'e-procurement' (no filters)
('electronic procurement' or 'e-procurement') AND 'supply chain' AND NOT 'public'	('electronic procurement' or 'e-procurement') AND 'supply chain' AND NOT 'public'
<i>'Filter= journal article'</i>	<i>'Filter= journal article / peer-reviewed'</i>
<i>Filter= CABS 4/3 (plus relevant 2) rated journal</i>	<i>Filter= CABS 4/3 (plus relevant 2) rated journal</i>

3. The key words were identified and selected based on the stated initial aim of the study and an initial overview review of the mainstream literature in the field of e-procurement and supply chain performance. The key words used are presented in Table 2.

4. As part of the inclusion criteria of the review, articles on e-procurement and supply chain performance published in the year 2000 onwards were selected.
5. Searches for literature on e-Procurement and supply chain performance in 4*/3* rated (CABS) journals (with some relevant articles from 2* rated journals in Scopus and Business Source Premier Databases) were carried out (used filters applied included 'Publication Type: Academic Journal'; 'Peer-reviewed'; 'Document Type').
6. Relevance of the papers to the review was first based on review of their title and abstract relating to e-procurement and supply chain performance. Also, papers that focused on e-procurement as
7. Papers that focused on e-procurement at organisational level, elaborates how companies acquire goods and service through their interaction with suppliers well included.
8. The final stage of the search and scrutiny focused on assessing the whole article.

2.3.2 Conducting the e-procurement research review

In the second stage of the review, the four steps illustrated in figure 5 were followed, that is to say, the search and selection protocol was implemented. In the first step, the search terms (table 2) were applied to search for relevant literature (based on title and abstract) in the Scopus and BSP databases, 333 and 244 articles respectively were identified. 268 of these articles, including duplicates, were removed because of their irrelevance. As a result, 309 articles were maintained for their relevance. The papers that focused on the public sector were excluded per the search terms/keyword of the review. After applying points three, five and six of the protocol above, 147 articles remained based on the criteria. These articles were subjected to full text evaluation and scrutiny based on the full inclusion and exclusion outlined in review protocol point six. Based on this, 93 articles were removed because they were found not to be e-procurement and supply chain performance specific papers. The full implementation of the protocol yielded 61 papers which hence formed the final carefully selected literature for the next stage of the analysis. A list of attributes to record for each of the 61 literature contributions was developed as part of the review process to evaluate the papers to ensure a comprehensive

understanding. The attributes were: author(s), year, purpose /aim, data collection strategy, e-procurement dimensions, method of analysis, theory, focus of e-procurement, relevant findings, country of study and unit of analysis. The attributes allowed the articles to be grouped in various ways thus helping to facilitate and guide the discussion of the electronic procurement and supply chain performance literature.

2.4 Descriptive analysis of e-procurement literature

Descriptive analysis was conducted to provide essential insight about the nature of the electronic procurement and supply chain performance literature selected. Data collection methods, constructs, methods of data analysis, industry type, country of study and time horizon (cross-sectional or longitudinal), e-procurement and supply chain performance constructs, e-procurement specific dimensions and study participants constituted the descriptive analysis dimensions examined. These dimensions for each paper are presented in Table 3.

2.4.1 Data collection methods

Data collection methods were assessed to uncover and understand the nature of the e-procurement and supply chain performance research undertaken. Authors have used diverse methods: structured questionnaires, interviews, case study, systematic literature review, secondary data (objective data), some used multiple data collection tools others were SLRs or other secondary based studies. The review indicates that 30 of the papers employed structured questionnaire (e.g. Hallikas et al, 2021; Madzimore et al., 2020; Pattanayak and Punyatoya, 2019), with this being the highest data collection tool in the papers that met the criteria of the review. Structured interviews, with 10 papers, was the next most used data collection strategy. Five out of the 61 articles did not collect data and this can probably be attributed to the author's intention to develop framework to guide organisations to practically utilise electronic procurement and supply chains effectively (e.g. Kameshwaran et al., 2006; Chang et al., 2004).

For the rest of the articles, five articles used a case study method, four employed both case study and observation approach four papers employed both structured

questionnaire and unstructured interviews, two articles used objective data (secondary data generated through organisation's operations) and finally one paper employed systematic literature review, shows diversity in the choice of data collection strategy by the authors in the field.

2.4.2 Data analysis method

The data analysis methods employed were examined to identify variation across studies in the e-procurement and supply chain management literature. The examination revealed 13 papers used covariance based structural equation modeling (CB-SEM) (e.g. Madzimore et al., 2020; Pattanayak and Punyatoya, 2019; Chang et al., 2013) which was the dominant method among the papers sampled. Followed by 10 papers employed partial least square structural equation modeling (PLS-SEM) (e.g. Teo and Lai, 2009; Tai et al., 2010; Purchase and Dooley, 2010), the next most prevalent data analysis technique utilised by the papers. This is followed by eight articles that used regression analysis, five studies used descriptive statistics and four used simulations. The rest of the papers used techniques such as functional analysis, e-taxonomy, Delphi, content analysis, factor analysis, thematic analysis, cluster analysis (e.g. Garrido et al., 2008; Angeles and Nath, 2007; Massa and Testa, 2007).

2.4.3 Industry type

The type(s) of industry examined in the studies was evaluated. The review reveals that out of the 61 papers, 14 authors conducted their research in the manufacturing companies, and this is the dominant sector in the body of papers (e.g. Al-Hakim et al., 2012; Hung et al., 2014; Kim et al., 2015). Eight papers used companies that engage in businesses such as Food, chemical and pharmaceutical, electronics, construction, automotive and transport. This was followed by seven papers that used both manufacturing and service companies in their research (e.g. Purchase and Dooley, 2010; Hallikas et al, 2021; Soares-Aguiar and Palma-dos-Reis, 2008).

The telecommunication sector received considerable attention, being the industry focused in five articles. The remaining articles focused on retail, construction, procurement, health and hospitality.

2.4.4 Country of study

The country of study was assessed to understand the geographical location, dispersion and any distinct focal points of the research undertaken on e-procurement and supply chain management. Out of the 61 papers, 12 articles conducted the study in the USA, being the country with the highest number of studies among the articles that met the inclusion criteria of the review. The next country is Taiwan with four papers, followed by South Africa and Spain with two papers each. The analysis reveals that only one paper used one of these countries as the source of data collection; Finland, Netherlands, Thailand, Malaysia, United Arab Emirates, Central Europe, Australia, Singapore, China, Hong Kong, UN organisations and Greece. The remaining papers did not involve empirical data collection (e.g. Knudsen, 2003; Berlak and Weber, 2004; Caridi et al., 2004). This shows that the rich electronic procurement and supply chain literature has been generated from multiple geographical contexts indicating a high dispersion across countries.

2.4.5 Time horizon

The review examined the extent of usage of a cross-sectional or a longitudinal approach for data collection to understand which of these methods dominate research on e-procurement and supply chain management. The review revealed that 52 out of the 61 papers used a cross-sectional approach (e.g. Brandon-Jones and Kauppi, 2018; Hallikas et al, 2021; Madzimore et al., 2020; Pattanayak and Punyatoya, 2019; Ramkumar et al., 2019). Four papers used longitudinal survey technique and five papers did not collect data.

2.4.6 E-procurement and supply chain performance constructs

The descriptive analysis includes understanding e-procurement and supply chain performance constructs in the papers that met the inclusion criteria.

The review indicated that all the 61 articles used e-procurement and supply chain performance as constructs in their research. However, 15 of the papers used e-procurement as the independent variable and supply chain performance as the dependent variable (e.g. Essig and Arnold 2001; Chang et al, 2013; Chibani et al., 2018; Pattanayak and Punyatoya 2019; Madzimure et al., 2020; Hallikas et al., 2021). The review further revealed that e-procurement was used in connection with other specific variables that are mostly used in the e-procurement and supply chain literature such as Information flow quality, logistics fulfillment quality, technology, strategic sourcing, operational performance, sustainability, market participation, and overall firm performance (e.g. Chang and Wong, 2010; Vaidyanathan et al., 2012; Kim et al., 2015; Ibem and Laryea, 2015). This shows the extension of the e-procurement construct to other important business disciplines in the procurement literature is promoting stronger theory building.

2.4.7 E-procurement specific dimensions

The review covered the identification of specific dimensions of the e-procurement construct used in the previous research. The findings reveal that 56 papers studied e-procurement as a construct in its own right (i.e. without associating to a more specific dimension) (e.g. Al-Hakim et al., 2012; Bayazit, 2014; Vaidyanathan et al., 2012; Hung et al., 2014; Chibani et al., 2018; Kim et al., 2015; Yu et al., 2015). Five articles on the other hand, used a similar specific dimension as a measure of e-procurement; namely e-sourcing, e-negotiation, e-informing, e-design, e-evaluation, e-tendering and e-reverse auction (e.g. Piotrowicz and Irani, 2010; Chang et al., 2013; Madzimure et al., 2020; Pattanayak and Punyatoya, 2019). This indicates that the previous e-procurement literature is dominated by research that analysed e-procurement as a single factor construct.

2.4.8 Study participants

The review ascertained differences in study participants used in the previous research. The results show that 27 articles that used purchasing managers/professionals/ officials

as study participants in their studies were the highest (e.g. Reunis et al., 2004; Croom, 2000; Kothari et al., 2005; Tatsis et al., 2006; Rai et al., 2006).

This is followed by 11 articles that used senior managers of the organisation and six articles that used suppliers and customers as study participants (e.g. Chang et al., 2013; Hallikas et al., 2021; Madzimore et al., 2020). For the remaining articles, some used staff of a research company, e-procurement users, staff of pharmaceutical companies, participants from stock exchange, while others did not use any unit of analysis (e.g. Adebajo, 2010; Chang et al, 2004; Raghavan and Prabhu, 2004). The results indicate that most of the research in the field of e-procurement and supply chains used the purchasing personnel as the unit of analysis in their studies to build the procurement and the supply chain literature.

Table 3: Attribute table for descriptive analysis

Author(S); Year	Data Collection Strategy=N	Variables (I, D, Med, Mod)	Analysis method	E-procurement dimensions	Industry	Country (Data Collection)	Unit of Analysis / Respondents / Scope	Cross-Sectional / Longitudinal
Hallikas et al. (2021)	Structured questionnaire (101)	I=External data analytics capabilities I= Digital procurement capability I=Internal analytics capability D=Supply chain performance/ Business performance	PLS-SEM	None	Manufacturing and Service companies	Finland	large and medium-sized companies/Top and Middle management/ Dyadic	Cross-sectional
Madzimore et al. (2020)	Structured questionnaire (283)	I=E-procurement, D=Supplier integration D=Supply chain performance	SEM	E-sourcing, e-negotiation, e-informing, e-design e-evaluation	Retail SMEs	South Africa	Managers of SMEs	Cross-sectional
Pattanayak and Punyatoya (2019)	Structured questionnaire (214)	I=Supply chain technology internalisation, I=E-procurement Med=Supply chain integration D=supply chain performance	SEM	E-sourcing, e-negotiation, e-informing e-design and e-evaluation.	Construction	India	Corporations / Managers/consultants / Unilateral	Cross-sectional
Ramkumar et al. (2019)	Structured questionnaire (132)	I=Information flow quality I=Logistics fulfillment quality	PLS-SEM	Perceived ease of use, perceived usefulness and perceived value of e-	Corporate companies	India	Corporate/ Director/vice president (operations/IT)/ General manager (logistics/supply	Cross-sectional

		D/Med=organisational buyers' perception of e-procurement services D=satisfaction.		procurement services			senior managers and corporate buyers/Network	
Brandon-Jones and Kauppi (2018)	Structured questionnaire (137)	I=E-procurement adoption M =E-procurement acceptance and Antecedent of acceptance D=E-procurement performance effects.	PLS-SEM	None	E-procurement users at a university in the Netherlands.	Netherlands.	E-procurement users	Cross-sectional
Chibani et al. (2018)	None	I=E-procurement D=Supply chains	Simulation (Genetic algorithm adapted to dynamic optimisation)	E-procurement implementation	None	None	None	None
Ibem and Laryea (2015)	Structured questionnaire (603)/ Interviews (7)	I=Categories of e-procurement Technologies and Tools Used	Mixed method-descriptive statistics and content analyses	E-notification; e-exchange and e-submission	Construction firms	South-Africa	Procurement / Supply Chain Officials/ Contractors	Cross-sectional
Kim et al. (2015)	Structured questionnaire (137)	I=Strategic sourcing I=E-procurement Business environment and characteristics D-Performance	PLS-SEM	Usage of e-procurement and impact of e-procurement.	Manufacturing firms	USA	Purchasing and supply management executives	Cross-sectional
Yu et al. (2015)	Structured questionnaire (193)	I=E-procurement infusion D=operational performance	PLS-SEM	Intensity of use (INTC) and organisational acceptance	Service organisation	USA	Purchasing professionals	Cross-sectional

				(ACCP)				
Bayazit (2014)	Structured questionnaire (342)	I=Benefits, drivers, barriers and Critical success factors of e-procurement D=E-procurement implementation.	Descriptive statistics	None	Institute of Supply Management (ISM).	USA	Procurement and supply management professionals	Cross-sectional
Hung et al. (2014)	Structured questionnaire (105)	I=Web-based procurement Med=Supplier performance, Advantage of reduced transition cost, time and enhanced partnership D=Organisational performance	PLS-SEM	None	Manufacturing firms	Taiwan	Senior procurement executives and Suppliers	Cross-sectional
Chang et al. (2013)	Structured questionnaire (108) Interview (4)	I=E-procurement M=Partner relationship/Information sharing and supply chain integration D=supply chain performance	SEM	E-design, e-sourcing, e-negotiation and e-evaluation	Hard disk drive and telecommunication industry, Steel industry, and Biochemistry industry	Taiwan	Procurement managers	Cross-sectional
Rotchanakitumnuai (2013)	Structured questionnaire/ Interview (186)	I=E-procurement success factor D=E-procurement adoption (balanced scorecard)	Regression analysis	Technical capabilities of e-procurement system. Trust in online intermediary	Private, Public, and government organisations	Thailand	Purchasing personnel	Cross-sectional
Al-Hakim et al. (2012)	Structured questionnaire (104)	I=Trust I=Dependency D=E-procurement adoption	PLS-SEM	None	Manufacturing firms	Malaysia	Suppliers and customers of the manufacturing firms	Cross-sectional

Adebanjo (2010)	Case study method (59 sites)	I=E-procurement D=Sustainability	Qualitative-based functionality analysis	Sustainability of e-procurement	Food industry	Global (not a single country)	E-cluster members	Cross-sectional
Chang and Wong (2010)	Structured questionnaire (180) and Interview	I=E-procurement adoption Mod=Trust D=E-marketplace participation D=Firm performance	SEM and thematic analysis	Cost and process conformation	Manufacturing firms and small-to- medium companies.	Taiwan	Top managers/ procurement managers/ officers	Cross-sectional
Quesada et al. (2010)	Structured questionnaire (368)	I=E-procurement technology usage D=Procurement practices D=Procurement performance	SEM	None	Institute for supply management practitioners	USA	Procurement specialists	Cross-sectional
Gamal (2010)	Structured questionnaire (316)	I=Ease of use I=Subjective norm I=Behavioral control I/D= (Attitude and Perceived usefulness) D=Intention to use e- procurement	SEM	None	Economic and Commercial organisations	United Arab Emirates,	Purchasing/ Supply managers and officers	Cross-sectional
Garrido-Samaniego et al. (2010)	Structured questionnaire (98)	I=E-procurement D=Structure of the buying centre (Size and Composition)	Regression analysis	None	Multi-task companies	Spain	Purchase managers	Cross-sectional
	Multi case study design	I=B2B electronic procurement	Taxonomy	E-sourcing,	Information technology/Hi- tech electronic	Central Europe	Senior and	Cross-sectional

Piotrowicz and Irani (2010)	(20)	D=Information systems		e-tendering, e-informing, e-reverse auctions, e-MRO, and web-based enterprise resource planning (ERP).	component sector		middle purchasing/ Logistics managers, and IT departments, Direct system users from purchasing, logistics departments	
Purchase and Dooley (2010)	Structured questionnaire (317)	I= Supplier Pressure M=Supplier participation I/D= Perceptions of task improvements & convenience I/D= Internal organisational support D=e-procurement intention	SEM	E-procurement intentions	Manufacturing industry, Primary industry, and service industry	Australia	Purchasing professionals and purchasing managers	Cross-sectional
Ronchi et al. (2010)	Interviews (12)	I=Current situation (financial and organisational performance) D=Future situations (financial and organisational performance) Endogenous factors (target and invested resources) Exogenous factors (organisational inertia)	Delphi methodology	Efficiency, decentralisation, transparency, control, maverick-buying reduction, supply-base rationalisation	Energy Healthcare equipment Aircraft Telecommunication Pharmaceutical	None	Purchasing managers	Cross-sectional

		E-procurement systems (architecture and functionalities)						
Smart (2010)	Interviews- (4)	I=E-procurement D=Supply management	Case study	None	Large multinationals		Senior Executives and e-procurement managers	Cross-sectional
Tai et al. (2010)	Structured questionnaire (137)	I=Web based e-procurement D= Buyer immediate measure, Buyer integrated process, Buyer organisational performance, Supplier performance, and Partner relationship.	PLS-SEM	None	Manufacturing firms	Taiwan	Senior managers, purchasing managers/ officers	Cross-sectional
Trkman and McCormack (2010)	Semi-structured interviews (100)	I=Cost, lead time and Value at risk D=E-procurement implementation.	Simulations	None	Oil Industry equipment, chemical, cement, and oil exploration and development industries.	Houston, Nazareth, Calgary and Switzerland	Buyers, procurement managers, commodity managers, directors of procurement, directors of the supply chain, IT managers, Vice president of the supply chain, suppliers and Strategic Sourcing managers.	Cross-sectional

Teo et al. (2009)	Structured questionnaire and interviews (141)	I=Technological factors I= Organisational Factors I= Environmental Factor D=E-procurement adoption	Logistic regression analysis and PLS-SEM	E-procurement adoption	Companies from the Singapore 1000 directorate	Singapore		Cross-sectional
Gunasekaran et al. (2009)	Structured questionnaire (39)	I= Status and readiness, Perceived benefits, Critical success factors, Perceived barriers, and Perceived future organisational performance D=E-procurement adoption	Microsoft Excel	None	SMEs.	Southcoast of Massachusetts.	Managers and owners	Cross-sectional
Teo and Lai (2009)	Structured questionnaire (109)	I=E-procurement usage I/D=E-procurement value D=Financial performance improvement	PLS-SEM	E-procurement volume, e-procurement Diversity, E-procurement breadth, and e-procurement depth	Corporate companies	Singapore	Senior procurement executives	Cross-sectional
Aslani, et al. (2008)	Structured questionnaire (81)	I=E-procurement D= Employees satisfaction, Job formality and Work and business relationship	Regression analysis-descriptive and inferential statistics)	None	Food/drinks, chemicals, plastics, metallic products, scientific instruments/sy stems and electrical appliances.	Italy, Greece, Germany, France, the UK and Austria	Industrial enterprise/ chief executives	Cross-sectional
Chang et al. (2008)	Interviews (4)	I=Business and IT Environment Med=FIT	Multiple-case study	None	High technology firm	China	Procurement and purchasing managers	Cross-sectional

		D=Performance of electronic procurement.						
Garrido et al. (2008)	Structured questionnaire (103)	I= E-procurement intensity use D=Consequences (Organisational and Economical)	Cluster analysis/ ANOVA/ MANOVA	E-procurement intensity use	Food Chemical and pharmaceutical, electronics, construction, automotive, metallurgy transport informatics, equipment and other	Spain	Purchasing/ marketing managers	Cross-sectional
Gunasekaran and Ngai (2008)	Structured questionnaire (74)	I= Perceived benefits of e-procurement I= Critical success factors in e-procurement I=Perceived barriers to e-procurement implementation I=Organisational performance with e-procurement D=E-procurement implementation	Descriptive analysis	None	Corporate industries	Hong Kong	Key participants from Hong Kong stock exchange	Cross-sectional
Pearcy and Giunipero (2008)	Structured questionnaire (128)	I= Firm size D= E-procurement applications	Regression analysis	None	Institute for Supply Management	USA	Purchasing professionals and academicians	Cross-sectional
Soares-Aguiar and Palma-dos-Reis (2008)	Structured questionnaire (240)	I= Organisational context, Technological context and Environmental context	Logistic Regression	None	Manufacturing, Commerce and Service industries	Portugal	CEO/Board member, managing directors, chief information	Cross-sectional

		D=E-procurement system adoption					officers and chief purchasing officers and others	
Vaidyanathan and Devaraj (2008)	Structured questionnaire (131)	I=Information flow Process quality M=Logistics fulfillment process quality D=E-procurement performance	SEM	None	Aerospace, automotive, electronics, and consumer products manufacturing industries.	USA	Purchasing and procurement managers	Cross-sectional
Walker and Harland (2008)	Structured questionnaire, case study and interactive workshop	None	Regression analysis	None	All United Nations organisations	United Nations	Heads of purchasing or procurement	Longitudinal
Angeles and Nath (2007)	Structured questionnaire (185)	None	Factor analysis	None	Manufacturing and Service industries	None	Procurement managers and professionals/	Cross-sectional
Massa and Testa (2007)	Case study, Observation and Interviews (16)	I=E-procurement D=Knowledge management	Thematic analysis	E-sourcing, e-tendering, e-reverse auctioning and e-informing	Customized electronics equipment manufacturer Global company (GC)	Europe, Latin America and Asia	The staff working in the research setting of the company	Longitudinal
Mishra et al. (2007)	Structured questionnaire (412)	I= Extent of Internet use in search and Extent of Internet use	SEM	None	Manufacturing firms (Industrial machinery, Electrical and Electronic, machinery, transportation	USA	Procurement or production managers	Cross-sectional

		in Order, initiation and completion (OIC) D=Procurement process performance			equipment, and measuring, and controlling instruments)			
Batenburg (2007)	Interviews, structured questionnaire and objective data (3475)	I=E-procurement adoption D=Employee size and industry size	Regression and thematic analysis	None	Chemical, ICT health textile electronics, trans-equipment business service tourism and retail	7 European countries	General managers	Cross-sectional
Wu et al. (2007)	Structured questionnaire (144)	I=Antecedent M=Intensity of e-procurement adoption D=Outcomes	SEM	Coordination application use and transactional application use	Telecommunications, computer hardware, Semiconductor and manufacturing equipment industries	USA	Senior executives (directors and managers)	Cross-sectional
Kameshwaran et al. (2007)	None	E-procurement	Mixed linear integer-multiple criteria optimisations using goal programming	None	Buying organisations	None	Buyers and suppliers	None
Rai et al. (2006)	Structured questionnaire (166)	I=EPI assimilation, EPI usage, top management support, IT sophistication and EPI infrastructure. D=Procurement productivity	Cluster analysis	E-reverse auctions (ERA), e-catalog management innovations (ECM), e-order fulfillment innovations (EOF), e-payment and settlement innovations (EPS).	Institute of supply management (ISM) database/ industrial machinery and equipment, electronics equipment, wholesale trade of durables, and	USA	Presidents, vice presidents, and operations, purchasing managers/ network	Cross-sectional

					business services.			
Tatsis et al. (2006)	Case study, interviews and observations	E-procurement drivers and impediments	Thematic analysis	None	Manufacturing industry	Greece	Procurement/logistics managers	longitudinal
Kothari et al. (2005)	Semi-structured interviews (14)	I=E-procurement D=Supply chain management	Descriptive analysis	E-procurement adoption	Hospitality industry	USA	Director of purchasing, purchasing managers, controller, general manager, Housekeeping Manager	Cross-sectional
Puschmann and Alt (2005)	Phone based interviews	I=E-procurement D=Supply chain	Benchmarking	None	Multinational companies. (manufacturing)	Europe and North America	Purchasing specialist	Cross-sectional
Berlak and Weber (2004)	Literature review	E-procurement	Descriptive analysis	E-procurement technologies	Manufacturing SME's	None	Suppliers	Cross-sectional
Caridi et al. (2004)	Literature review	E-procurement	Qualitative-Business process modelling and Simulation	None	Multi-national pharmaceutical companies	None	Pharmaceutical companies	Cross-sectional
Chang et al. (2004)	None	E-procurement	None	None	None	None	None	None
Raghavan and Prabhu (2004)	None	E-procurement	Simulation	Decomposing e-procurement processes	None	None	None	None
Reunis et al. (2004)	Exploratory interviews	I= (Perceived experience, communication, demonstration, enforcement, training,	Cluster analysis	E-procurement adoption	Oil and energy, electronics/chemical and pharmaceutical	Dutch	E-procurement experts (academics, consultants,	Cross-sectional

		involvement, risk reduction and reward) M= Industry practitioners D=factors of e-procurement adoption dissemination			al and railway and transportation.		and suppliers) and E-procurement users (Industry practitioners)	
Knudsen (2003)	None	Corporate strategy, procurement strategy and e-procurement tools.	None	E-procurement tools	None	None	None	None
Essig and Arnold (2001)	Secondary data from electronic marketplaces	I=E-procurement D=supply chain management	None	E-procurement sustainability	Electronic marketplace	None	Buyers	Cross-cross sectional
Croom (2000)	Semi-structured interviews (37)	Web-based procurement Management of operating resources supply.	Quasi-Delphi method	None	Multi-national organisations	United Kingdom, continental Europe and the United States.	Purchasing managers, information systems managers	Longitudinal
Vaidyanathan et al. (2012)	Structured questionnaire	I=Security D=E-procurement performance Mod=Process inter-dependency, Mod=process complexity Control variables=No. of employee and industry type	SEM	E-procurement performance	Manufacturing	None	Procurement/purchasing managers	Cross-sectional
Pearcy and Giunipero, (2008)	Structured questionnaire (142)	I-E-procurement D=Supply chain integration	Factor analysis, T-test and logistic regression	None	Institute for supply management	USA	Purchasing/supply management professionals	Cross-sectional
Khorana et al. (2014)	None	E-procurement	None	None	None	EU	None	None
Chirchir et al. (2015)	Structured questionnaire and interviews	I=E-procurement adoption	Pearson product moment correlation	E-procurement adoption	Food industry	Kenya	Line managers and staff from the procurement,	Cross-sectional

	(365)	D=Supply chain management practices	coefficient and linear regression				administration and suppliers	
Fu et al. (2004)	Case study	E-procurement	None	None	Auto parts	Taiwan and US	None	None
Rajkumar (2001)	None	E-procurement	None	None	None	None	None	None
Chang et al. (2008)	Case study	E-procurement	Thematic analysis	None	Supply companies	China	Suppliers and administrators	Cross-sectional

2.5 Thematic analysis of e-procurement and supply chain performance

One of the main aims of the review was to provide thematic analysis of the electronic procurement and supply chain performance literature. Initially, 13 themes emerged from the review, but through a rigorous assessment and iteration of analysis, some of the themes were merged and refined, resulting in 11 key themes evident in the body of work analysed. These themes and the associated literature contributions are summarised in Table 4 and elaborated in the subsequent sections. The thematic analysis identified 11 themes: (1) Adoption of e-procurement; (2) Drivers of e-procurement; (3) E-procurement systems; (4) Implementing e-procurement; (5) Benefits of e-procurement; (6) Barriers, challenges and risks of e-procurement; (7) Effect of e-procurement practices; (8) Usage of e-procurement applications; (9) Factors affecting (Including antecedents/enablers) e-procurement systems; (10) E-procurement and supply chain performance; and (11) Overview of theories relating to e-procurement and supply chain performance.

The first theme is the adoption of e-procurement which encompasses an organisation's decision and acceptance of using the electronic tools and systems for purchases. The second theme, the drivers of e-procurement, encapsulates the motivations for e-procurement systems that underpin its adoption. The third theme pertains to e-procurement systems which focus on the electronic systems that organisations install to perform e-procurement functions. The fourth theme deals with implementing e-procurement, which is an action-oriented stage where management puts the system to use. The fifth theme captures the benefits organisations gain from implementing the internet-based purchasing method. The sixth theme is the barriers, challenges and risks associated with adopting the internet-based system. The seventh theme is the effects of the e-procurement practice, capturing how e-procurement influences the company's operations when implemented. Usage of e-procurement applications, theme eight, explains how an organisation uses e-procurement systems to achieve procurement purpose. The ninth theme, factors affecting e-procurement, focuses on the enablers and antecedents. The tenth theme concerns the nexus between e-procurement and supply chain performance.

Finally, eleventh theme presents overview of theories relating to e-procurement and supply chain performance. The eleven themes are discussed into detail in the following sub-sections.

Table 4: E-procurement and supply chain performance themes

Theme(s)	Author(s)
Adoption of E-procurement	Brandon-Jones and Kauppi (2018)
	Ibem and Layea (2015)
	Al-Hakim et al. (2012).
	Chang and Wong (2010)
	Gamal (2010)
	Reunis et al. (2004)
	Batenburg (2007)
	Croom (2000)
	Knudsen (2003)
	Chang and Wong (2010)
	Gunasekaran and Ngai (2008)
Drivers of E-procurement	Purchase and Dooley (2010)
	Fu et al. (2004)
	Tatsis et al. (2006)
	Yu et al. (2015)
	Gunasekaran et al. (2009)
	Puschmann and Alt (2005)
	Rai et al. (2006)
	Chang et al.(2004)
	Chirchir et al. (2015)
	Vaidyanathan and Devaraj (2008)
	Smart (2010)
	Rajkumar (2001)

E-procurement systems	Berlak and Weber (2004)
	Raghavan and Prabhu (2004)
	Chang et al. (2004).
	Soares-Aguiar and Palma-Dos-Resis (2008)
	Puschmann and Alt (2005)
	Chang et al. (2008)
Implementing E-procurement	Tai et al. (2010)
	Kameshwaran et al. (2007)
	Adebanjo (2010)
	Bayazit (2014)
	Ibem and Layea (2015)
	Hung et al. (2014)
	Raghavan and Prabhu (2004)
	Vaidyanathan et al. (2012)
	Rotchanakitumnuai (2013)
Benefits of E-procurement	Piotrowicz and Irani (2010)
	Trkman and McCormack (2010)
	Gunasekaran et al. (2009)
	Croom (2000)
	Massa and Testa (2007)
	Gunasekaran and Ngai (2008)
	Puschmann and Alt (2005)
	Walker and Harland (2008)
	Rotchanakitumnuai (2013)
	Walker and Harland (2008)
Barriers, challenges and risks of e-procurement	Angeles and Nath (2007)
	Gunasekaran and Ngai (2008)
	Tatsis et al. (2006)
	Gunasekaran et al. (2009)

Effect of e-procurement practices	Quesada et al. (2010)
	Pearcy and Giunipero (2008)
	Ramkumar et al. (2019)
	Tai et al. (2010)
	Aslani et al. (2008)
	Smart (2010)
	Vaidyanathan et al. (2012)
Usage of e-procurement applications	Quesada et al. (2010)
	Smart (2010)
	Garrido-Samaniego et al. (2010)
	Walker and Harland (2008)
	Teo and Lai (2009)
	Garrido et al. (2008)
	Soares-Aguiar and Palma-Dos-Reis (2008)
	Teo et al. (2009)
	Wu et al. (2007)
	Mishra et al. (2007)
	Rajkumar (2001)
	Caridi et al. (2004)
	Kothari et al. (2005)
Factors affecting antecedents/enablers) procurement systems (Including of e-	Rotchanakitumnuai (2013)
	Teo et al. (2009)
	Soares-Aguiar and Palma-Dos-Reis (2008)
	Walker and Harland (2008)
	Mishra et al. (2007)
	Al-Hakim et al. (2012)
	Bayazit (2014)
	Khorana et al. (2014)
Wu et al. (2007)	

	Chang et al. (2008)
E-procurement and supply chain performance	Kothari et al. (2005)
	Tai et al. (2010)
	Chang and Wong (2010)
	Madzimore et al. (2020)
	Halikas et al. (2021)
	Smart (2010)
	Pattanayak and Punyatoya, 2019
	Ronchi et al. (2010)
	Chang et al. (2013)
	Chibani et al. (2018)
	Puschman and Alt (2005)
	Essig and Arnold (2001)
	Pearcy et al. (2008)
	Kim et al. (2015)
Overview of theories relating to e-procurement and supply chain performance	Ibem and Layea (2015)
	Purchase and Dooley (2010)
	Ramkumar (2019)
	Vaidyanathan and Devaraj (2008)
	Kim et al. (2015)
	Pattanyak and Punvatona (2019)
	Soares-Aguiar and Palma-Dos-Resis (2008)
	Vaidyanathan et al. (2012)
	Teo et al. (2009)
	Gamal (2010)
	Essig and Arnold (2001)

2.5.1 Adoption of e-procurement

The literature provides an account on the adoption of e-procurement in organisations from different perspectives (Brandon-Jones and Kauppi, 2018; Ibem and Layea, 2015; Al-Hakim et al., 2012; Knudsen, 2003). Chang and Wong (2010) define the adoption of e-procurement as the usage of technology for searching, quoting, and obtaining goods and services through the internet. The analysis shows that companies adopt the internet-based purchasing for similar reasons; to advance purchasing strategy and policy, for cost management, to short transaction time, to minimise fraud, for supplier management, to minimise supply chain risks, and to help manage company resources (Batenburg, 2007, Reunis et al., 2004; Croom, 2000).

Diverse frameworks for the study and adoption of e-procurement have been proposed in the past research. For instance, Gunasekaran and Ngai (2008) proposed a framework to guide the adoption of electronic procurement involving four key dimensions: perceived benefits of e-procurement, perceived barriers of e-procurement, critical success factors of e-procurement adoption and perceived organisational factors of e-procurement. Chang and Wong (2010) conceptualized e-procurement adoption from two broad perspectives: (a) 'reduced cost' which involves improving coordination between firms to minimise cost of operations, and (b) 'process conformances' which encompasses the use of internet technologies as a means of facilitating the procurement process. Gamal (2010) used the Technology Acceptance Model (TAM) to explain the adoption of electronic procurement, and posited that the dimensions, which include ease of use, usefulness, attitude, subjective norm, and behavioral control, lead to the intention to use e-procurement. Al-Hakim et al., (2012) hypothesised trust and dependency to underpin the decision to adopt e-procurement in organisations.

The decision to adopt the online purchasing technique has been reported to mostly be made by the top managers who have the required information about the available options and understand the consequences of using the internet for purchases (Batenburg, 2007). However, the analysis revealed that the adoption of e-procurement represents a change in the operational structure of the organization, the change reflecting at the macro-level

of the organisation, the micro-level of individual adoption and the meso-level where individual actors influence the adoption behavior of each other which transforms the process of company adoption and change (Reunis et al., 2004).

In conclusion, organisations are reminded that implementing e-procurement represents a major change in the entire organisational structure and a major transformation in the business processes. It is therefore reasonable to propose that adequate preparation in terms of resources acquisition is one of the key interventions to improve slow e-procurement adoption and avert possible failures.

2.5.2 Drivers of e-procurement

Drivers of electronic procurement are the factors that reinforce or motivate organisations to adopt and implement the online purchasing method. The prior literature presents the drives of e-procurement from diverse conceptual perspectives. The previous research (e.g. Purchase and Dooley, 2010; Fu et al., 2004; Chang et al., 2004; Yu et al., 2015; Chirchir et al., 2015) indicates that the intention to seek operational improvements is one of the key driving forces behind e-procurement. Operational improvements in tasks promote transactional efficiencies by helping companies to accumulate wealth through cost reduction, minimizing work content and shortening the time needed to perform tasks. Studies further reveal that some of the operational efficiencies that can be achieved through electronic procurement are short-time delivery, proper management of inventory levels and efficient distribution of information in the supply chain (Rai et al., 2006; Vaidyanathan and Devaraj, 2008; Puschmann and Alt, 2005).

The existing studies emphasise the intention to build stronger collaboration with suppliers as one of the key drivers of the online-based purchasing system (Tatsis et al., 2006). This collaboration happens through the opportunities that allow companies to access the buying network for suppliers and buyers (Gunasekaran et al., 2009). Although this is the intention, sometimes in practice companies overlook the strategic aspect in the process where buyers have a very minimum influence over the choice of suppliers and the products they intend to purchase (Puschmann and Alt, 2005). Buyers rely on the electronic information from the supplier source but have no opportunity to inspect the

product, thus exposing buyers to risks associated with the transaction due to imperfect information (Rai et al., 2006). The previous research has shown that e-procurement is associated with information flow in the supply chain for suppliers and buyers (Barngetuny, 2015).

According to Chirchir et al. (2015), in this respect, e-procurement has changed the face of procurement enhancing procurement satisfaction performance and logistics quality processes (Vaidyanathan and Devaraj, 2008). These strategic intentions about information and communication influence the organisation's decisions to use the internet-based procurement system to provide ease of business transactions.

In summary, the analysis indicates that several motivating factors reinforce organisation's willingness to adopt and implement e-procurement. The literature emphasized the availability of resource and personnel (e.g. company staff and suppliers) as dominating drivers of e-procurement. Moreover, it is evident from the analysis that the literature does not present industry specific drivers of e-procurement, instead highlighting it from a broad perspective where all the industries are considered as having similar organisational structures, culture and business processes. Further, the drivers were reported from the developed economies perspective, while any peculiar to the industries in the emerging economies were not specifically featured in the literature.

2.5.3 E-Procurement systems

The study of e-procurement systems is a notable theme in the past research (Chang et al., 2004; Smart, 2010; Soares-Aguiar and Palma-Dos-Resis, 2008; Rajkumar, 2001; Berlak and Weber, 2004). The system in this context refers to electronic applications that facilitate electronic transactions in e-procurement, that is to say, the systems that must be in place to make e-procurement functional. Smart (2010) highlights important e-procurement systems such as (1) buying/requisition to pay (RTP) application (for buyer-side e-procurement), (2) supplier catalogue sites (for vendor-side e-procurement), (3) electronic marketplace (for many-to-many e-procurement), (4) reverse auctions (for buyer-controlled online tenders), and (5) e-REX (for buyer analysis support). Each is explained in turn, based on Smart (2010).

Buying/requisition to pay (RTP) application is hosted by the purchasing organisation to enable users to search for products, access orders, receive orders and make payments for products. The application functions through catalogues that belong to the suppliers or access products data from supplier sites through punch-out. Supplier catalogue sites is a website hosted by firms that exhibit assortments of products in an electronic catalogue. Through this system, customers are allowed to order online by using point and click system connected to shopping basket, check-out and the like. Electronic marketplace is a web portal which allows buyers and suppliers to access online stores to transact business. Suppliers provide contents enabling buyers to browse in multiple catalogues on the same site. Reverse auctions is an online real-time bidding event that allows buyers to enter into contracts with designated suppliers who offer discounts in bids to win contracts, thus the lowest bidders win the bid, though different criteria might be applied to award the contract. E-REX is a group of applications that offer support to buyer analysis of supply markets and suppliers. It involves search tools, supplier rating and scoring systems, bid analysis tools and assessment techniques. The application is designed to aid decision making and assessment of buyers.

Rajkumar (2001) identified three e-procurement buyer software systems: e-catalog, auctions and marketplaces (net market/exchange software). The buyer software allows users to conduct business electronically and assist the buying company in areas such as order placement, catalog management, payment, reporting and the like. E-catalog software can be accessed by the users through their desktop that are often customized by their company. The software enables users to choose suppliers from the lists on their catalogs not beyond the limit specified by the purchasing management. Unauthorized users get their documents routed to the right channels and manage the workflow. The e-catalog is important for reviewing product purchase patterns and providing information that assists in facilitating supplier negotiations. It automates the transaction processing and minimises cycle times, facilitating buying to focus more on relevant activities such as strategic sourcing. However, Rajkumar (2001) notes that e-catalogs can be costly and difficult to maintain. Auctions are an e-procurement technology that allows companies to hold auctions, and which come in two forms: forward and reverse auctions. Regarding

forward auctions, Rajkumar (2001) explains that sellers display their goods/services for sale and allow buyers to bid for the goods or service; excess capital equipment and inventory are for instance sold through forward auctions. In reverse auction buyers send their request for quotes for items they intend to purchase to enable sellers to bid.

The software offers ease of transactions because it allows different types of auction rules; open or closed bids, detailed information and reserve prices which the organisation can specify. In marketplaces (net market/exchange software) companies aggregate the data from pool of suppliers and filter to provide customized views of prices, terms and other important features for each buying company (Rajkumar, 2001). Marketplaces might be independent trading exchanges, portals or virtual markets which enhance collaboration and exchange of data among industries and service type is not limited to cataloging but can advance to transaction management in e-procurement.

Chang et al. (2004) elaborated issues and design principles of an e-procurement system, the development processes involving generic procurement processes, data entities employed in the system, and functional diagrams and technical architecture for e-procurement system development. In their study, the procurement platform was developed on JAVA and entirely leverages application-server technology, and e-procurement platform architecture has three tiers: (a) the *database* tier: a standard relational database management system employed to gain access through Java Database Connectivity (JDBC) which can be grouped to host large volumes of data which are basically from supplier catalogs that contain technical drawings, images, text and videos; (b) the *application server* tier: which embodies the procurement application logic, taking is the form of an object model that hosts relational data contained in the database, offers comprehensible information that supports procurement decision-making. The data are gathered and simplified into this model from several sources such as complex ERP and other systems; and (c) the *presentation* tier, which uses a web server that allows users to gain access to the application's information via a common web browser, and which is divided into three parts; the first part allowing procurement managers of the purchasing organisation to have access to the procurement functions, the second part

allowing sales representatives of individual vendors to access catalogue management functions and tools to get access to RFQs that are offered to them, to prepare and submit quotations, to manage orders and to log order processing purposely for tracking, and the third and final part which are tools for application administration, including an application programmer's interface (API) that facilitates integration to other systems through several channels and extends the functions of the system for custom application and workflow development.

Soares-Aguiar and Palma-Dos-Resis (2008) describe e-procurement systems as a Web-based client or server application that replaces the manual procurement process and figure 6 illustrates the e-procurement functionalities. In this framework, the authorised users use a browser and a search engine to search for information needed to prepare a requisition in conformity with organisation's procedures. When acquisition is authorised, it automatically becomes an order that is sent to the supplier for fulfillment and shipment and payments are made upon arrival of the order at the buyer's establishment. The electronic catalog at the centre of the procurement management unit hosts specifications and prices of products from suppliers, allow suppliers to access the enterprise server and update the information about their products and services. Moreover, it contains tools that allow managers to do analysis to make procurement decision, authorisation and security module provides user's data access to ensure quality of messages shared between the agents in the transaction. Firms can advance to market-making functionalities when the already mentioned functionalities have been adopted.

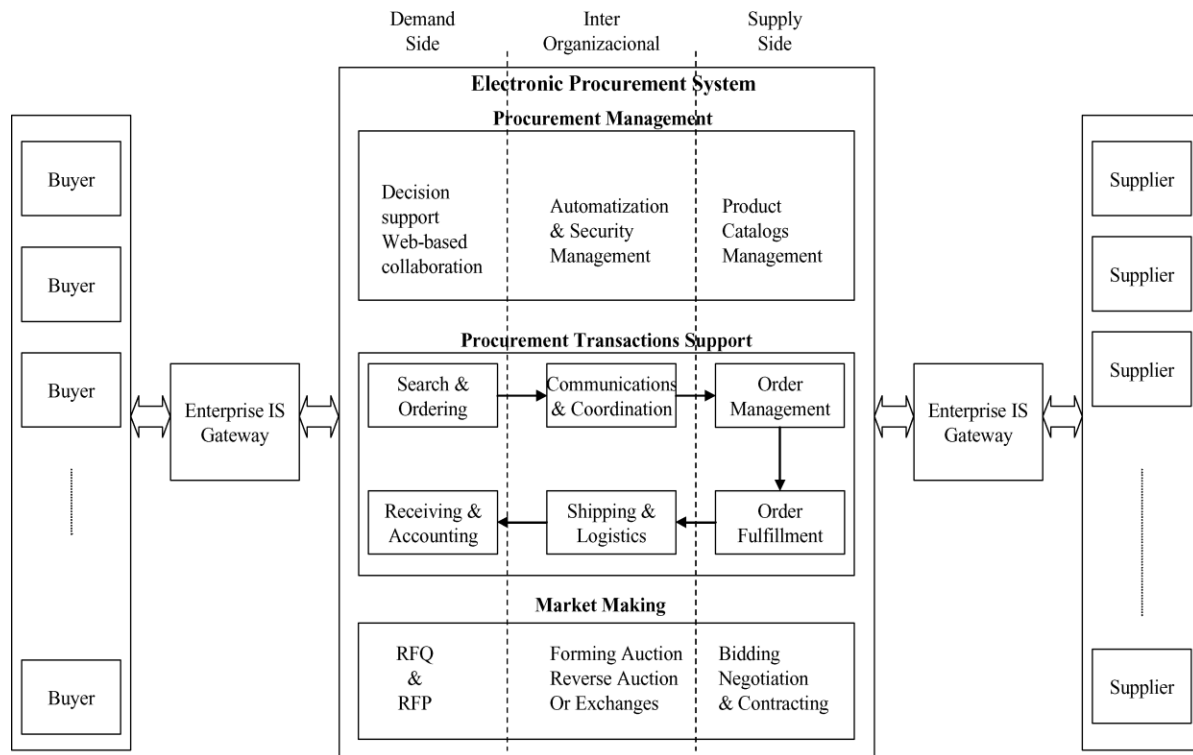


Figure 6: Main functionalities of E-procurement identified in Soares-Aguiar and Palma-Dos-Resis (2008)

Chang et al. (2008) presented a typology of e-procurement systems using a case of Taiwanese original equipment manufacturers (OEMs). The companies use three types of e-procurement applications to link their suppliers: (a) application to application (AP-to-AP), (b) e-commerce (EC) turnkey, and (c) web-based procurement systems. Chang et al. (2008) explained that the AP-to-AP systems uses extensible markup language (XML) technologies such as the RosettaNet process standard to assimilate the procurement process of buyers and suppliers to automatically exchange information between the enterprise resource planning (ERP) technologies of the parties involved. Integrating e-procurement system with AP-to-AP ensures a stronger relationship between buyers and sellers. Regarding turnkeys, suppliers install turnkey software such as electronic data interchange (EDI) for buyers to upload their purchasing orders to the supplier's turnkey electronically. Web-based procurement systems are buyer's buying portal that suppliers gain access through web browsers.

When data is sent through either EDI turnkey or web-browser, it does not automatically turn into formats and structures needed by the information systems of the parties at the receiving end, leading to errors and further scrutiny. Therefore, Chang et al. (2008) noted, merging EDI and web-browser is weaker compared to AP-to-AP connections, and thus in China, most of the suppliers use web-based procurement systems to link their manufacturers.

Raghavan and Prabhu (2004) demonstrated a software agent-based framework for e-procurement dividing e-procurement into a cluster of business processes. The framework shows models for the business processes, provides UML diagrams for the process models and shows an implementation prototype for each of the process models. The framework was developed in the context of e-procurement and it is an agent-based architecture that captures the entire operational processes in e-procurement, as illustrated in Figure 7.

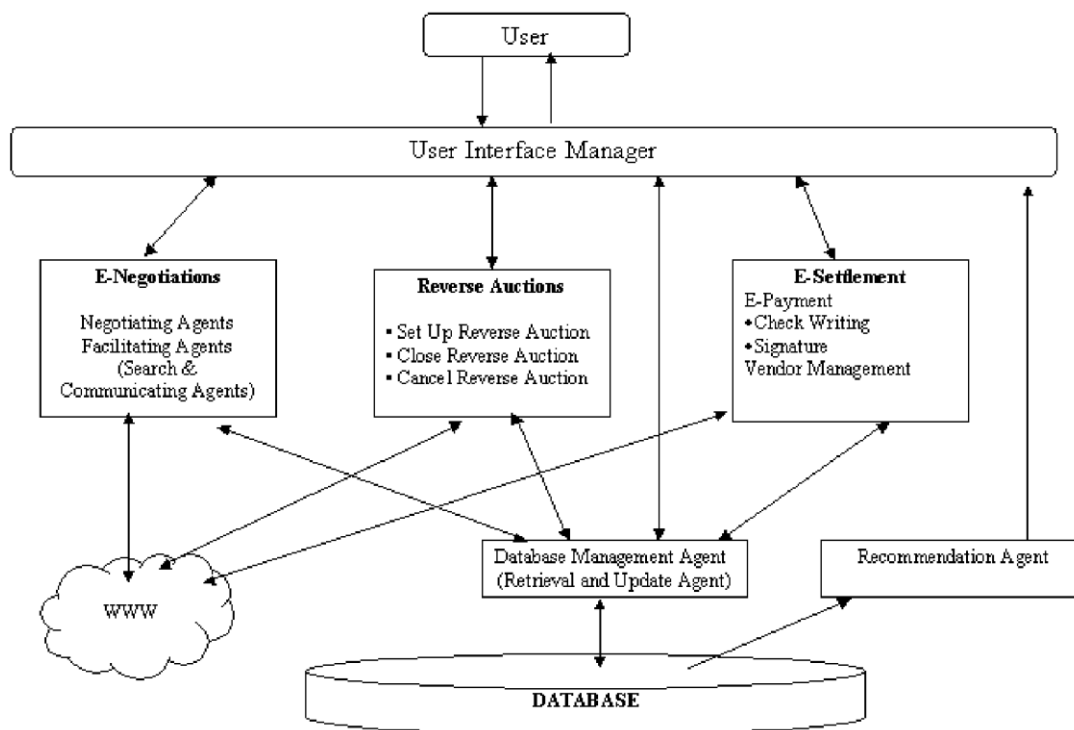


Figure 7: Framework for e-procurement identified in Raghavan and Prabhu (2004)

Puschmann and Alt (2005)'s work focused on what informs organisations' decisions to adopt a particular e-procurement system. According to the authors, the companies Bayer and Xerox's decisions to implement a particular e-procurement system was influenced by the existing ERP and procurement systems. Xerox assessed e-procurement systems from Ariba, Commerce One, Oracle and SAP and selected SAP solutions based on integration capability with their existing SAP R/3 system. Puschmann and Alt (2005) noted technological maturity as one of the main criterion for choosing an e-procurement system. They further reported that Cisco chose Ariba's e-procurement system because it offered a better-quality integration into the Oracle system and was user friendly. One of the key characteristics of e-procurement systems is that it is able to integrate with back-end systems, and to this end Cisco's Ariba system could pick all user information: username, password and IP address from the Peoplesoft human resource system. Further, the system had other interfaces that integrate the Oracle financials and material management system.

In conclusion, e-procurement systems represents a potentially complex technological application, as evidenced by the aforementioned studies proposing different e-procurement systems and how the systems function to meet the intended purposes for adopting it. However, it is also evident that ERP seems to play critical and central role in the functionality of the e-procurement systems, and moreover, none of the authors proposes a specific e-procurement system peculiar to a particular sector (service or manufacturing), and thus organisation-based e-procurement system might be important to encourage its adoption and implementation.

2.5.4 Implementing e-procurement

Several of the studies selected for the thematic analysis made an effort to explain the implementation of electronic procurement with varied suggestions and proposals (Ibem and Layea, 2015; Bayazit, 2014; Hung et al., 2014; Tai et al., 2010; Kameshwaran et al., 2007; Raghavan and Prabhu, 2004; Adebajo, 2010). Holistically, e-procurement brings a massive change and transformation in the core approach of conducting business (Bayazit, 2014).

During implementation, top management defines the objective, mission, and goals, and formulates policies and strategies to make electronic procurement a reality (Adebanjo 2010; Tai et al., 2010) and this should be aligned with the entire business goals of the organisation to avoid failures (Rotchanakitumnuai, 2013; Hung et al. 2014; Raghavan and Prabhu, 2004).

At implementation stage, all the existing procurement operations are automated (e.g. electronic data interchange- EDI is installed) alongside digitalised procedures to meet the required service (Hung et al., 2014). The e-procurement system is built around easy-to-access technologies and ensures all possible standards are fulfilled (Tai et al., 2010). Equally important, an e-procurement system should integrate the firm and its business processes with suppliers and manage the interconnections between them (Rotchanakitumnuai, 2013). Staff competence and capacity, training and adequate resources are pre-requisite ingredients for the successful implementation of the online purchasing system (Rotchanakitumnuai, 2013).

Beyond the above factors, Bayazit (2014) reported other factors that companies should take into consideration when implementing e-procurement: (1) collaboration with suppliers is important at the implementation stage, it is essential to provide suppliers with technological infrastructure that they are ready to use, sophisticated e-procurement technology otherwise deter suppliers from investing in such systems which deny the organisation its expected benefits of implementing the purchasing system; (2) outsourcing (use of a consultant firm) of the implementation of e-procurement, concluding that larger companies stand a higher chance of paying costs for outsourcing consultants compared to the smaller organisations, and (3) the importance for companies to consider some critical success factors such as IT support, knowledge about priorities of the organisation, supplier and contract management, information and e-procurement infrastructure, top management support and commitment and flexibility of the system.

To help guide implementation, Vaidyanathan et al. (2012) highlighted the e-procurement process illustrated in figure 8, identifying the location of the implementation sites necessary for fulfilling the tasks of responding to requests for information and quotes,

acknowledging order receipt, order preparation for shipment, shipment, invoice preparation and account receivable management.

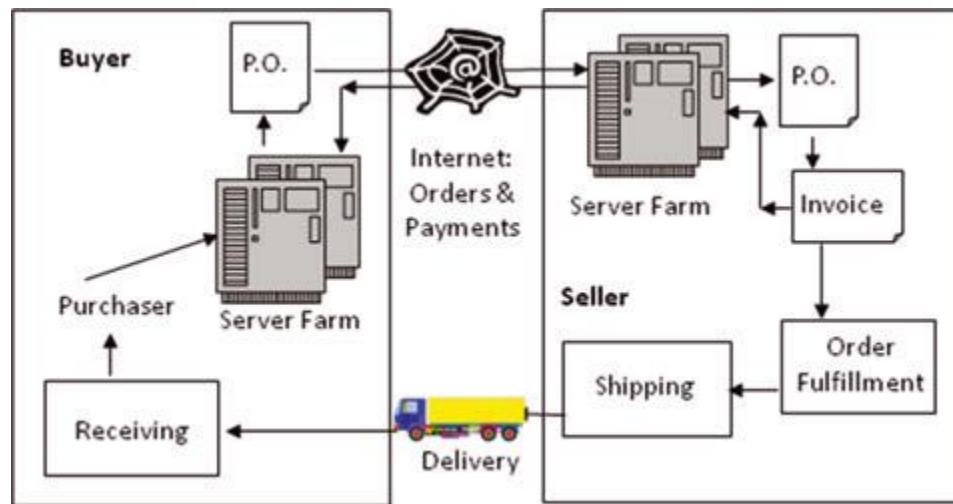


Figure 8: E-procurement process identified Vaidyanathan et al. (2012)

It is interesting to note that despite the attention on implementing e-procurement, none of the studies that were analysed actually presented what could be considered to be a comprehensive framework elaborating a process for guiding the implementation of e-procurement. The contributions nevertheless highlight best practices which generally organisations can adopt as a pathway in implementing e-procurement for better procurement outcomes. Accordingly, it is reasonable to conclude that companies should embrace the practices for implementing e-procurement, align it with organisational goals, vision and mission supported by a strong management commitment might lead to successful implementation.

2.5.5 Benefits of e-procurement

The analysis identified several benefits of using the online purchasing system for business transactions. Several sources have given it attention through empirical work

(e.g. Piotrowicz and Irani, 2010; Trkman and McCormack, 2010; Gunasekaran et al., 2009; Croom, 2000; Massa and Testa, 2007).

The analysis revealed that past research groups the benefits of e-procurement under different broad headings; operational and strategic, strategic and opportunity, tactical, direct and indirect, market efficiency, process efficiency, and effectiveness (Piotrowicz and Irani, 2010). Gunasekaran et al. (2009) grouped the benefits under three key headings, namely (1) *Strategic*, which encompasses organisational change and market change, (2) *High leverage opportunities*, which include enhancing stronger relationships with existing suppliers and building relationships with new suppliers, and (3) *Operational advantages* which involve effective purchasing.

Gunasekaran and Ngai (2008) summarised the benefits of e-procurement as minimizing administrative costs, shortening the order fulfillment cycle time, lowering inventory levels, reducing the cost of paying for goods, and preparing organisations for enhanced technological collaboration and planning with business partners. Piotrowicz and Irani (2010) and Gunasekaran et al. (2009) shares similar view that when e-procurement is implemented, the company can enjoy costs reduction, reduced order fulfillment time, shorter buying cycle time, minimised number of suppliers, lower head count to support purchasing transactions, maximized flexibility, receiving current information about orders, and help to control spending.

Puschmann and Alt (2005) reported that the online purchasing system allows companies to decentralize operational procurement processes and centralize strategic procurement processes as a result of optimized supply chain transparency. The electronic procurement system benefits suppliers by facilitating the entire purchasing process. Through an electronic platform, suppliers upload their application for registration that enables them to interact, share ideas and relevant information (Rotchanakitumnuai, 2013). From a policy perspective, Walker and Harland (2008) indicated that e-procurement in the public domain can be recognised as a policy tool and can help, for example, governments to minimise costs of doing business to make better decisions for value

In summary, adopting and implementing e-procurement is considered beneficial to all organisations, although it is recognized some may not enjoy the full benefits of the system depending upon their unique characteristics and operations (Trkman and McCormack, 2010; Gunasekaran et al., 2009; Croom, 2000; Massa and Testa, 2007). Benefits that relate to strategic and cost management have been extensively discussed, while the other have been given a minimum less attention. Nevertheless, it is clear that companies can access numerous opportunities through e-procurement usage to improve their operations for optimal business performance.

2.5.6 Barriers, challenges and risks of e-procurement

E-procurement is not without challenges, barriers and risks. The analysis revealed that many authors share common ideas and perspectives on the barriers, challenges and risks associated with adopting and implementing e-procurement. It is clear that some of challenges relate to pre-adoption and some to post-adoption (Gunasekaran et al., 2009; Angeles and Nath, 2007; Gunasekaran and Ngai, 2008; Tatsis et al., 2006). The challenges are summarized in Table 5.

Table 5: The challenges of e-procurement

Challenges	Source
Technology uncertainty	Tatsis et al. (2006)
Process change	
Cultural change	
Lack of logistical infrastructure	
International trade through internet is immature	
Value (capabilities of web technologies are inadequate)	
Inadequate resources	Gunasekaran and Ngai (2008)
Lack of motivation of staff	
Resistance to new technology	
Lack of top management support	
Lack of standard interchange formats for e-procurement	

Internal end-user resistance to lean multiple procurement systems	Angeles and Nath (2007)
Project costs overrun in catalog rationalisation/ implementation, training and indirect costs	
Difficulty of eliminating maverick buying	
Lack of capital	Gunasekaran et al. (2009)
Lack of expertise and technical skills	
Lack of technologies and tools	
Resistance to change	
Lack of top management support	
Security of transactions	
Lack of e-procurement supplier solutions	
High costs of technology	
Lack of legal framework	
Lack of technical expertise	
Lack of e-procurement knowledge	
No real business benefits identified	
Lack of data exchange standards	
Lack of business relationships with suppliers	

From Table 5 it can be discerned that matters and issues relating to technology dominate the barriers, risks and challenges with all the papers sharing similar concerns and perspectives about e-procurement and use of technologies (Gunasekaran et al., 2009; Angeles and Nath, 2007; Gunasekaran and Ngai, 2008; Tatsis et al., 2006). The consistent but varying concerns about e-procurement technologies demonstrate the success of e-procurement largely depends on acquisition and the organisation's ability to effectively use e-procurement technologies.

The attitude and capabilities of people (top management, staff expertise, knowledge, skills and willingness) involved in the adoption and implementation of e-procurement has also been given a significant attention among authors.

Some of the personnel issues found were resistance to new technology, low motivation, lack of top management support and commitment and resistance to change (Angeles and Nath, 2007; Gunasekaran and Ngai, 2008). Lack of support, commitment and expertise of the organisation's staff can lead to real and unforeseen consequences that hampers the smooth implementation of internet-based procurement systems (Angeles and Nath, 2007; Gunasekaran and Ngai, 2008; Gunasekaran et al., 2009).

Financial resources was one of the prominent issues associated with the adoption of e-procurement among the papers that qualified for inclusion in the review (Angeles and Nath, 2007; Gunasekaran et al., 2009). Lack of financial resources can cripple management's dream of employing the internet-based procurement system, and conversely management's role in providing finances becomes critical for successful implementation and sustainability of e-procurement (Angeles and Nath, 2007). Finances is needed to fund the required new technology, hire experts if needed and for many other activities needed to help ensure the success of the e-procurement system. Many contributions (e.g. Gunasekaran et al., 2009; Tatsis et al., 2006; Gunasekaran and Ngai, 2008) emphasise the critical role of finances as one of the important resources that organisation require in adopting and implementing e-procurement successfully. Interestingly, areas such as security concerns, relationship with suppliers, legal matters, cultural issues, lack of data exchange standards and international issues were not highlighted within the papers that met the inclusion criteria. It is worth noting that wider reading notes that these factors and challenges can also be challenges if poorly managed by organisations and can contribute to e-procurement failure.

2.5.7 Effect of e-procurement practices

The effects of e-procurement practices have received attention in the mainstream e-procurement literature (Ramkumar et al., 2019; Tai et al., 2010; Smart, 2010; Percy and Giuniperom, 2008; Aslani et al., 2008). Generally, e-procurement practices affect procurement practices and procurement performance (Quesada et al., 2010). Ramkumar et al. (2019) indicated that the effects happen at two levels: *individual* and *organisational* level productivity and efficiency.

The internet-based procurement plays an integral role in boosting performance and making a renowned change in purchasing materials and ensuring collaboration among the players of the supply chain (Tai et al., 2010).

Similarly, Tai et al. (2010) proposed a web-based e-procurement impact model based on supply chain orientation involving operational and strategic impact. Tai et al. (2010)'s study revealed that implementing web-based e-procurement minimises transactions and inventory costs and enhances production planning, bringing changes in purchasing, and transforming purchasing activities from operational to a strategic function. Organisations that implement web-based e-procurement methods for purchases can minimise transaction cycle time and error rate and smooth integration of process of purchases, inventory, and supplier delivery performance and boost buyer organisational performance, and furthermore, e-procurement promotes good partnership between buyers and suppliers through information sharing and technology dependence.

However, the literature demonstrates that e-procurement not only can exert positive influence on organisations but can also lead to some operational difficulties. Vaidyanathan et al. (2012) revealed that e-procurement is time-consuming, expensive and more complex than how companies often initially perceive. For instance, they explained that the data management and procedures in catalog content management (SAP CCM) are highly complex, and that due to these complexities, users encounter long and difficult procurement processes which can negatively affect crucial business priorities. Furthermore, new technologies generate risks for electronic commerce and one of such risks is security which has been a hindrance to the use of electronic commerce channels and remains one of the crucial issues in e-procurement.

Information security has become one of the main challenges in e-procurement due to the huge volumes of sensitive and confidential information exchange among partners and the negative side effect is the opportunities that cybercriminals get access to valuable information through theft (Vaidyanathan et al., 2012). Some instances of information security threats are password sniffing, data modification and spoofing are inherent in e-

procurement; thus, the use of internet reduces legal protection (Vaidyanathan et al., 2012).

The literature thus reveals that e-procurement has both positive and ripple effects on the operations of organisations when used to handle procurement transactions. Implementing e-procurement practices can lead to a major transformation in the entire businesses due to the introduction of new technologies and alteration in the procurement procedures. It follows that organisations that seek to implement e-procurement practices should expect such change from the outset, and in order to ensure detailed enough preparations to embrace the change for optimal procurement performance.

2.5.8 Usage of e-procurement applications

The usage of e-procurement applications has gained significant attention in the e-procurement and the supply chain management literature (Garrido-Samaniego et al., 2010; Kothari et al., 2005; Wu et al., 2007; Mishra et al., 2007; Teo and Lai, 2009). The usage of e-procurement application encapsulates the extent to which electronic networks and activities that assist electronic communication, information dissemination, offer support through public or private networks (Quesada et al., 2010). Smart (2010) indicated that firms have adopted e-procurement technologies and as a result suppliers use purchasing systems such as electronic catalogues, e-marketplaces, market aggregators, online reverse auctions and supporting tools for search and analysis.

Kothari et al. (2005) noted that as of 2003, approximately 82% of the world's top 200 global companies were preparing to fully implement e-procurement solutions and e-procurement adoption was expected to increase at a high pace. According to Garrido et al. (2008) as of 2006, 15.7% of the world's population had access to the internet with the USA being the highest user and where penetration rate was close to 70% of the country's population ahead of China and Japan, and in Spain 90% had internet connectivity and 48.3% of them owned websites. The introduction of web technologies has allowed firms to engage in online procurement of strategic items and essential services and as a result, the US market for instance, had attained 11% and 12% business growth because of adoption of e-procurement technologies (Teo et al., 2009).

Organisations such as Dell, IBM, and Cisco have made significant process efficiencies from using internet technologies in procurement (Mishra et al., 2007).

According to Rajkumar (2001), e-procurement technologies are important for information exchange between the organisation and its suppliers in business transactions. Wu et al. (2007) found that coordinating e-procurement applications has a direct influence on perceived efficiency gains. Soares-Aguiar and Palma-dos-Reis (2008) reported that e-procurement adoption and e-procurement systems play an integral part in e-procurement transactions. Organisations need e-procurement applications to reduce human efforts, encourage repetitive buying and minimise paperwork to boost performance (Walker and Harland, 2008). Companies attain commercial value from utilising e-procurement applications and technologies (Mishra et al., 2007). However, Caridi et al. (2004) revealed that e-procurement applications offer no value to organisations or can even disrupt value if it departs from the strategic role of organisational functions in the transactional process.

In conclusion, the usage of e-procurement applications is increasing among organisations and nations and has the potential to grow further as many firms are gaining a lot of interest in using such application for procurement transactions. The e-procurement applications have made significant contributions to organisational success by streamlining procurement processes and the supply chains by eliminating the manual procurement system.

2.5.9 Factors affecting (Including antecedents/enablers) e-procurement systems

The previous literature incorporates identification of the antecedents and enablers of e-procurement (Rotchanakitumnuai, 2013; Teo et al., 2009; Soares-Aguiar and Palma-Dos-Reis, 2008). Past research gives several factors that reinforce the company's decision to adopt the internet-based purchasing system. Walker and Harland (2008) mentioned organisational, readiness, supply, strategic and policy as factors that influence the adoption of e-procurement: (1) organisational factors are size and type of operation; (2) readiness involves availability of e-procurement technologies and staff expertise; (3) supply factors include availability of efficient supply chain and competent suppliers; (4) strategic factors is the intention to gain a competitive advantage; and (5) policy factors

relate to using e-procurement as a policy tool to support public procurement policy to enhance transparency and efficiency.

Mishra et al. (2007) proposed that heterogeneously distributed resources which involve procurement process digitalisation and organisational procurement empower firms to employ the internet to different extents across multiple procurement stages. Al-Hakim et al., (2012) grouped the antecedents under two main headings; internal and external factors. The internal factors include organisational culture, employee attitude, management structure, leadership, organisational learning, IT resources and the company's financial situation, whereas the external factors are the competitive environments of the company and social network, which encompasses trade association, accreditation agencies all informing firms' decision to adopt e-procurement. The literature shows that organisation's intention to promote information sharing is an enabler of e-procurement adoption. Teo et al. (2010) postulated that the use of the internet for electronic procurement comprises exchange of information between the firm and its partners to ensure order and acquisition information availability in the supply chain. E-procurement technologies (such as e-RFX) enable better coordination between users and suppliers, leading to enhanced productivity, low operational costs and optimized use of resources (Bayazit, 2014).

Teo et al., (2009)'s framework which portray adopter and non-adopters of e-procurement included three factors: technological, organisational and environmental factors. The technological factors reflect perceived direct benefits, perceived indirect benefits and perceived costs. The organisational factors encompass firm size, top management support and information sharing culture, and the environmental factor is the business partner influence, that is to say, organisations who have adopted one form of technology influence their partners to adopt same.

Khorana et al. (2014) proposed a framework demonstrating the enablers of e-procurement adoption in the EU. The factors that can possibly influence adoption of e-procurement in the EU are (1) infrastructural standardisation, (2) information assurance and security framework, (3) overall business environment, and (4) organisations,

stakeholders and incentives. Regarding infrastructure standardisation, it suggests that e-procurement should be aligned with legal framework and infrastructure supported by business initiatives and strong stakeholders interaction (Khorana et al., 2014). Information assurance and security framework involves the level of inter-operability and standardisation of solutions in place, which affects the advancement of e-procurement. Overall business environment is about the circumstances of the market and structure that determines contracting undertaking; regulation about communication, data storage and usage of specific procedures and decision about matters that affect the market structure. Organisations, stakeholders and interaction encompasses the contracting authorities and organisations and how individual roles and responsibilities are well-defined and how these interact.

Wu et al's. (2007) model shows that top management emphasis, organisational learning ability and normative pressures are antecedents of intensity of e-procurement adoption (coordination application and transactional application use). Their model indicates that top management emphasis and organisational learning ability are organisational characteristics and normative pressure relates to the external environment. The model emphasises that top management support for information technology plays a crucial role in its adoption. Because of high investments in technologies (e.g. ERP) and the importance of gaining acceptance within many functional areas, top management commitment becomes highly relevant to ensure the success of implementing such systems. Organisation's learning ability can possibly define the level of adoption and implementation of technology attainable in any given time frame, and thus often combines learning the system and knowing how the systems can be utilised to enhance the current operations of the company. Normative pressure is an environmental factor that encompasses a situation where organisations adopt innovation to stay updated with competitors in the industry. Wu et al. (2007) explain that when competitors adopt an innovation, the other firms in the industry realise that they cannot be competitive for their inability to adopt the innovation, and therefore organisations often adopt the innovation simply in pursuit of also gaining a competitive edge rather than because of an independent assessment of its usefulness.

In summary, the literature demonstrates that the enablers and antecedents of e-procurement are external and internal factors and have tended to do so from an EU based enablers and antecedents of e-procurement perspective. However, it is apparent that the e-procurement antecedents and enablers framework from the perspective of developing economies and the manufacturing sector is missing in the extant literature.

2.5.10 E-procurement and supply chain performance

It is clear from the review of the literature that e-procurement technologies remain an important aspect of supply chain management (Kothari et al., 2005; Ronchi et al. 2010) and crucial for supply chain participants (Tai et al., 2010). Essig and Arnold (2001) share this view, that the internet-based purchasing system is regarded as one of the key enablers of supply chain management. As noted by (Chang et al., 2013) e-procurement is considered a new strategic view of supply chain management, with supply chain management professionals using e-procurement to link supply chain members, and in doing so enhancing speed of information distribution and limiting non-value adding processes (Pearcy et al., 2008; Chang and Wong, 2010). Chibani et al., (2018) put this subject matter in a different context by looking at dynamic optimisation for highly agile supply chain in e-procurement.

Several studies have analysed e-procurement and supply chain performance together (Halikas et al., 2021; Madzimure et al., 2020; Pattanayak and Punyatoya, 2019; Smart 2010) and have demonstrated a direct relationship between them (Chang et al., 2013; Hallikas et al., 2021). Chang et al. (2013) investigated the relationship between e-procurement and supply chain performance in Taiwan, hypothesizing that e-procurement positively influence supply chain performance. E-procurement was evaluated with specific dimensions: e-design, e-sourcing, e-negotiation and e-evaluation, and supply chain performance was evaluated in terms of tangible and intangible performance. The results proved a direct and significant positive relationship between E-procurement and supply chain performance.

Hallikas et al. (2021) investigated digitalizing procurement: the impact of data analytics on supply chain performance. Data was gathered from 348 participants working in manufacturing and service supply chain actors of Finnish biorefinery companies. Hallikas et al.'s (2021) model included digital analytics, digital procurement, and internal data analytics as independent variables, supply chain performance as a mediator variable and business performance as the dependent variable in a model. The model hypothesised digital procurement to influence supply chain performance, and evaluated supply chain performance in terms of flexibility, resource efficiency, integration, cost, speed, reliability and transparency. Digital procurement was evaluated in terms of e-bidding, e-billing, e-RFP, e-order change, e-order, and e-order confirmation. The results showed a strong positive relationship between digital procurement and supply chain performance.

Kim et al. (2015) focused on contextual analysis of the impact of strategic sourcing and e-procurement on performance. The study took survey responses from 137 managers in US manufacturing companies. The main concepts (constructs) were strategic sourcing, e-procurement and performance. The status of purchasing, internal coordination, information sharing with suppliers and supplier development were defined as antecedents of strategic sourcing, and the antecedents of e-procurement are usage of e-procurement and impact of e-procurement. Finally, performance was evaluated from three perspectives: financial performance, operational performance and supply chain performance. The results indicated that e-procurement significantly influences firm performance, and that e-procurement was found as a significant contributor to strategic sourcing.

Pattanayak and Punyatoya's (2019) study sought to analyse how e-procurement and supply chain technology internalisation influence supply chain performance through supply chain integration. Data was obtained from 214 respondents involving project managers, supply chain managers, procurement managers and consultants, and structural equation modeling was employed for data analysis. The study reported a significant positive effect of e-procurement and supply chain performance.

Smart (2010) investigated e-procurement and its impact on supply chain management in the industrial sector (four multinational firms) using thematic parameters obtained from the literature. The study found that multinational firms have a well-organised market strategy based on segmentation model, thus e-procurement tools are used strategically to utilise and expand that strategy towards the supply base. The buying firms employ e-procurement tools to minimise number of suppliers and leverage their volumes in price-competitive markets.

The aforementioned studies establish a direct and positive relationship between e-procurement and supply chain performance. Two studies focused on the manufacturing sector, indicating that the manufacturing sector has received attention in the study of e-procurement and supply chain management.

2.5.11 Overview of theories relating to e-procurement and supply chain performance

The analysis revealed that electronic procurement has been studied from the perspective of a diverse set of theoretical perspectives. These are presented and explained in Table 6, which provides a synthesis of the theories and how they have sought to provide theoretical understanding for e-procurement.

Table 6: Theories relating to e-procurement

Theory	Application to e-procurement and supply chain.	Author(s)
Innovation theory diffusion	Innovation diffusion theory has been used in the procurement domain to study technology adoption at the organisational level	Ibem and Layea (2015)
Technology acceptance model (TAM)	Used as foundation theory to explain factors influencing the use of electronic procurement systems and two acceptance factors, namely perceived usefulness and perceived ease of use, influencing behavioural intention.	Purchase and Dooley (2010)

Technology acceptance model (TAM)		Extended TAM model, theorising buyers' perceived ease of use, perceived usefulness and perceived value of e-procurement services to have effects on their continuance intentions.	Ramkumar (2019)
Dynamic theory	capability	Used dynamic capabilities theory as a theoretical lens in a model to investigate the information flow quality between buyers and suppliers as antecedents of logistics fulfillment quality process led to quality performance	Vaidyanathan and Devaraj (2008)
Dynamic theory	capability	Applied the theory to examine the effects of strategic sourcing and e-procurement as a company's capability on performance.	Kim et al. (2015)
Resource based view theory (RBV)	view	Used RBV to portray the idea that when firms adopt e-procurement, they can utilise their technological capabilities to create value in the e-procurement process when they migrate from traditional procurement systems.	Vaidyanathan and Devaraj (2008)
Resource based view theory (RBV)	view	Applied RBV, theorising that user-level determinants of buyers' satisfaction are influenced by the quality of e-procurement services provided, which consider information systems as resources.	Ramkumar et al. (2019)
Social system view theory	technical	Used it as a basis to argue that the supply chain of the construction industry consists of sub-contractor, supplier, sub-supplier, client, and consultant, thus social integration among these groups of actors is relevant for the success of the supply chain.	Pattanyak and Punvatona (2019)
Institutional theory		Used the institutional theory in the field of procurement to examine the organisational factors that explain the adoption of e-procurement.	Soares-Aguiar and Palma-Dos-Resis (2008)

Agency theory	Applied the agency theory to address transactional relationships between parties with different goals in the presence of doubt	Vaidyanathan et al. (2012)
Technology organisation and environment theory (TOE)	Used the TOE framework to investigate the factors connected to adoption of e-procurement.	Teo et al. (2009)
Theory of planned behaviour	Applied it as a foundation theory in the procurement literature to test the adoption of electronic procurement, posits that individual behaviour influences technology adoption, type of technology and users and the context.	Gamal (2010)
Williamson's (1985) transaction theory	Applied the theory to examine market problems in the field of electronic procurement.	Essig and Arnold (2001)

The analysis indicates that Technology Acceptance Model (TAM), Resource Base View and Dynamic Capabilities theories have been applied mostly to date to explain e-procurement and supply chain performance. The literature demonstrates that the associated authors have applied these theories in the e-procurement and supply chain management literature to achieve different theoretical purposes, thus contributing to strong theory building.

2.6 Summary – Conclusion and gaps in e-procurement/SC performance research

The chapter has elaborated the e-procurement and supply chain performance constructs, and through a systematic literature review, electronic procurement and supply chain performance specific papers were identified and organised to solicit for the themes that have emerged. To conduct this activity properly, a descriptive analysis of the papers that met the inclusion criteria was carried out. The descriptive analysis covered: data collection methods, constructs, methods of data analysis, industry type, country of study and time horizon (cross-sectional or longitudinal), e-procurement and supply chain performance constructs, e-procurement specific dimensions and study participants.

Thematic analysis was then conducted to identify patterns or themes in the literature, and organise and examine them (Nowell et al., 2017), to provide understanding and new insight (Naeem et al., 2023). Eleven prevalent themes were identified and examined in the previous sections. The review revealed that the previous research has given much attention to these areas of study in the e-procurement and supply chain management literature. It is interesting to note that the majority of the literature contributions focused on the benefits/outcomes of electronic procurement, with less attention given to its barriers, application, antecedents and enablers. Based on the descriptive and thematic analyses, the review highlights study gaps for further research and for the current study and highlights the need to approach further studies with clear ideas about the procurement and the supply chain literature.

E-procurement adoption has been given plenty of attention in previous research (Brandon-Jones and Kauppi, 2018; Al-Hakim et al., 2012). However, most of the studies on the adoption of practice-procurement have been done in the developed economies (e.g. Batenburg, 2007; Reunis et al., 2004; Wu et al., 2007; Berlak and Weber, 2004; Al-Hakim et al., 2012; Gamal, 2010). Only few studies have looked at it from developing countries perspective (e.g. Chang and Wong, 2010; Ibem and Layea, 2015). The limited research in this area of study calls for more studies to determine how e-procurement adoption is growing in the emerging economies to enrich the knowledge of e-procurement practitioners and government agencies willing to use it for policy purposes.

Effects of e-procurement practices were identified as one of the themes in the e-procurement literature (Smart, 2010; Vaidyanathan et al., 2012). The previous literature is clear about both positive and negative changes that organisations experience when e-procurement is implemented. For instance, the past studies highlight the positive effects of e-procurement practices on supply chain integration (Madzimore et al., 2020), supply chain integration in SMEs and managers' perception of e-procurement (Quesada et al., 2010), and supply chain management in the industrial sector (Smart, 2010). The studies have tend dwell much on the positive effects of e-procurement more than the negative effects. However, knowledge about this other side of the e-procurement will help

organisations to make informed decisions. The side effects of implementing e-procurement are beyond the scope of the current research, but future studies can extensively dig deeper into the negative effects of adopting e-procurement.

E-procurement implementation emerged as one of the central themes, with many researchers sharing diverse knowledge about it (Ibem and Layea, 2015; Bayazit, 2014; Hung et al., 2014; Tai et al., 2010; Croom, 2000). Because electronic procurement is a new buying system, many organisations cannot embark on implementing it under a confused situation where no clear procedure exists, and lack of a clear path has led to failures in implementing the electronic-based purchasing method to meet the demands of the current market (Angeles and Nath, 2007; Gunasekaran and Ngai, 2008; Tatsis et al., 2006). However, the existing studies have paid little attention to developing a clear roadmap to guide companies to implementing e-procurement in organisations (e.g. Chang et al., 2004). Based on this insight, intensive research and further studies are required to develop and propose frameworks to help lead companies across diverse fields to properly implement e-procurement to boost the performance of their operations.

Enablers and antecedents of e-procurement have attracted the attention of the research community (Rotchanakitumnuai, 2013; Teo et al., 2010; Soares-Aguiar and Palma-Dos-Reis, 2008; Walker and Harland, 2008; Mishra et al., 2007). A majority of the studies mentioned internal factors such as firm size, top management support, perceived benefits, technology competence as antecedents/enablers of electronic procurement. However, relative minimum attention has been given to external factors contributing to the adoption of e-procurement. Companies are making efforts to adopt e-procurement system to boost their performance to gain a competitive advantage. As a result, the understanding of antecedents/enablers of the electronic-based purchasing method is important for theory and practice. The absence of extensive work on external antecedent/enablers of e-procurement literature leaves a research gap that future research can and should address, in support of helping practitioners to make informed decisions.

The usage of e-procurement applications has attracted the attention of scholars (e.g. Quesada et al., 2010; Garrido et al., 2008; Rai et al., 2006; Cardi et al., 2004). The e-procurement literature indicates that e-procurement technologies influence the perception of managers (Quesada et al., 2010). Furthermore, electronic data exchange, inter-organisational systems, e-commerce, e-sourcing, and e-auctions are information systems that support supply chain management (Quesada et al., 2010). Rai et al. (2006) for instance noted that research on usage patterns of e-procurement innovations among buyer organisations is limited. Garrido et al. (2008) also emphasises the relevance of using e-procurement application at buying centers. This indicates that this area of research is important for motivation and encouragement among users of e-procurement and potential users. However, the past studies to date have given insufficient attention to investigating the rate at which organisations are using e-procurement applications to encourage potential users. Therefore, this area of research can be a source of motivation for future studies for decision making and practice.

Past research has hailed e-procurement as a panacea for many of the challenges hampering the performance of organisations. Many studies were found to have examined the benefits of e-procurement from an organisational perspective (Tatsis et al., 2006; Trkman and McCormack, 2010; Walker and Harland, 2008; Gunasekaran et al., 2009; Gunasekaran and Ngai, 2008) and categorized the benefits of e-procurement as financial or nonfinancial and tangible or intangible (Piotrowicz and Irani, 2010) including to the supply chain (Puschmann and Alt, 2005; Kothari et al. (2005). However, studies revealing the benefits of e-procurement from the buyer or supplier perspective are still quite limited, despite suppliers and buyers being arguably the most important parties to e-procurement, not least because their participation in the process is essential for its success. Based on this, future studies can uncover the benefits of e-procurement from the supplier and buyer perspective to encourage participation in e-procurement transactions.

The challenges associated with e-procurement have been a significant theme in the e-procurement literature (Gunasekaran and Ngai; 2008; Angeles and Nath, 2007; Tatsis et al., 2006; Trkman and McCormack, 2010).

The challenges/risks of implementing e-procurement have been mainly researched at organisational level (Tatsis et al., 2006; Angeles and Nath 2007; Gunasekaran et al., 2009). However, the challenges of e-procurement at the individual level (employees) of the organisation have a major influence on the entire procurement process. To this end, it is reasonable to argue that scholars must turn their attention to looking at barriers, and indeed conversely the enablers of the technology-based procurement at the individual level. This is important for understanding the e-procurement challenges from a diverse perspective because each employee might have a peculiar challenge that needs attention and a specific perspective, and equally there may be common challenges and enablers from the individual user perspective. Filling this latter research gap appears to be an important area for research with significant implications for theory, management and policy.

One of arguably the most salient under-researched areas that emerged through the review concerns the relationship between electronic procurement and supply chain performance. Although this area of research is starting to gain momentum in the extant literature with authors now focused on giving it attention (Pearcy et al., 2008; Puschman and Alt., 2005; Pattanayak and Punyatoya, 2019; Chibani et al., 2018), these existing studies have generally tended to focus primarily on the direct relationship of e-procurement and supply chain performance. However, Chang (2013) showed that some intervening variables can influence the relationship between e-procurement and supply chain performance. Despite this, it is clear that few studies have channeled their attention to the factors that influence the relationship between e-procurement and supply chain performance. This gap forms the central basis of the current study, and therefore, it is the main objective of the current research to fill this gap, specifically by analysing the intervening role of quality of information, supplier efficiency, perceived ease of use, perceived usefulness and top management support on the relationship between e-procurement and supply chain performance and doing so in the context of the manufacturing sector.

2.7 Summary

This chapter analysed the e-procurement and supply chain performance literature. The analysis identified 11 themes: (1) adoption of e-procurement, (2) drivers of e-procurement, (3) e-procurement systems, (4) implementing e-procurement, (5) benefits of e-procurement, (6) barriers, challenges and risks of e-procurement, (7) effect of e-procurement practices, (8) usage of e-procurement applications, (9) factors affecting (including antecedents/enablers) of e-procurement systems, (10) e-procurement and supply chain performance, and (11) overview of theories relating to e-procurement and supply chain performance. Descriptive analysis of the literature was provided and each theme was discussed. The preceding final section of the chapter has elaborated research gaps in the e-procurement and supply chain literature and has identified the gap that the current research seeks to fill.

Based on the insight presented in this chapter, the next chapter presents the theoretical framework which includes detailed description of the study constructs, theoretical foundation and development of the hypotheses.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1 Introduction

The previous chapter provided a systematic analysis of the e-procurement and supply chain performance literature, and identified themes and gaps, including that which the current research contributes to fill. This chapter builds on the theoretical foundations identified previously to develop a conceptual framework of the effects of e-procurement on supply chain performance. This chapter is organised as follows: the next section 3.2 presents the study's theoretical framework and defines the study constructs. Section 3.3 then presents the underpinning theories, based upon which section 3.4 then sets out the research hypotheses. Section 3.5 provides a summary of the chapter.

3.2 Conceptual framework

Based on the literature review, the thesis proposes a theoretical model that sets out the proposed interplay between e-procurement, perceived ease of use, perceived usefulness, supplier efficiency, quality of information, top management support and supply chain performance, as depicted in Figure 9. The model posits that e-procurement exerts a direct effect on supply chain performance. The model further predicts that the direct effects of e-procurement on supply chain performance are influenced by supplier efficiency and quality of information. Specifically, the model proposes the mediating effect of supplier efficiency and quality of information, respectively, on the relationship between e-procurement and supply chain performance. Further, the model posits that perceived ease of use, perceived usefulness and top management support play an important moderating role between e-procurement and supply chain performance. The study hypotheses are presented in Table 7. The model controls for job title, years of work experience, number of employees, type of industry and educational qualification.

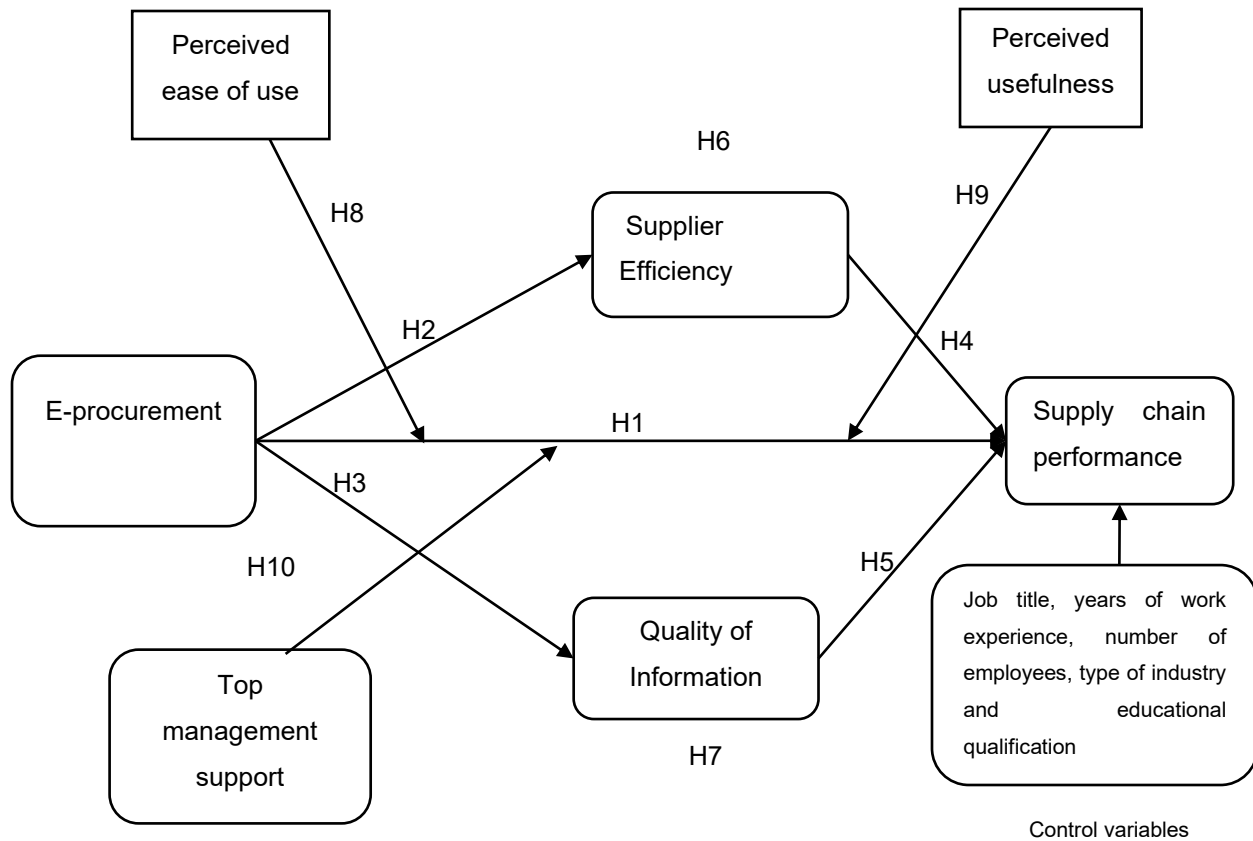


Figure 9: Research model

Source: Developed by the author

Table 7: Research hypotheses

NO	Hypothesis	Source
H1	E-procurement has a positive effect on supply chain performance	Chang et al. (2013), Hallikas et al. (2021), Smart (2010), Barngetuny and Kimutai (2015), Mutangili (2019), Nandankar and Sachan (2020)
H2	E-procurement has a positive effect on supplier efficiency	Antonio et al. (2003), Zahay and Handfield (2004), Singh and Chan (2022), Charnor and Quartey (2024)

H3	E-procurement has a positive effect on quality of information	Chang et al. (2013), Hashim et al. (2022), Rotich and Okello (2015), Mavidis et al. (2024)
H4	Supplier efficiency has a positive effect on supply chain performance	Kumar et al. (2018), Mose et al. (2025), Janet and Kiarie (2015), Jenoui and El Abbadi (2026)
H5	Quality of information has a positive effect on supply chain performance	Kankam et al. (2023), Marinagi et al. (2015), Masa'deh et al. (2022)
H6	Supplier efficiency mediates the relationship between e-procurement and supply chain performance	Hong and Shao (2021), Meixell (2006), Sundarraj and Shi (2012), Roy and Subroto (2003), Purchase and Dooley (2010)
H7	Quality of information mediates the relationship between e-procurement and supply chain performance	Carayannis and Popescu (2005), Garrido et al. (2008), Kumar and Ganguly (2021), Mansoori et al. (2014), Birhanu et al. (2022), Hamadneh et al. (2024)
H8	Perceived ease of use moderates the relationship between e-procurement and supply chain performance.	Wei et al. (2026), Wang and Lu (2025) Ma and Liu (2005), Iconaru (2013)
H9	Perceived usefulness moderates the relationship between e-procurement and supply chain performance	Zaineldeen et al. (2020), Nandankar and Sachan (2020), Alshammari and Al-Mamary (2025)
H10	Top management support moderates the relationship between e-procurement and supply chain performance	Rotchanakitumnuai (2013), Young and Poon (2013), Hsu et al. (2019)

3.2.1 E-Procurement

E-Procurement in the present study is defined as the use of electronic tools and technologies and internet applications for purchases that involve integration, management, automation, and enablement of the organisation's procurement (Tatsis et al., 2006). The concept of e-procurement is based on the usage of technology for searching, quoting and obtaining goods or resources through the internet (Chang and Wong, 2010). It encompasses an information technology-based model that manages the process between the parties in a purchasing transaction (Hung et al., 2014). E-

procurement incorporates several activities in the buying process involving a network of communication technology within and outside the organisation (Garrido et al., 2008).

3.2.2 Supply chain performance

As noted earlier, a supply chain is the alignment of companies that facilitate the supply of products or services to the market, involving manufacturers, suppliers, transporters, warehouses, wholesalers, retailers, other intermediaries and customers (Felea and Alb, 2013), and the processes that transpire between them must be unified to be efficient (Pearcy et al., 2008) and require careful management for optimal output (Min et al., 2019; Asante-Darko and Osei, 2023). Supply chains depend on the exchange of appropriate information about operational data, including for example, annual contracts and periodic progress reporting, to function effectively in real-time (Tai et al., 2010). Supply chain performance can comprise very tangible (e.g. costs resource efficiency quality) and less intangible (e.g. quality, capacity utilisation,) elements (Chang et al., 2013).

Supply chain performance can include performance measures such as on-time delivery, reduced lead time, responsiveness, cost reduction, conformance specifications, process improvements and time-to-market (Pattanayak and Punyatoya, 2019), flexibility, speed, reliability and transparency of the supply chain (Hallikas et al., 2021).

3.2.3 Supplier efficiency

The past research demonstrates that suppliers are one of the key parties within the supply chain (Hung et al., 2014; Rajkumar, 2001; Kameshwaran et al., 2006) and therefore inescapably contribute to their effectiveness (Chibani et al., 2018). To this end it has been argued extensively that supplier selection and performance evaluation are critically important (e.g. Essig and Arnold, 2001). Suppliers are an important mechanism of adding value to the purchasing organisation and should be closely incorporated into the supply chain (Smart 2010). Supplier efficiency is demonstrated in their ability to meet their responsibilities, such as delivering products and services to customers in the right quantities, right location, at the right time and an acceptable cost (Quesada et al., 2010). Furthermore, supplier efficiency involves their ability to deliver defect-free products

according to the supplier quality agreement and share information about materials used during the manufacturing process and carbon emissions (Govindan et al., 2023).

The role of suppliers is eminent in the previous literature (Chang et al., 2008; Smart, 2010; Mishra et al., 2007; Rai et al., 2006). In the context of private manufacturing in Ghana, e-procurement has gained a significant attention among suppliers (Abdulatif et al., 2022). Suppliers play integral role in the performance of the manufacturing firms in Ghana (Armoh et al., 2023; Danquah et al., 2025). Their relevance is demonstrated in their ability to ensure flexibility and just-in-time delivery which is crucial for the output of the manufacturing firms in Ghana (Benah and Li, 2020). They take active part in the work-in-time process inventory, new product development, internal engineering, manufacturing and purchasing operations which leads to reduced costs, shorter lead times, lower development risks and compressed development cycles (Owusu-Bempah et al., 2013). The crucial role of suppliers and their contribution to Ghana's manufacturing highlights the importance to study supplier efficacy in the private manufacturing in Ghana.

3.2.4 Quality of information

The previous literature emphasises the crucial role of information in all business processes and transactions (Chang, 2013; Ragowsky et al., 1996; Hassandoust et al., 2024). Information can be described as numerical data, factual knowledge, narrative accounts, and even opinions and evaluations, and it is considered a raw material for the mind, developing human skills, knowledge and wisdom (Kaye, 1995). Quality of information includes timeliness, accuracy, convenience of access and reliability (Forsslund, 2007). From a business perspective, information quality plays a significant role by enhancing customer knowledge, confidence, self-efficacy and in turn producing higher perceived value and consequently, for example improving customer intentions to participate (Alotaibi, 2025). Further, it is important for strategic decision-making and overall organisational performance (Moshood et al., 2025).

Information plays a critical role in management of the manufacturing sector, the entire company needs information to act, function and perform for sustainability and survival (Kofi Opoku et al., 2023; Agyabeng-Mensah et al., 2025). Information technology is one

of the key drivers of firm performance of the manufacturing in Ghana (Owusu, 2025; Grace Tetteh et al., 2024). The manufacturing companies in Ghana depends on access to the right information for key decision making to facilitate the entire business processes (Tetteh, 2024; Laddha et al., 2022; Adabor and Osei-Gyebi, 2025). Access to right information is indispensable tool to the manufacturing in Ghana (Fu and Avenyo, 2024).

3.2.5 Top management support

The concept and importance of top management support have been recognised extensively in the literature (Uddin and Jayaram, 2025; Young and Poon, 2013). Top management support refers to providing the needed support to business processes and/or giving clear guidelines for the smooth running of a business (Hsu et al., 2019). The literature has also defined it as a positive attitude directed at giving explicit support for an information system (Kemei et al., 2018).

Top management will often determine the type of technology that fits their core business and policies and facilitate access to training for the users accordingly, and as the highest decision-making body in the organisational hierarchy, their activities are likely to affect every operation of the firm (Yaacob et al., 2019; Young and Poon, 2013; Hsu et al., 2019). They disseminate relevant information to every part of the organisation to ensure proper coordination of activities relating to work processes (Lee and Joo, 2020). Top management provide support such as resource allocation, setting up project review committees when needed, identify the right personnel for tasks and empower people to take up responsibilities (Kemei et al., 2018). Studies have, however, shown that effective top management support varies across industries (Zwikael, 2008).

The previous literature highlights the relevance of top management support to the manufacturing companies in Ghana (Dadzie et al., 2024; Grace et al., 2024; Awuah-Gyawu et al., 2025). In Ghanaian manufacturing, top management support drives supply chain operational performance (Adusei et al., 2023), supplier development (Amoako et al., 2022), procurement performance (Agbeka et al., 2025), sustainable supply chain management (Asuah et al., 2024) and has a role in boosting manufacturing overall performance (Sarpong-Danquah et al., 2022). The vital role of top management support

in the growth of the manufacturing sector in Ghana emphasises the importance to determine how it influences the link between e-procurement and supply chain performance in the private manufacturing.

3.2.6 Perceived ease of use

Perceived ease of use (PEOU) is the perception of the user that the system can be easily used without extra effort to achieve meaningful results (Surendran, 2012). Perceived ease of use is one of the dimensions of the Technology Acceptance Model (TAM) proposed by Ma and Liu (2005). It is the degree to which people are confident that the adoption of information communication technology (ICT) requires minimal effort or applying a learning method will improve their performance (García et al., 2024). PEOU significantly predicts the user attitude on the acceptance of technology (Martin, 2022) and contributes to user satisfaction with technology (Legramante et al., 2023).

3.2.7 Perceived usefulness

Perceived usefulness (PU) is the degree to which an individual is confident that a system will improve their job performance (Legramante et al., 2023). It is the person's acceptance of an application framework that boosts their performance at the workplace (Zaineldeen et al., 2020; Martin, 2022). PU aligns with people's enthusiasm that increases their capability to carry out important functions (He et al., 2018). It has been associated with job relevance, which refers to people's perception of the degree to which a particular system can be applied to their job (Marikyan and Papagiannidis, 202).

3.2.8 Control variables

The practice of including control variables in a model has been observed by the previous research, Vaidyanathan et al. (2012), Jiménez et al. (2022) and Chen et al. (2022). Based on this insight, control variables (Job title, years of work experience, number of employees, type of industry and educational qualification) were included in the model due to their perceived influence on the dependent variable (Supply chain performance). Previous research has shown that firm size (number of employees) can influence the activities of the supply chain (Soares-Agular and Palma-Dos-Reis, 2008) and logistics

supply chain management has been associated with technical proficiencies, qualitative abilities and operational expertise (Cantoni et al., 2024), indicating that educational qualification and years of work experience might influence supply chain performance. (Lien and Wang, 2025). Experience of qualified professionals is important for managing supply chain operations efficiently (Kang et al., 2025). Knowledge management in collaborative supply chain offers a sustainable supply chain in production innovation, minimises project time and enhances quality and customer satisfaction (Badea et al., 2015). Table 8 summarises the constructs adopted in the study's conceptual model.

Table 8: Definition of study constructs

Constructs	Definition	References
E-procurement	Business to business purchasing practice that utilises electronic commerce to identify potential source of supply to purchase goods and services, to transfer payment, and to interact with suppliers.	Pearcy and Giunipero, (2008)
Supply chain performance	Supply chain performance encapsulates tangible (e.g. costs, quality) and intangible (e.g. capacity utilisation, resource utilisation) output attained through efficient utilisation of supply chain management practices	Chang et al. (2013), Madzimure et al. (2020), Bigliardi and Bottani (2014), Saleheen et al. (2018)
Supplier efficiency	Supplier efficiency is the supplier's ability to meet their responsibilities such as delivering products and services to customers in the right quantities, appropriate location, at right time and at acceptable cost.	Quesada et al. (2010), Govindan et al. (2023), Mishra et al. (2007)
Quality of information	Quality of information refers to the good attributes of information that reflect characteristics such as timely, accuracy, convenient to access and reliability.	Forslund (2007), Chang (2013), Ragowsky et al. (1996), Hassandoust et al. (2024).
Perceived ease of use	Perceived ease of use (PEOU) is the perception of the user that the system can be easily used without extra effort to achieve meaningful results.	Surendran (2012), Ma and Liu (2005), García et al. (2024) Chen et al. (2012), Gamal (2010)
Perceived usefulness	Perceived usefulness (PU) is the degree to which individual is confident that a system will improve their job performance.	Legramante et al. (2023), Ma and Liu (2005), Marikyan and Papagiannidis (2022) Chen et al. (2012), Gamal (2010)
Top management support	Top management support is the positive attitude towards providing an explicit support for information system.	Kemei et al. (2018), Hsu et al. (2019), Kemei et al. (2018)

3.3 Theoretical foundation -Technology Acceptance Model (TAM)

This section elaborates the theoretical foundations of the study, explaining Technology Acceptance Model (TAM) as the theory underpinning the proposed relationships, and justifying their use in this research.

3.3.1 Technology acceptance model (TAM)

The Technology acceptance model was developed to help understand the application of technologies in the context of organisations and the model stipulates that the acceptance of technology is influenced by individuals' willingness to use it (Tang and Hsiao, 2016). The TAM model predicts acceptance behaviour and has specific variables; perceived ease of use, perceived usefulness, attitude towards use, behavioural intention to use and system usage (Ma and Liu, 2005). The meaning of these variables is presented and summarised in Table 9.

Table 9: Dimensions of technology acceptance model

Label	Meaning	Source
External variables	These are characteristics such as self-efficacy, norms of subjective, and conditions of technology use.	Sholikhah and Sutirman (2020)
Perceived usefulness	A belief that performance is based on the usage of technology.	Chen et al. (2012)
Perceived ease of use	A trust of using a technology with very minimum effort without a special knowledge.	Chen et al. (2012)
Attitude towards use	It refers to the person's feeling (negative and positive) for engaging in target behaviour. For example, system usage.	Fathema et al. (2015)
Behavioural intention to use	The likelihood that the person will be involved in the behaviour. It is an antecedent of real behaviour because the degree at which the person value certain behaviour	Almulla (2021)

System usage	contributes to the occurrence of the behaviour.	Willingness to perform an action based on one's intention. A particular usage behaviour is influenced by intention.	Nguyen et al. (2022)
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TAM itself is rooted in several other theories, including the theory of reasoned action which is built on the premise that the social behaviour of persons is influenced by an attitude that is projected to envisage information system use (Davis, 1989). TAM has been used specifically to predict acceptance, adoption and use of information technologies (Chen et al., 2012). According to TAM, the user's intention to use determines the maximum usage of a technology, and the user intention has been posited to positively influence the user's overall attitude towards technology usage, the intention is influenced by perceived usefulness and perceived ease of use (Moon and Kim, 2001). Davis et al. (1989) proposed a TAM model which demonstrates that perceived usefulness has a direct influence on behavioural intention to use the technology while perceived ease of use exerts a direct positive influence on attitude towards technology use in such a way that it exerts a positive impact on behavioural intention to use technology as illustrated in Figure 10.

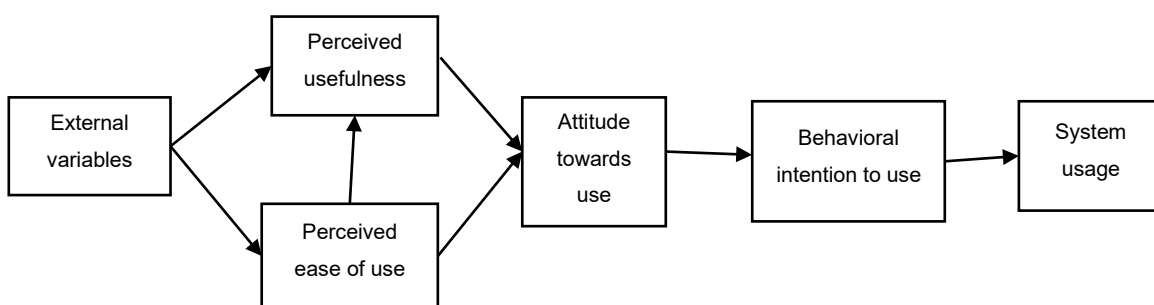


Figure 10: The original technology acceptance model adopted from (Ma and Liu, 2005)

The original TAM has been upgraded to include a component that explains resources as one of the important elements of the model (Moon and Kim, 2001). The research community has shown that resources are key elements of adopting information systems (Moon and Kim, 2001; Sivo et al., 2018). Resources stimulate one's motivation to use information systems. In this context, resources comprise of organisational and human resources the user requires for the usage of an information system - some of these resources are time, money and equipment that facilitate the adoption of technology, and otherwise, the absence of these resources might deter persons from using a particular technology (Sivo et al., 2018), as illustrated in Figure 11.

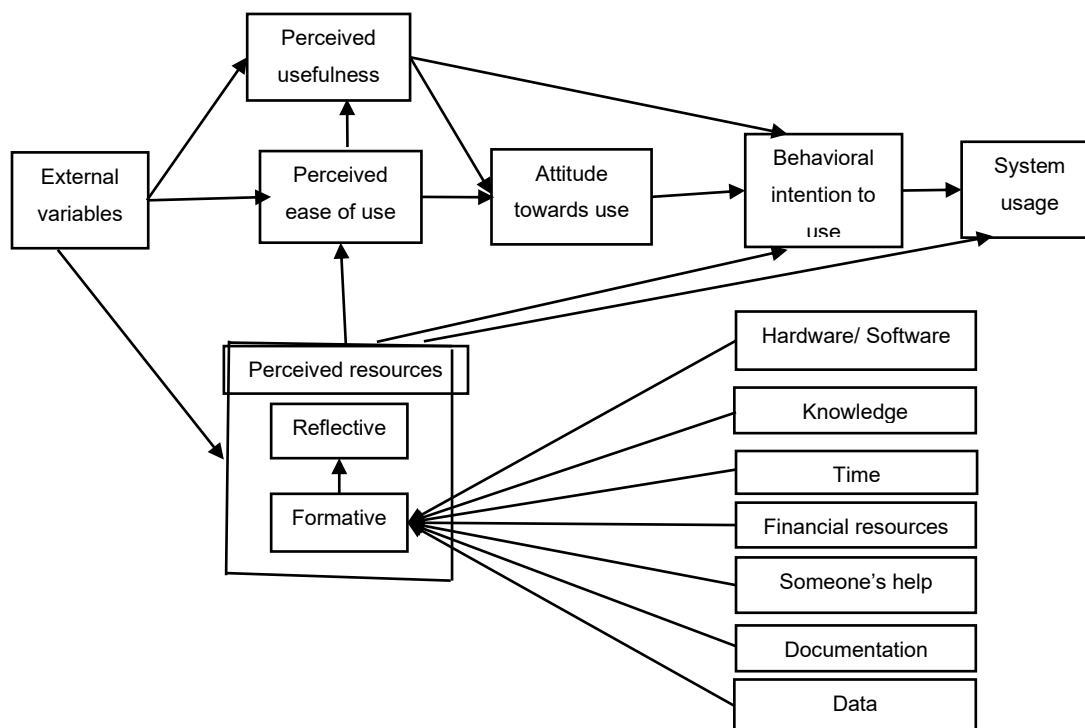


Figure 11: The extended model of technology acceptance adopted from Sivo et al. (2018) TAM has been efficient in explaining user behaviour towards technology acceptance and it is statistically trustworthy and valid (Yucel et al., 2013) and has been used extensively in the previous literature. For instance, in 2020, Scopus published 945 TAM related papers and approximately 885 publications were made in 2019, and a year after the

pandemic outbreak, 1218 papers were published from diverse TAM related viewpoints - therefore, during the pandemic, 2764 papers on TAM were published in Scopus before June 2022 (Rosli et al., 2022).

TAM is consistent with the objective of the current research which seeks to determine how usage of electronic technology for procurement influences supply chain performance. The TAM model shows a link between users' person's emotions and the use of technology and mainly centres on acceptance of information technology as its core theoretical foundation (Huang and Huang, 2017). When users perceive that using information technology for purchases will be easy and useful, it motivates them to accept the electronic purchasing technique (Gamal, 2010). The user acceptance of the system is based on perceived usefulness and this promotes a stronger network of activities and equitable distribution of resources, enhances ability to share special documents and supply chain related information (Mas'adeh, 2016). When companies automate their purchasing system for benefits such as efficient data management and integration, it can lead to better turn-around time, minimizing mistakes, promoting effective monitoring and improving buying decisions (Ramkumar et al., 2019). E-procurement system self-efficacy can be improved by managers through development activities to enhance the adoption rate of suppliers, buyers and other personnel (Alaweti et al., 2014).

3.4 Hypotheses development

The sub- sections that follow, in turn discuss the study hypotheses: the direct effect of e-procurement on supply chain performance (3.4.1.1); the direct effect of e-procurement on supplier efficiency (3.4.1.2); the direct effect of e-procurement on quality of information (3.4.1.3); the direct effect of supplier efficiency on supply chain performance (3.4.1.4); the direct effect of quality of information on supply chain performance (3.4.1.5); the mediating role of supplier efficiency (3.4.2.1); the mediating role of quality of information (3.4.2.2); the moderating effect of perceived ease of use (3.4.3.1); the moderating effect of perceived usefulness (3.4.3.2); the moderating effect of top management support (3.4.3.3).

3.4.1 Direct effect

3.4.1.1 E-procurement and supply chain performance

The relationship between electronic procurement and supply chain performance is supported in the procurement literature (Chang et al., 2013; Hallikas et al., 2021; Smart, 2010; Barngetuny and Kimutai, 2015; Mutangili, 2019; Nandankar and Sachan, 2020; Jaiyeoba et al., 2025). The past research shows that the use of technology in the purchasing process can reduce total purchasing cost; thus, web-based models enhance the value of the supply chain (Piera et al., 2014; Thompson, 2025). Online procurement can reduce order cycle errors, increase efficiency in procedures, enhance quick payments to suppliers, and improve customer relationships and lead time (Waithaka and Kimani, 2021). Sandhu (2020) noted that enhancing and automating the procurement practice is considered a key function of the supply chain. Purchase and Dooley (2010) added that using electronic procurement is relevant provided the process efficiencies are attained within the supply chain. According to Vaidyanathan and Devaraj (2008), e-procurement minimises operational costs throughout the supply chain (Mogere, 2022).

Chepkwony et al. (2016) reported that e-ordering and e-informing are key parts of e-procurement and should be utilised properly to increase supply chain performance. E-procurement reduces the cost of the supply chain and encourages quick and swift response (Mutangili, 2019). Siddiqui et al. (2022) added that fast-moving processes, fast-moving supply chain orders, and quick response to orders are important functions of automating the procurement system that contribute positively to supply chain performance. Based on these arguments and observations, this study hypothesised that:

H1: E-procurement significantly influences supply chain performance in the manufacturing sector in Ghana.

3.4.1.2 E-procurement and supplier efficiency

A recent relevant finding by Walker et al. (2023) shows that supplier nonperformance is a critical risk when competition exists in a contract. Thus, selecting a viable supplier is crucial because of the uniqueness of the e-procurement process (Bottani and Rizzi, 2005). In an attempt to reduce business risks and improve product quality, suppliers are

expected to deliver defect-free goods and services at the right time (Denhere et al., 2023; AlQubaisi et al., 2021). Research on the contribution of e-procurement to enhancing better outcomes of suppliers has received considerable attention (Antonio et al., 2003; Zahay and Handfield, 2004; Singh and Chan, 2022; Charnor and Quartey, 2024). Generally, employing e-procurement applications has a direct and indirect influence on efficiency gains (Wu et al., 2007). The past research indicate that e-procurement assists suppliers to routinely replenish the inventory level on their own (Seetharaman et al., 2020). Dedrick et al. (2008) investigated the relationship between a manufacturer's use of e-procurement and the number of suppliers in its supply chain and found that the use of e-procurement was related to purchasing from more suppliers for custom goods.

Through e-procurement, buyers access products from suppliers and fulfil the requirements of the procurement process, (Muthoni and Mutuku, 2021) such as adding to shopping carts, creating requisitions, looking for approval, getting purchase orders, and creating electronic invoicing to integrate the supply chain of suppliers and payment systems (Biraori Oteki, 2021).

E-procurement contributes to supplier relationship management (Blake and Maria, 2002; Muthoni Ndei and Mutuku, 2021) and enhances supplier performance (Tai et al., 2010). Based on this insight, this study proposes that:

H2: E-procurement will have a positive impact on supplier efficiency in the manufacturing sector in Ghana.

3.4.1.3 E-procurement and quality of information

Information is one of the significant tools for leveraging business processes and operations in organisations (Budinorman et al., 2021; Singh, 2025). According to the existing literature, one of the drivers of e-procurement is information sharing (Chang et al., 2013; Hashim *et al.*, 2022) and better management of information (Djuyandi, 2019). E-procurement contributes to information sharing in all parts of the company according to Chirchir et al. (2015). Buyers need information to act and make purchase decisions to order products and services (Appel et al., 2020). The previous literature has shown that

the e-informing aspect of e-procurement represents the distribution of purchasing information among both internal and external players through internet technology (Rotich and Okello, 2015; Mavidis et al., 2024). E-informing enables information to meet specific qualities including accuracy, adequacy, criticality, timeliness and credibility, to enhance supply chain performance (Amalia, 2017). This is because e-procurement is a web technology that facilitates the procurement transaction (Gurgun et al., 2024) through practices like disseminating and receiving information about quotations, tenders, contract awards and payment and contributes to better communication in trade (Hashim et al., 2022). However, e-procurement is an application that works between organisations with the intention of smooth sharing of communication and information (Špaček and Špačková, 2023), and the weight of available evidence indicates that e-procurement directly supports quality of information. Accordingly:

H3: E-procurement has a positive impact on the quality of information in the manufacturing sector in Ghana.

3.4.1.4 Supplier efficiency and supply chain performance

Suppliers provide support to the functioning of the supply chain to limit its risk and other challenges (Kumar et al., 2018; Mose et al., 2025) and significantly contribute to its sustainability and development (Hashemi et al., 2019). Manufacturers, for instance, are highly interested in finding efficient suppliers who are fit for the job to provide unique products and services that can contribute to optimal performance (Jum'a, 2020). Not surprisingly therefore, selecting appropriate suppliers is a key strategic activity that influences supply chain performance (Janet and Kiarie, 2015; Jenoui and El Abbadi, 2026). Building relationships with strategically efficient suppliers plays a crucial role in management in the supply chain (Garcia-Buendia et al., 2025), and their relationship management plays a crucial role in enhancing supply chain efficiency and competitive positioning (Denhere et al., 2023). Due to the important role of suppliers, (Kumar et al., 2025) organisations ensure supplier collaboration in operations and institute information sharing processes with suppliers (Duong and Ha, 2021; Masudin et al., 2025). Buyers also expect suppliers to do well in terms of quality, cost, better delivery, and service

enhancement in the short term and in the long-term capabilities (Kotcharin et al., 2024; Singh and Pandey, 2024). Based on this insight, it is anticipated that:

H4: Supplier efficiency significantly influences supply chain performance in the manufacturing sector in Ghana.

3.4.1.5 Quality of information and supply chain performance

The use of information communication technology has reinforced organisation's ability to be more innovative in the use of supply chains for improved performance (Candela and Ulises, 2022). Sharing crucial information about possible dangers is important for preventing a breakdown of the supply chain (Xiao and Khan, 2024; Yin et al., 2025). The extant literature shows a strong association between information quality and supply chain performance (Kankam et al., 2023; Marinagi et al., 2015; Masa'deh et al., 2022). In terms of supply chain performance, proper dissemination of information enhances stronger collaboration among the partners due to the existence of a stronger network of activities (Baihaqi and Sohal, 2013; Ryciuk et al., 2026).

Based on the quality of information, organisations can manage the supply chain and respond to the diverse demands of buyers on time (Ellitan and Muljani, 2017; Rahmoune, 2026) and foster the decision-making process on the supply chain (Gorla and Scavarda, 2012). Information sharing not only integrates the activities of the intermediaries of the supply chain but also improves internal and external work processes of the chain (Gebisa and Ram, 2021; Basit et al., 2024; Cai et al., 2025). Sharing appropriate information with supply chain partners about product information, price, timing, forecasts, product specifications, and capacities offers them the opportunity to attain efficiencies and proficiencies (Kotcharin et al., 2024). Similarly, access to information in the supply chain enhances transparency and trust among the parties in the supply chain (Shahadat et al., 2024) and is considered a unique capability which is crucial for competitive supply chains (Kotcharin et al., 2024). Based on the above discussion, it is proposed that:

H5: Quality of information has a positive impact on supply chain performance in the manufacturing sector in Ghana.

3.4.2 Mediation effects

3.4.2.1 E-procurement → supplier efficiency → supply chain performance

The procurement literature shows that the suppliers play a key role in e-procurement and supply of goods and services (Hong and Shao, 2021; Meixell, 2006; Sundarraj and Shi, 2012; Roy and Subroto, 2003). Supplier involvement is considered an essential external factor that drives e-procurement usage and enhancement in supply chain efficiency advancement through better collaboration (Purchase and Dooley, 2010). The implementation of e-procurement in companies offers the opportunity to connect to important suppliers that help cost control and monitoring that enhances supplier performance in business operations (Oppong, 2020; Kanyepe and Alfaneta, 2025). Truong (2019) reported that if buyers doubt the capability and reliability of a supplier in e-procurement systems, it will discourage them from using e-procurement for buying. Organisation's access to the right suppliers is a tough activity for most organisations as this can have a significant impact on performance and the organisation's chances of getting defect-free products and services (Fu et al., 2019; Westhuizen and Ntshingila, 2020; Jenoui and El Abbadi, 2026). Thus, access to the right supplier and how business processes are well coordinated to acquire skilled suppliers are vital activities for the company's success (Mostafa, 2019; Ali et al., 2025; Fang et al., 2024). Suppliers are good facilitators of purchasing negotiations and the speedy delivery of goods (Devaraj, 2012; Waithaka and Kimani, 2021). Electronic purchasing helps organisations to minimise the cost of operations through the intervention of the right suppliers, according to Carlos et al. (2014). The previous research shows that key supplier relationship management is a significant mediator between supply chain orientation and firm buying effectiveness (Miocevic and Crnjak-Karanovic, 2012). If the right suppliers are well integrated into the activities of the organisation (Sithi et al., 2025) it has a significant impact on operational success (Buzzetto et al., 2020; Maddah et al., 2025)

. Based on these arguments, it is anticipated that:

H6: Supplier efficiency will mediate the relationship between e-procurement and supply chain performance in the manufacturing sector in Ghana.

3.4.2.2 E-procurement → quality of information → supply chain performance

The previous literature emphasises the crucial role of the quality of information in e-procurement and supply chain management and performance (Carayannis and Popescu, 2005; Garrido et al., 2008; Kumar and Ganguly, 2021). Information sharing in the supply chain is important for increasing the awareness of consumers' needs and expectations, which leads to better outcomes for an organisation (Mansoori et al., 2014; Birhanu et al., 2022; Hamadneh et al., 2024). Quality of information drives the implementation of e-procurement in diverse ways (AlQubaisi et al., 2021) and contributes positively to supply chain efficiency (Badea et al., 2015). For instance, key business functions of the procurement process, both internal and external resources, can be fully controlled to boost profitability through information (Mabhodha and Choga, 2021). Additionally, the usage of information technology and computer-based networks (Kohli and Malik, 2025) improves e-payment and enhances supply chain management (Okwaro, 2017).

Some previous studies have reported that the quality of information serves as an effective mechanism that coordinates e-procurement and the activities of the supply chain of companies. Chang et al. (2013) found information quality as a significant mediator between e-procurement and supply chain performance. Similarly, Birhanu et al. (2022) reported that information sharing partially coordinated the link between customer integration and operational performance. Due to the significant role of quality of information, the previous literature has also noted that information asymmetries in purchasing contract development can result in poor and undesirable performance if not properly controlled (Beal, 2022; Yang and Lu, 2025). Based on these insights, it is expected that:

H7: Quality of information will mediate the relationship between e-procurement and supply chain performance in the manufacturing sector in Ghana.

3.4.3 Moderation Effect

3.4.3.1 E-procurement → perceived ease of use → supply chain performance

Technological advancements that assist fast work progression have attracted the attention of many scholars, especially those concerned with computing systems which

helps to solve complex problems (Salar and Hamutoglu, 2022). However, people's perception of a particular technology influences its usage and acceptance (Wei et al., 2026; Wang and Lu, 2025). Past research has shown that perceived ease of use drives individuals' acceptance of technology in organisational settings (Ma and Liu, 2005). Iconaru (2013) found, for example, that the direct effect of perceived ease of online purchasing on attitude decreases as the buyers advance in skills and knowledge in online purchasing. When order accuracy is abundant, as perceived by the purchaser, the person perceives e-procurement transactions to be easy to use as a result of efficiencies connected to the system (Ramkumar et al., 2019). Thus, user perception is important as it determines whether e-procurement is beneficial to the organisation (Purchase and Dooley, 2010). This is possible when the e-procurement system provides users with easy means of ordering goods and services, and hence not having to go through any difficult transaction processes (Alaweti et al., 2014).

Conversely, when a system is seen as more complicated, people abstain from it, and in this sense, are therefore likely to adopt a system that is easier to use to achieve results (Carlos and Soares, 2011). Due to the important role of perceived ease of use in using e-procurement technology, it is anticipated that:

H8: Perceived ease of use will moderate the relationship between e-procurement and supply chain performance in the manufacturing sector in Ghana.

3.4.3.2 E-procurement → perceived usefulness → supply chain performance

Gamal (2010) reported that users' intention to use the e-procurement system is influenced by perceived usefulness. The technology acceptance model has been widely used to explain the adoption of online technologies (Zaineldeen et al., 2020; Nandankar and Sachan, 2020; Alshammari and Al-Mamary, 2025) and the literature shows that perceived usefulness enhances the effect of e-procurement (Nandankar and Sachan, 2020). Digital technologies can facilitate supply chain processes such as demand management, production, procurement, and warehousing and also supply chain functions like supplier selection, demand forecasting and logistics planning (Yang et al., 2021). Ramkumar (2019) suggested that if a system is flexible and helpful to use, it is possible to offer the

intended benefits, which triggers reuse. The past literature has similarly indicated that user acceptance, in this case of supply chain stimulators, is influenced by perceived usefulness (Mulyati et al., 2018). The previous studies have shown that perceived usefulness facilitates the utilisation of social networks (Amadu et al., 2018; Arikan and Acar, 2026). Ramkumar (2019) reported that perceived usefulness plays a significant role in fulfilling order timeliness and organisational buyers' continued use of e-procurement. Brandon-Jones and Carey (2011) found a positive association between user-perceived e-procurement quality and both system and contract compliance. The significant role of perceived usefulness in contributing to e-procurement use and supply chain performance provides the basis for the prediction that:

H9: Perceived usefulness will moderate the relationship between e-procurement and supply chain performance in the manufacturing sector in Ghana.

3.4.3.3 E-procurement → top management support → supply chain performance

The past research emphasises the important role of top management support in achieving the intended purpose of e-procurement namely positive supply chain outcomes (Rotchanakitumnuai, 2013; Young and Poon, 2013; Hsu et al., 2019). Top management occupies the uppermost position in organisations with designations such as chairman, chief executive officer, and managing director (Yaacob et al., 2019). People who are entrusted with these positions provide resources in terms of money and human resources that have expertise in designing e-procurement, information technologies, infrastructure and legal framework of the system (Jiménez et al., 2022). Top management support facilitates the path of e-procurement by instilling a greater sense of motivation in workers to smooth the purchasing process, reduce the cost of goods, moderate the cost of operations to achieve a competitive advantage and create a better atmosphere of e-procurement patronage (Marei et al., 2021). Top management support is an important enabler for decision making that can solve difficulties related to supply chain sustainability (Xiao and Khan, 2024; Shafique et al., 2024) and is widely recognised to influence supply chain practices and information technology usage (Darmasaputra et al., 2020; Ali et al., 2026). Technology innovation fails if top management refuses to provide

the necessary support, which can lead to numerous undesirable consequences (Daoud and Ibrahim, 2018; Al Karim et al., 2025). Som and Anyigba (2022) suggested that it is important to maximise management commitment to invest in information support systems (Zhang et al., 2024) to attain optimal supply chain performance. Based on the above discussion, this study anticipates that:

H10: Top management support will moderate the link between e-procurement and supply chain performance in the manufacturing sector in Ghana.

3.5 Summary

This chapter has drawn on Technology Acceptance Model to develop a conceptual framework involving e-procurement, supplier efficiency, quality of information, perceived ease of use, perceived usefulness, top management support and supply chain performance as constructs.

Hypotheses were developed portraying the direct effects of e-procurement and supply chain performance. The model further postulates that supplier efficiency and quality of information mediate the relationship between e-procurement and supply chain performance, and hypothesises that perceived ease of use, perceived usefulness and top management support moderates the link between e-procurement and supply chain performance.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter elaborates on the methodology for data collection, analysis, and presentation of results. The first aspect details the various paradigms and the reason for choosing a specific paradigm (deductive approach) for the current research. The next part describes cross-sectional and longitudinal studies and explains their difference. The chapter discusses data collection methods, research population and sampling techniques. This is followed by survey development and survey administration. The next section is the measurement and theoretical models, discussion of structural equation modeling (SEM) and the rationale for choosing it. The chapter highlights the ethical considerations during data gathering, and the chapter summary is the final section.

4.2 Research Paradigm

Research paradigms is a framework that guides how a scientific study should be conducted and represents a researcher's beliefs about the world around him/her (Henseler et al., 2015). It encompasses abstract thinking and upholds principles that guide how the researcher perceives the world, assigns meaning, and acts in it (Denzin and Lincoln, 2000). From a methodology perspective, it defines the researcher's point of view regarding the research design to employ in a study and how data is analysed (Kivunja and Kuyini, 2017). Paradigm is the evolution of scientific practice grounded in the wisdom and understanding of individuals about the world and the nature of knowledge (Al-Ababneh, 2020). The literature divides the research paradigm into four parts: epistemology, ontology, methodology and axiology (Kivunja and Kuyini, 2017). Furthermore, some studies group paradigm under four headings as ontology, epistemology, methodology and methods (Yong et al., 2021) as illustrated in Figure 12.

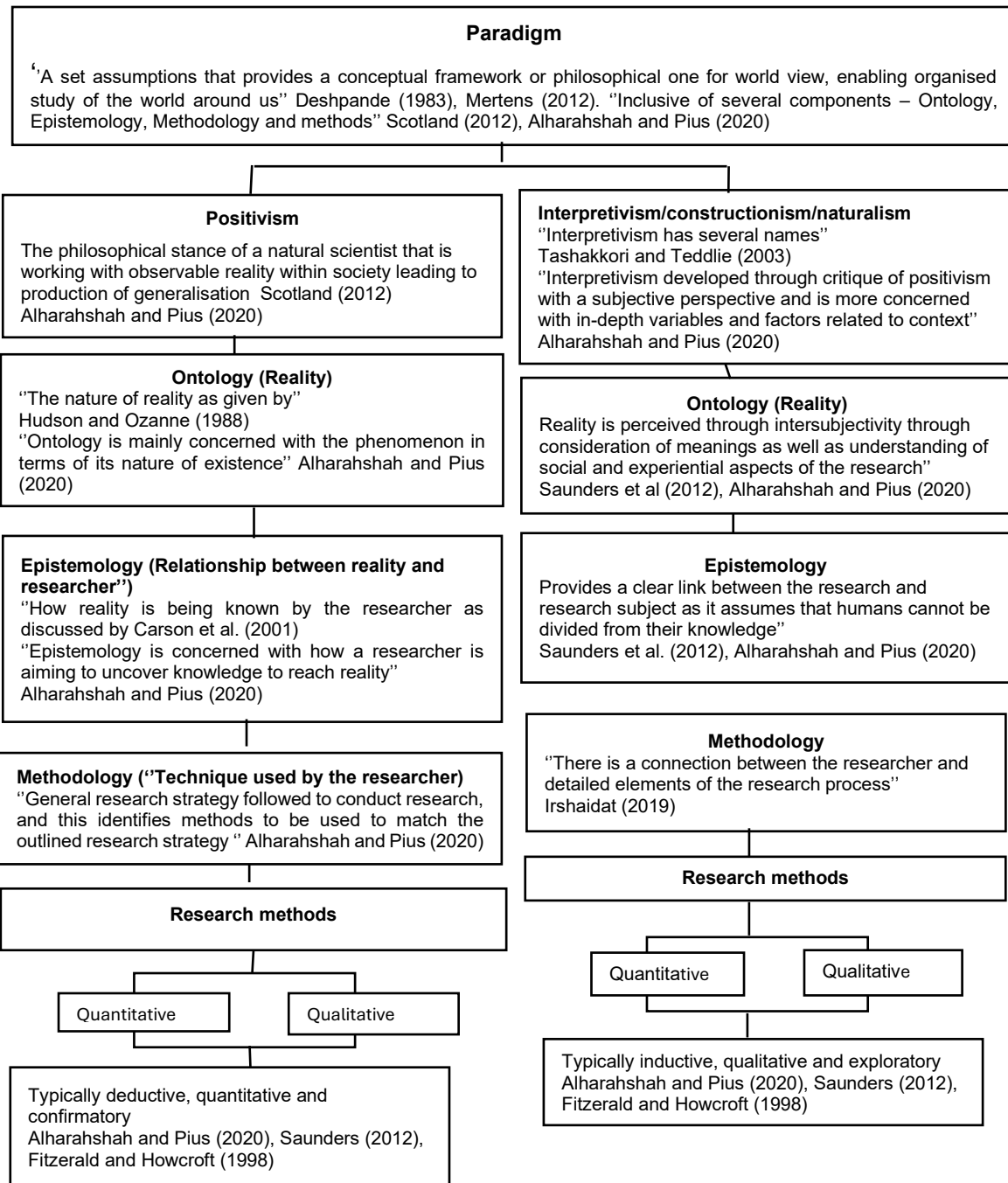


Figure 12: Research paradigm adopted from Yong et al. (2021)

Epistemology focuses on the nature, origin and scope of getting insight into the understanding of a specific knowledge (Lim, 2023). It is the philosophy underlying the beliefs of research about a specific type of knowledge and the method of creating it. The researcher's belief represents his/her epistemological stance (Sol and Heng, 2023).

The levels of epistemology are (1) perception which refers to researchers perceiving the world and changing it to knowledge of facts, (2) production which represents knowledge creation, and (3) justification, which concerns how knowledge is put to the test and justified (Boon et al., 2022).

In qualitative study, epistemological understanding represents a situation where the investigator comes closer to the participants and gathers mainly subjective facts through the researcher's observation. The investigator creates knowledge through the subjective experience of the informants or the population, gets to know the participants better and tries as much as possible to reduce the objective distance between the investigator and the participants (Musmini and Yuniarta, 2019). From quantitative perspective, epistemology maintains commitment to objective measurement and observation (Hammersley, 2008). Researchers' interest is to determine averages and trends in dataset, take valid steps to control variations from these trends and generate results to a larger population. Accordingly, validity and quality focuses on measurement, generalisation, and controlling variables to minimise bias (Hammersley, 2008). The bottom line is, in business research, epistemology explores the relationship between the business investigator and the business knowledge they pursue. Qualitative and quantitative approaches basically represent different epistemological framework for theorizing the nature of knowing, social reality and procedures for understanding these phenomena (Bryman, 1988). The most important part of epistemology is examining what meets the standard of acceptable knowledge in the field of business (Lim, 2023).

Ontology is about the existence of material, social, cultural and political settings (Ejnavarzala, 2019) and emphasises the existence of the physical world which is made up of objects, and their conditions of causal behaviour (Boon and Van Baalen, 2019). The

literature refers to it as a “science of being” and it covers all sciences because it involves all things that exist (Busse et al., 2015). Whereas methodology involves procedures of observing causal relationships, ontology entails the basis of causal structures of the world and provides the road map for the beginning of analysis to assist in making sense of the theories about the social world.

In a nutshell, ontology constitutes reality, or put another way, “what is”. A researcher is required to take a stance on how he/she perceives how the world truly works (Scotland, 2012).

Axiology is a concept that emphasises values that could be exhibited in all manner of disciplines and contexts, such as ethics, economics, politics, religion or war, (Little et al., 2012). This aspect of science gives meaning to truth and emphasises that science is used to advance human dignity and that science should be applied to human beings in a more dignified manner (Handriana, 2013). Axiology has four main elements: (1) it specifies what is good, (2) it identifies what can be considered as an object of moral concern, (3) it captures the relationships between the elements in the axiology, and (4) the axiological possible space which encompasses the whole axiology and it is made up of goods, subjects, relationships and attitudes (Danaher, 2021).

Methodology is the concept of data/knowledge production, approach to analysis, game plan, and research architecture that determines the usage of specific research data collection and analysis methods. It represents the procedure for conducting a particular research and directs the researcher’s decision about the type of data needed for a study and data collection techniques that fit the aim and objective of a study (Rehman and Alharthi, 2016). The methodology is a research plan that transforms ontological and epistemological logic into procedures that direct the way research should be conducted and explicitly shows the values and ethics that guide research (Antwi and Hamza, 2015).

4.2.1 Positivism (quantitative approach) vs Interpretivism (qualitative approach)

Positivism and interpretivism are the main paradigms researchers employ in philosophy for empirical research and analysis. Positivism (ontology) is synonymous with reality

whereas interpretivism (epistemology) is about how scientists learn about reality and understand the world around them (Junjie and Yingxin, 2022). According to positivist philosophy, understanding of reality is based on observation and human beings are observed, measured and tested; they exhibit behaviour in response to generalized rules (Petty et al., 2012).

The positivist analyses the relationship between independent and dependent and it is purely quantitative and the output of its analysis shows direct and indirect effects.

Additionally, the relationship between the variables can be causal (the change in the independent variable causes the same change in the dependent variable), (Park et al., 2020). However, positivism has been criticised because the causal relationships that are determined in the study of natural science are not applicable. Moreover, some scholars believe that any theory in natural science cannot be simple because the world is dynamic and people have diverse and complex views that influence the complex nature of theories (Maksimović and Evtimov, 2023).

On the other hand, interpretivism (epistemology) finds facts that can be observed and measured and the phenomena that are observed help to develop credible data (Alharahsheh and Pius, 2020). Interpretivists believe that both reality and truth are created, not discovered, and the meaning of the world around them can be interpreted subjectively through observation (Rehman and Alharthi, 2016). Interpretive researchers are also interested in causal relationships, but probe further and deeper to uncover and understand the cause of a phenomenon (Chowdhury, 2014). Additionally, interpretivists believe that the experience of a social narrator shapes the understanding of reality socially. The researcher must provide meaning and diverse interpretations of the research findings obtained from the data gathered under different situations (Pervin and Mokhtar, 2022). Those with an interpretive view contend that organisational realities cannot be separated from the actors, realities are socially constructed by the nature of the organisational factors and a better interpretation of any situation can be attained through a qualitative approach (Uduma and Sylva, 2015). However, interpretivism focuses on

studying a specific problem or phenomenon in a particular population, so, the generalisation of findings is impossible (Pulla and Carter, 2018).

Positivism is rooted in natural science whereas interpretivism is grounded in social science indicating the difference between these research philosophies. From the positivist's perspective, the natural world cannot be understood till it is manipulated by the scientist and the interpretivist holds the view that the world is meaningful but can be interpreted subjectively (Goldkuhl, 2012). There is a clear line between positivism and interpretivism though both philosophies emphasise quality, systematic research, consistency, proper communication of ideas and truth (Alborough and Hansen, 2023).

4.2.2 The adoption of the positivism (quantitative) paradigm in this study

In the 19th century, Augustine Conte, a French philosopher thought that reality could be observed and this notion is the scientific paradigm. Positivism emphasises the purpose of research as testing a hypothesis through a scientific approach. The position of Conte led the worldwide philosophy of positivism which sees entire knowledge as an outcome of mental sensual understanding which can be developed by observation and experiment (Alakwe, 2017). Positivism was adopted by the research community in the pursuit of objectivity, causality and neutrality of values. Positivism has undergone many changes with various identifications such as emperiocriticism, logical positivism and logical empiricism and in the 20th century, philosophers know it as analytical philosophy (Odu and AbayomiAluko, 2022).

Subsequently, positivism has gained major recognition in business research where scholars use it to guide reasoning and understanding knowledge. For instance, Mohajan (2020), Chang et al. (2013), Hallikas et al. (2021), Kim et al. (2015), Khan et al. (2022), Masudin et al. (2021), Bahambari and Kelidbari (2015) and Singh and Chan (2022) employed quantitative methods in the study of e-procurement and supply chain performance in the manufacturing and other sectors.

The previous literature confirms the strengths and weaknesses of all the three research paradigm/approach in business research. It has been suggested that the choice of a

particular research design should be influenced by the research objectives and questions (Queirós et al., 2017). The current research follows the principles of positivism and thus seeks to establish causality among the variables: electronic procurement, supply chain performance, perceived ease of use, perceived usefulness, top management support, supplier efficiency and quality of information. The position of this thesis is that objective reality can be manipulated through causal relationships and test hypotheses to establish statistical inferences in the manufacturing sector in Ghana and generalize the results.

Based on the above insight, this thesis accordingly employs a quantitative research approach to answer the research questions because the main objective is to examine the impact of e-procurement on supply chain performance, the mediating role of quality of information and supplier efficiency as well as the moderating role of top management support, perceived ease of use and perceived usefulness in the manufacturing sector in Ghana. Additionally, the quantitative method follows a logical procedure to examine the phenomenon and its relationships, provide answers to questions on relationships in the confinement of variables to provide an explanation, predict and control variables (Mohajan, 2020) and it is suited for a situation where variables can be defined, separated and connected to form hypotheses (Hammargberg et al., 2016).

There has been a major paradigm shift in social science research methods due to the disagreement among scholars in the early-mid twentieth century over the validity of quantitative and qualitative research methods. This insight often precipitated or necessitated the move to use a mixed-method research design that combines both qualitative and quantitative methods (Neupane, 2019) to overcome the weaknesses of the previous methods. According to Gómez-Diago (2020), a paradigm shift happens when the basics are changed in the knowledge of a field of study or the initial traditions are refuted (Gómez-Diago, 2020).

Quantitative research is rooted in the positivist paradigm and uses deductive reasoning (Das, 2022). This method uses fresh data collection to investigate a problem (Rahi, 2017). The numerical data answers questions such as who, how much, what, where, when, how many and how (Apuke, 2017). The quantitative method often tests the relationship

between two variables (hypothesis testing) to create meaning and provide answers to questions (Daniel, 2016). The method is based on the assumption that there is a single objective reality and social reality is assumed to be the outcome of a causal relationship between actions. The quantitative method uses mathematics to represent phenomena, and in many scenarios the mathematical illustrations test a relationship between two or more variables (Borgstede and Scholz, 2021). One of the advantages of this method is its ability to minimise the researcher's personal bias and give comprehensive knowledge about reality (Savela, 2018). Capturing a large sample for analysis can be ascribed to the abilities of the quantitative method, and interpretation of results and conclusions can be drawn with less ambiguity because the quantitative study is closed-ended (Song, 2023).

However, the weakness of the quantitative method lies in the researcher's detachment from the study population, meaning that the researcher is separated from the respondents which makes it difficult to access in-depth knowledge of the problem of the study (Daniel, 2016). Additionally, Das (2022) noted that due to the large sample nature of the quantitative study, it requires a large amount of resources which could make it less cost-effective (Prasad, 2017).

Although quantitative research is used in research in an effort to maximize the reliability of results, qualitative research has also gained a lot of popularity in modern-day research (Morse, 2020). Qualitative research deals with studying the nature of phenomena, particularly, their quality, different behaviours, natural characteristics, values, belief systems, and culture, but minimum consideration is given to their range, frequency, relationships or links of cause and effect (Busetto et al., 2020). Additionally, the qualitative research paradigm generally focuses on understanding human behaviour: attitudes, opinions, feelings and body language through observation (Patel and Patel, 2019). Some of the data collection methods of qualitative research are participant observation, unstructured interviews and describing records (Rahman, 2016). The nature of this method offers researchers the opportunity to access rich and detailed information about the research population which creates room for a deeper insight into the research problem that provides adequate answers to the research questions (Mwita, 2022).

However, the literature indicates that qualitative research is not without weaknesses; it is time-consuming and involves a huge amount of data and as a result, leads to confusion that makes conclusions and generalisations uneasy as an acceptable practice a researcher should be able to communicate results well to the consumers of the study (Song, 2023). The past literature reveals that policy makers might show low interest in the results of a qualitative study as stakeholders are more likely to prefer the results of the quantitative study to inform decision-making (Rahman, 2016).

Despite all the weaknesses, qualitative study has a good reputation and it is contributing extensively to theory development and practice (Jackson, 2015). The latest development of the research paradigm is the mixed research method which combines both qualitative and quantitative research methods (post-positivist and interpretivist philosophical framework) and it is now often considered a 'third' paradigm (Sharma et al., 2023). The central theme of this method is built on the premise that quantitative and qualitative tools are combined to create a better understanding of a phenomenon (Shakouri, 2014). One of the recognised strengths of the mixed research method is that it is flexible in terms of methodology and offers a sound basis for understanding of research problem thereby offering the opportunity to provide detailed answers to research questions and generalize the findings to the larger population (Shakouri, 2014).

The Mixed-method research method on the other hand is generally more time and resource-consuming because researchers using it often find it difficult to work within estimated time and cost (Dawadi et al., 2021). For example, recruiting participants and a team for data collection requires extra effort (Dawadi et al., 2021). Moreover, some scholars believe that the mixed research method is a repetition of qualitative and quantitative methods and there is nothing new about this method, it hence it cannot be recognised as a third paradigm (Fàbregues et al., 2021).

4.3 Research Approaches (Deductive vs Inductive)

Inductive and deductive reasoning are philosophical approaches underlying the research direction of a researcher (Henseler et al., 2015). In inductive research, the target of the researcher is to build theory from the available data using fresh scientific data

(Bhattacharjee, 2012). The inductive approach comprises deriving understanding or building concepts through careful observation (Sauce and Matzel, 2017). Put differently, it is the individual perspective of truth that leads to generalisation (Henseler et al., 2015). However, there is a claim that the researchers who rely on the inductive approach have limited knowledge about the patterns of theories and the research data (Zalaghi and Khazaei, 2016).

The deductive approach, on the one hand, tests existing theory, extends, refines and improves it (Bhattacharjee, 2012). The notion and mental processes behind deductive reasoning have been argued mostly in the psychological literature (Coetzee and Monti, 2018). According to the literature, the deductive approach starts from a general stand to specifics, thus starting from existing theory, developing a hypothesis or a set of hypotheses from it, testing the hypothesis/hypotheses and revising the theory based on the findings (Woiceshyn and Daellenbach, 2018).

Both inductive and deductive approaches are important for knowledge enhancement and theory building. The inductive approach is important when there is a limited theory in a specific area of study and the deductive is needed when there are more competing theories of a similar problem and researchers want to locate which theory/theories provide a better understanding of the situation/phenomenon (Bhattacharjee, 2012).

In line with the positivism paradigm /quantitative approach (identified above), and hence grounded in the merits, the deductive reasoning approach was adopted in this study. Accordingly, based on the literature, the expected causal relationships between e-procurement, supplier efficiency, quality of information, and supply chain performance, and the influence of top management support, perceived ease of use and perceived usefulness were expressed in a theoretical framework and set of hypotheses.

4.4 Time horizon (cross-sectional vs longitudinal design)

Cross-sectional research collects data, measures the exposure and outcome at the same time and generalizes the results (Setia, 2016). This research design is used when there is not enough resources and time, collects data once within a short period and it provides

a snapshot of the research phenomena (Henseler et al., 2015). It is used to study economic characteristics in surveys of large numbers of companies or people and in many cases the companies represent a lot of industries and the research focuses on determining similarities and differences between the industries (Henseler et al., 2015). The advantage is that it is less time-consuming and economically manageable (Kandi and Vadakedath, 2021).

However, it is difficult to identify a sample large enough to be a representative of the sample and separate the phenomena under research from the other factors that can affect the correlation (Henseler et al., 2015).

Longitudinal research design is in social sciences and mainly focuses on stability and transformation in areas such as development, social and mental psychology and emphasises time as its main characteristic (Laher et al., 2019). The different formats of longitudinal research are total population design, repeated cross-sectional design, revolving or rotating panel design and longitudinal panel design (Bala, 2020). The literature emphasises multiple data collection at different times as a main characteristic of the longitudinal method (Plano Clark et al., 2015). In such studies, the associated data collection instrument (e.g. questionnaire) remains unchanged to ensure its ability to collect data consistently at separate periods, although the questions can be slightly varied if a major change in circumstances has occurred in the intervening period (Smith and Yung, 2019).

In summary, cross-sectional research is different from longitudinal research concerning design, timing and methods of analysis (i.e. not comparing data across different time periods vs comparing data across different time periods). Cross-sectional research is important for examining the direct link between variables using correlations whereas longitudinal design has been noted as having greater capacity to establish a causal relationship between variables (Laher et al., 2019). The present study adopted cross-sectional research design to guide the data collection. Due to time constraints and limited resources, the research data was collected once from thirty manufacturing companies in Greater Accra and Ashanti regions of Ghana. Following the principles of cross-sectional

study, the field data was analysed and reported to minimise the problems associated with cross-sectional research in relation to identification of sample section, right procedures were followed to select the sample (ref: 4.7). Also, data cleaning procedures, measurement and structural model validation methods (validity and reliability) were used to validate the dataset to reduce the possibility of not separating the phenomena under study from other factors that can influence the correlations.

4.5 Data Collection Methods

The data collection method refers to the strategies or techniques that are employed by the researcher to gather data, and the data could be either qualitative or quantitative (Bryman, 2016). The literature divides data into two main groups primary and secondary: the primary data is new original/ fresh data that is obtained from the source for the first time whereas secondary data has been gathered previously but is available to the researcher, and may have been statistically transformed (Cheong et al., 2023). Primary data is trustworthy because it remains in its original state compared with secondary data which is likely to have been transformed or refined by another entity or individual (Ahuja, 2022). The type of data determines its collection method - a mismatch between a data collection technique and a type of data can affect the outcome of a study. The past literature captures several data collection methods of which the most frequently used ones are discussed in turn below, namely: interviews, experiments observations, survey and secondary source (systematic literature review and content analysis).

Interview is one of the methods of qualitative research and logically, it is dominated by intensive human interaction that allows respondents to provide answers to questions through conversation that focus on individual experience, opinions, feelings, fears and the like (Knott et al., 2022). The literature describes interviews as a data collection method which the interviewer asks questions, and the interviewee shares their view in answering the question on a particular topic of common interest, embracing human interaction as a means of generating knowledge and stressing the social meaning of research data (Bryman, 2016). The various forms of interviews are face-to-face, group, telephone, e-mail or internet interviews (Bolderston, 2012). The questions could be structured or

unstructured, where the former is made up of standardized and predetermined questions and the latter follows no strict format and is not standardized (Mazhar et al., 2021).

Interviews are effective for theory building, offer deeper insight into phenomena and provide practical solutions to a problem (Dunwoodie et al., 2023). However, interviews are generally very time-consuming and can be prone to study bias due to small sample size and inconsistency in response and results (Alshenqeeti, 2014).

The choice of interviews in research depends on the design, the problem of investigation and research objectives.

Experiments: the investigator deliberately interferes with the activities of the participants to make inferences through imposed characteristics (João, 2022). The experimental research data collection is done through informal means and the research questions shape the data collection procedure (Wuest et al., 2014). Using experiments for data collection requires a well-designed plan that contains mathematical models and analysis (Apuke, 2017).

Observation is another common method of data collection and has proven to be efficient over time (Collis and Hussey, 2014). The observation method of data collection gives in-depth knowledge about people, places and their main behaviour, and is thus different from shared opinions or accounts of behaviour. During observation the observer can be present but does not influence the setting, on the other hand, can be part of the setting (Busetto et al., 2020). The observer can participate fully or partially within the setting (Bryman, 2016). Another form of observation is the use of technology like video recording in the form of structured template recording to unstructured field noting (Morgan et al., 2017). This method works better and has demonstrated a higher level of efficiency in capturing observation (Morgan et al., 2017).

The observation method offers researchers the opportunity to demonstrate their feelings for participants through their actions, see how participants interact with each other, their communication manners and the amount of time they consume engaging in daily activities (Morgan et al., 2017). It allows researchers to access important information which

participants may be reluctant to provide during interviews, making it more effective (Bryman, 2016).

The observation method, however, is not without challenges. The intensive engagement in the activities of the setting is time-consuming and can prove to be ethically difficult. There is also the possibility that some participants may adopt new behaviours and change their attitudes /when they become aware that they are the subject of the observation (Morgan et al., 2017).

Secondary data can be obtained by having access to published sources such as scholarly articles, books, magazines, newsletters, general websites, government records, unpublished personal records, dairies published printed sources, general websites etc. Searching through these documents for information is a recognised research method that has been applied long ago and the documents contain text, videos or visual material (Morgan, 2022). For example, researchers who conduct systematic literature reviews/meta-analyses use extraction methods to collect data from various valid sources and process it into a piece of meaningful information (Tawfik et al., 2019). The previous literature classifies secondary data collection as archival of qualitative documents (Dewi, 2022) and the investigator searches areas of interest in the topic under investigation (Schmidt et al., 2020). Moreover, content analysis can be employed to identify written or visual materials to identify specific information or data and this method is effective in identifying human behaviour and it is dominant in education research (Avcu and Avcu, 2022). Media content for instance, the data can be obtained from newspaper, articles and television programs rather than from people (Bryman, 2016).

4.5.1 Survey – the chosen method

The present thesis used a questionnaire to obtain data from the respondents in the manufacturing sector in Ghana. The choice was based on the problem of the study, the research design, the questions and the objectives. As quantitative research, the questionnaire is an efficient method for collecting quantitative data for the attainment of the overall objective of the study.

As noted above, a survey is a data collection-based research in social science research and it has been used for ages (Holtom et al., 2022). The literature describes a survey as an exploration of the opinions or the understanding of a community of people that uses multiple questions and they are determined by the researcher to gather data specified (Nayak and Narayan, 2019). According to Pozzo et al. (2019), the term survey is different from questionnaire but researchers' use them interchangeably survey represents the method whereas questionnaire is the application of a research instrument.

The survey method is mainly used to collect primary `data and it is efficient for collecting data from large samples (Christopher and Udoh, 2020). The past literature divides survey questions into four main parts namely, contingency/cascade format, matrix questions, closed-ended questions and open-ended questions (Roopa and Rani, 2012) as illustrated in Table 10.

Table 10: Types of survey questions

Type of question	Meaning	Source
Contingency/cascade questions	Answer based on response from the previous question.	Roopa and Rani (2012).
Matrix questions	Closed-ended question types are arranged in a form of matrix where the response options are the columns and the rows.	Liu (2017)
Closed-ended questions	Survey question that allows respondents to express their intension through a rating scale	Baburajan et al. (2022)
Open-ended questions	Survey questions that enable the respondents to express their opinion without strict restrictions.	Jayanthi and Shanthi (2022)

Surveys are cost effective, less time consuming and the results are generalizable because data is taken from larger samples (Rice et al., 2017). Moreover, for instance, online surveys prevent missing data because respondents are not allowed to answer the next question until the present question is answered (Nayak and Narayan, 2019). However, a survey has been criticised for its positivist epistemological view, separating

the sample from their social contexts and it is a subjective self-report that is highly associated with errors (Sturgis and Luff, 2021). The current thesis is a survey-based research, thus collecting data from the manufacturing companies in Ghana. One of the key and important requirements of quantitative study is the collection of data about the phenomenon through tested and approved tools and procedures (Hammarberg et al., 2016). According to Taherdoost (2021), the questionnaire is one of the recognised data collection tools for obtaining valid information from the research population.

A questionnaire is a set of questions which enable respondents to declare their opinion by providing answers and are of four types: cascade format, matrix, closed-ended and open-ended (Roopa and Rani, 2012). Questionnaires are either structured or unstructured and is used to collect primary data (Taherdoost, 2022).

Though the questionnaire is an efficient data collection instrument, it has both strengths and weaknesses. Questionnaires are efficient and preferable for collecting a large amount of data from a large sample (Taherdoost, (2021) and the respondents can provide information confidentially, and hence more readily, due to anonymity (Zohrabi, 2013). However, one of the key weaknesses of the questionnaire is that respondents may exaggerate their true opinion because social desires can influence them to overstate their intentions (Etikan, 2017). Moreover, without very careful thought, some questionnaires can suffer from inadequate/proper design to elicit adequate and unbiased information, which can lead to wrong or inappropriate data manipulation affecting the analysis offered by the empirical data (Pozzo, 2019).

Mostly, researchers use either printed (deliver by post) or online questionnaires depending upon circumstances that contribute to achieving valid results (Bryman, 2012). However, both printed and online questionnaire designs have pros and cons or their ups and downs. According to Bryman, (2012) an online questionnaire is a written survey that allows researchers to contact respondents through electronic mail. The web page grants respondents a lot of flexibility by allowing them to be independent, fast, easy to manage and comparatively low in terms of cost (Bryman, 2012). On the other hand, responses

sent through the Internet may lack measures ensuring confidentiality, privacy and associated with ethical issues (Singh and Sagar, 2021).

4.6 Study population

Statistically, the study population refers to the whole group from which information can be obtained (Bryman and Bell, 2015). Research population could comprise people, companies, locations, events, outcomes or anything that is well structured and defined with clear inclusion and exclusion standards (Banerjee and Chaudhury, 2010; Naseri and Rahmiati, 2022).

The statistical population must share common characteristics in line with the research interest and these characteristics qualify any member of the group to be part of the population (Bryman and Bell, 2015). In the current thesis, the research population is the manufacturing sector in Ghana that engages in the production of physical products. Using purposive sampling techniques, the research sample was drawn out of this population to facilitate the achievement of the purpose of the study and address the research questions.

4.7 Study sampling and unit of analysis

Sampling involves the process (often statistical) of determining the number of participants from a research population of interest and the sample represents the population that assists in answering the research questions (Taherdoost, 2016). Notably, sampling is different from a sample, the former is a method of selecting a section of the research population, and the latter represents a well-defined group that an investigator obtains data from (Blumberg et al., 2014). Also, a unit of analysis is the entity that serves as the basis of analysis, to draw a conclusion that provides insight into the results and provides answers to the research problem (Casteel and Bridier, 2021). The common sampling techniques are listed and explained in table 11.

Table 11: Sampling techniques

Sampling techniques	Explanation	Source
Simple random sampling	Each member of the population has equal chance of being selected.	(Taherdoost, 2016)
Systematic sampling	A sampling technique that allows every nth case after a random start is selected.	Taherdoost (2016)
Stratified random sampling	This technique divides the main population into different sections and layers and sample randomly from each section.	Shi (2015)
Cluster sampling	A sample procedure that divides the population into clusters and goes through first and second phases using ordinary sample techniques	Taherdoost (2016)
Multi-stage sampling	A combination of probability sampling techniques, usually used for bigger populations at a geographical location.	Etikan (2017)
Quota sampling	This method divides the research population into different groups for data.	Futri et al. (2022)
Snowball sampling	Participants are selected at the initial stage, the first sample recruits their peers and this is repeated throughout the sampling process.	Raifman et al. (2022)
Convenience sampling	The investigator uses a sample already available and easily accessible.	Golzar et al. (2022)
Purposive sampling	Gather information purposely to meet the objective of the study.	Blumberg et al. (2014).

The current study uses a purposive sampling technique to identify the sample out of the larger population which is the manufacturing sector in Ghana. Purposive sampling is used and appropriate to select respondents that are most likely to yield the appropriate information when the sampling frame is not accurately known, and when cost and time restrictions are therefore presented (Blumberg et al., 2014). It is a form of non-random sampling, and it is suitable to obtain data from certain persons who are custodians of the required information within the population (Campbell et al., 2020). Sample estimation is the act of determining sample size and it can affect the outcome of the study. For instance, the past literature.

Memon et al., (2020) suggests that a sample size of 100 participants for structural equation modelling is small, 100 to 200 is medium and a sample above 200 is considered large. However, the literature has also suggested that a sample of 200 is below the sample requirement of complex models that have non-normal distributions, specifically those that use maximum likelihood estimation (Memon et al., 2020).

In the current study, the target research sample comprised of 600 employees from a population of 15360 within manufacturing firms located in Ghana as shown in Table 12. These companies engage in the production of general goods in the areas of electronic/electrical, pharmaceutical, food and beverages/drinks manufacturing, metals and metal products manufacturing, chemicals, rubber, plastics, non-metallic product manufacturing, and machinery, equipment, furniture manufacturing and are located in the Greater Accra and Ashanti regions in Ghana. They play a significant role in Ghana's economy by employing young graduates to take up employment and contribute to GDP, helping to reduce the unemployment rate in Ghana. These companies engage in active electronic procurement practices in Ghana to acquire raw materials for their numerous production lines and distribute their finished goods through an array of designated routes across the country. Therefore, understanding the influence of e-procurement on supply chain performance can be properly investigated with the responses from employees engaged with the e-procurement applications of these organisations. The president/managing director/CEO, operations/production manager/senior officer, manufacturing manager/senior officer, procurement manager/senior officer, supply chain/logistics managers, information technology manager/officer and other senior managers/deputy managers were purposively selected to answer the questionnaire. Twenty (20) employees from each of the 30 organisations were included in the sample to receive the questionnaire as shown in Table 12.

Table 12: Research sample

	Company	Population	Sample
1	Cocoa Processing Company Limited	430	20
2	Prime Cocoa Limited	227	20
3	Wilmar Africa Limited	1000	20
4	Cable Metal Company Limited	125	20
5	Tropical Cable & Conductor Limited	62	20
6	Nexans Kabelmetal Ghana Limited	50	20
7	Kasapreko Company Limited	664	20
8	GIHOC Distilleries Company Limited	520	20
9	Obibini Blackman Company Limited	101	20
10	Coca Cola Bottling Company Limited	800	20
11	Adonko Company Limited	151	20
12	Special-Ice Ghana Limited	56	20
13	Promasidor Ghana Limited	1201	20
14	Twellium Industrial Company Limited	1078	20
15	Abyek Pharmaceutical Company Limited	58	20
16	DanniPharman Limited	1073	20
17	Kinapharma Limited	1012	20
18	Danadams Pharmaceutical Industry Ghana Limited	250	20
19	Donyma Steel Company	105	20
20	Sethi manufacturing company limited	421	20
21	Sollatek Electronics Ghana Limited	58	20
22	Aya TopTech & Fabrication	161	20
23	Alutrade Company Limited	297	20
24	Ghana Rubber Products Company Limited	459	20
25	Interplast Limited	703	20
26	PolyTank(s) Ghana Limited	1097	20
27	Duraplast Limited	800	20
28	Ghana Heavy Duty Truck & Equipment Manufacturing Co. Ltd	505	20

29	CFAO Equipment Ghana	153	20
30	Liebherr-Ghana Limited	1040	20
	Total	15360	600

4.8 Survey development

In this study, the survey instrument was developed to measure the seven constructs specified in the conceptual model, namely: electronic procurement, perceived ease of use, perceived usefulness, and top management support, quality of information, supplier efficiency and supply chain performance. The survey was developed based on an extensive literature review to understand the design of the questionnaire.

4.8.1 Questionnaire design

According to Aithal and Aithal (2020) questionnaires can be developed through an accepted procedure to help ensure reliability and validity of the data collected as illustrated in Figure 13. At the initial stage, the content of each question should be determined and this allows the researcher to proceed to develop the wording of the questions (Rameshbhai et al., 2016).

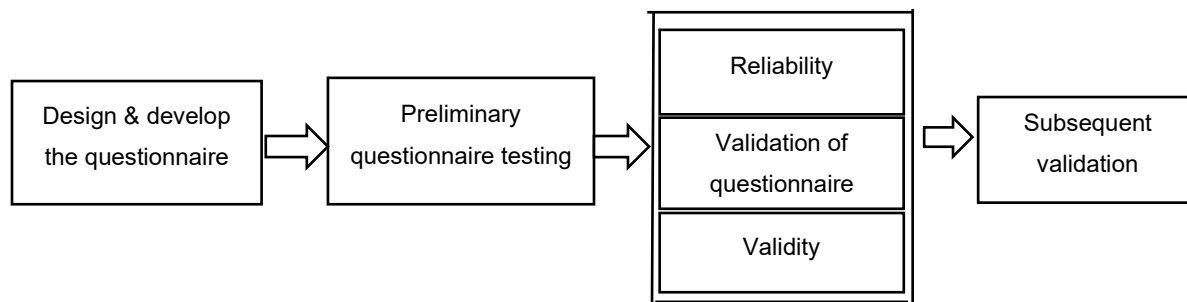


Figure 13: Survey design and development stages (Aithal and Aithal, 2020)

A thorough literature review led to the identification of previously adopted and validated questions (measurement scales). The questions were gathered from different sources measuring electronic procurement, perceived ease of use, perceived usefulness, quality of information, supplier efficiency, top management support and supply chain

performance (see appendix 1). The content of the questions - face and content validity - were rigorously ascertained to fully understand their eligibility to measure the constructs. Based on this exercise, some of the questions (measurement items) were slightly reworded to be fully consistent with the operations of the manufacturing industry and some were eliminated where not appropriate to ensure clarity.

Closed questions for each study construct were employed, assigned with a rating scale, precisely a 5-point Likert scale that allowed respondents to declare their level of agreement or disagreement (Holmes, 2023). The literature refers to such closed questions as scaled questions and the response can be framed in the form of a statement of question that allows participants to rate their level of understanding (Holmes, 2023). The questions have two parts: the first part captures the demographic information about the respondents and the second aspect seeks information about the study constructs.

4.8.1.1 Question type/format and sequencing

Question formatting means how the questionnaire is arranged, and how the ideas are structured and presented for the respondents and it includes the size, colour, and shape of the paper (Fanning, 2019). According to the literature, the question sequence is built on the premise that the first items in a questionnaire can influence late responses (Stefkovics and Kmetty, 2022). Therefore, researchers should decide the order of the questionnaire by using either a funnel sequence or an inverted funnel sequence. It has been suggested that the opening questions should be interesting and comparatively easy to answer. There is also a developing trend in social science that suggests putting demographic information at the end (Young, 2015).

An introductory preamble provided the background of the research, and the institution provided information about the researcher. The preamble also contained statements encouraging the respondents to participate in the study of their own free will.

The remainder of the questionnaire was structured into two parts. The first part was the demographic information of the respondents. The demographic information focused on the job title, years of work experience, number of employees, type of industry and

educational qualification. The second part of the question assessed the study variables: e-procurement, supplier efficiency, quality of information, top management support, perceived ease of use, perceived usefulness and supply chain performance.

4.8.1.2 Covering letter

During organisational recruitment and access to gatekeepers (Masso et al., 2025), a cover letter is an instrument that is used to explain their intentions and seek permission of the target respondents to engage in certain activities (Nicholas, 2019). According to Brodeur et al. (2025) collaboration with gatekeepers promotes more research participation. Gatekeepers are the entry point to the research population (Broadhead and Rist, 1976; Brooks, 2025). With regards to the current research, before questionnaire administration, letters were sent to the 30 manufacturing companies in Accra and Kumasi metropolis seeking their participation in the study. The content of the letter included the purpose and expected insightfulness of the study for practitioners, the researcher's institution, ethical issues and statements encouraging the participants to participate in the study. The covering letter was addressed to the president or the chief executive officer and the human resource managers of the company who were the gatekeepers of the data collection. Then, the participants were evaluated for their eligibility to participate in the study (Blasini et al., 2024; Fang et al., 2023). The eligibility criteria used to assess the population includes position and role of the participant in the company. Their position and role gives them legitimate authority to control and keep a specific type of information about the company.

4.8.1.3 Refining the Survey Instrument

Research instruments can be refined by applying validity and reliability measures to test the strength of the items and the constructs. Validity is the fitness of a research method and instruments and how they can effectively produce required, standard and appropriate results (Hair et al., 2010). Generally, the first stage of refining the instrument is examining the face validity of the items. Face validity means testing the practicality or the importance of the content using rational analysis based on expert judgment (Hair et al., 2010). Mostly, the content of the examination of the items takes into consideration of the wording, format

and layout of the questions (Taherdoost, 2016). Experts in a field are the people who have in-depth knowledge in a particular field of study and an instrument is classified as having face validity when the questions truly denote the whole content of the concept under study (Taherdoost, 2016).

Factor analysis is the statistical approach to extending content validity because it tests the content of the construct using a statistical tool and is usually used for constructs with many dimensions (Hair et al., 2010). The assessment based on the factor loadings is based on the correlation coefficient for the variable and factor. Factor loading indicates the variance explained by the variable on the particular factor. In practice, a factor loading of 0.60 or above indicates that the factor abstracts adequate variance from the variable (Silva et al., 2019). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are commonly used to test measurement models. EFA analyses the covariance in the entire items collectively and the items that share a higher degree of variance are turned into factors. CFA extracts the shared variance in the items that have been specified already to measure the same construct (Knehta et al., 2019).

One of the means of refining items is to test convergent validity. Convergent validity is the degree to which the construct measured is theoretically in harmony with its indicators (Hair et al., 2010). Some of the methods of testing convergent validity are factor loadings, composite reliability and average variance extracted. The average variance extracted is the sum of the square root of the factor loadings of the items that relate to a specific construct. It is calculated by dividing the sum of the squared loading by the number of the items measuring the construct and AVEs must be higher than 0.50 (Hair et al. 2021). The past literature recommends AVE as a statistical tool for testing and establishing convergent validity because it explains the level to which items are shared between the construct in structural equation modelling (SEM) (Hair et al., 2017). Composite reliability is attained by calculating the ratio between the construct and the composite variance. Furthermore, composite reliability takes its equation from intra-class correlation as the ratio of model variance to the total variance (Widhiarso and Ravand, 2014). Regarding cutoff point, the composite reliability values between 0.60 and 0.70 are considered "acceptable

in exploratory research, values between 0.70 and 0.90 range from “satisfactory to good.” values above 0.90 and higher than 0.95 are problematic (Hair et al., 2021).

Discriminant validity examines the constructs in a model to discriminate their ability to maintain unique identities with low correlation among them (Pehlivan et al., 2024). This type of validity test is built on the premise that the latent constructs should statistically vary simultaneously (Goyal and Aleem, 2023). To establish discriminant validity, the square root of AVE is compared with the inter-construct correlation and the square root of the AVE must be higher than the correlation coefficients among the constructs (Mahmoud et al., 2022).

Reliability tests remain one of the acceptable approaches for refining research instruments in social science research. Reliability means a data collection instrument will produce the similar results in different environments and also shows the efficiency of the data collection instrument in obtaining valid research data (Fitriyanto et al., 2019). In quantitative research, reliability means results and processes can be replicated (Leung, 2015). One of the reliability testing methods is Cronbach’s alpha and it is used to measure the internal consistency of the measurement items. The literature recommends 0.60 or higher for exploratory but in advanced research, an alpha coefficient of 0.70 or higher is recommended (Ab Hamid et al., 2017). However, it has been suggested that, in structural equation modelling research, Cronbach’s alpha is not applicable (Cheung et al., 2023).

4.9 Survey Administration

Survey administration (Rickwood and Coleman-Rose, 2023) can take the form of printed (paper) or electronic surveys (using the internet or electronic media) (Determann et al., 2017). The online survey instrument obtains data from respondents through internet technology such as e-mail or online survey platforms (Determann et al., 2017). The benefit of an online survey is its ability to collect data in a less time consuming manner and it can reach a population that may be harder to reach through postal means (Wieters, 2016). Additionally, online surveys tend to lower the amount of missing data and come with an often simpler format compared with the paper-printed questionnaire (Wieters, 2016).

Paper-based questionnaire is a printed survey that is distributed personally or delivered by post to the target group (Kelfve et al., 2020). This is a traditional approach to data collection and it is associated with high cost of printing and time consuming (Ebert et al., 2018).

The current study administered the survey through the Internet and the questionnaire was hosted on the Jisc online survey platform under the control of Brunel University, London. The software generates a link which allows respondents to have ease of access to complete the survey. To limit the amount of missing data, respondents were promoted to answer the present question before proceeding to the next question. The questionnaire was distributed through e-mails using a contact list obtained from the gatekeepers in the manufacturing organisations. To increase participation, there was a planned follow-ups and due to ethical issues incentives in any form were not given (Zweben et al., 2009; McCullagh et al, 2014; Wong et al., 2021). The follow-up were done through phone calls made to the gatekeepers every two weeks to remind them to encourage the respondents to answer the questions. Moreover, the respondents were encouraged to answer the questions by explaining the relevance of the research to the private manufacturing and other consumers of the findings of the thesis. The respondents were given a maximum of two months (i.e. 1st October to 5th December 2023) to complete the questionnaire. However, at the end of the period, some of them have not answered the questions and additional two was added to give enough space to complete the questions. The responses were imported after the end date and kept in an Excel file for future use.

4.10 The measurement model

The measurement model is the mathematical model made up of the study constructs. The measurement model could be positioned and evaluated as a formative or reflective model. The measurement model portrays the validity and reliability of the constructs, indicators and measurement items and their interrelations (Hair et al., (2014). The measurement scales are used to assign scores in terms of numbers to phenomena that are not possible to be evaluated directly or group items that represent theoretical variables that require mathematical values to be measured (Hair et al., 2017).

4.10.1 Formative vs reflective construct

One of the concerns of the previous literature is to consider whether the indicators are reflective or formative (Hair et al., 2021; Memon et al., 2018). The assumption behind the reflective measurement is that the latent variable influences the observable (Schuberth, 2021). To qualify a construct as formative or reflective, four main conditions are considered: a. the direction of causality of the construct to indicators b. the interplay among the indicators c. the degree of covariance among the indicators d. nomological network of the construct indicators (Hair et al., 2021). The principle behind one-dimensional constructs is that all the items measure the mother construct, are correlated and have internal consistency. Therefore, for a one-dimensional construct with reflective items, deleting an item causes no change to the strength of the construct but in formative measurement models, the items influence the construct, and removing an item causes a change in the meaning of the construct (Van Amelsvoort et al., 2020). Therefore, the treatment of reflective and formative constructs is significantly different. In the present study, all of the constructs were reflective constructs. Moreover, the measurement scales were all adapted from existing scales found in the literature, which has the advantage that their reliability and validity have already been tested and demonstrated and hence helps make the findings more reliable, and is an approach strongly advocated in the prior literature (e.g. Flynn et al., 1990; Frohlich, 2002; Bryman and Bell, 2015).

4.10.2 Measures of supplier efficiency, quality of information, perceived ease of use, perceived usefulness and top management support

The supplier efficiency scale was adapted from Li et al. (2015) and Santoso and Besral, (2018). The scale has five items evaluating how suppliers deliver materials on time and deliver the right quantity and quality when orders are placed by the purchasing entity. The quality of information scale was adapted from Anin et al. (2020). The scale is a single-factor scale with 5 items evaluating how accurate, timely, relevant, confidential and complete information are exchanged between the purchasing company and suppliers.

Perceived ease of use was a single-factor scale with 5 items adapted from Ramkumar et al. (2019) and Li et al. (2015) evaluating employee willingness to use information communication technology when they perceive that it is easy to use. The perceived usefulness scale was made up of 3 items examining the individual's willingness to use an information communication system adapted from Ramkumar et al. (2019). Finally, the top management support scale was adapted from Sánchez-Rodríguez et al. (2020) with 3 items evaluating managements' commitment to providing financial support, how top management prioritize e-procurement and adapt to new IT systems.

4.10.3 Measures of electronic procurement and supply chain performance

The study defined e-procurement as business to business purchasing practice that utilises electronic commerce to identify potential source of supply to purchase goods and services, to transfer payment, and to interact with suppliers (Pearcy and Giunipero, 2008). The e-procurement measure was a single-factor scale made up of 5 items adapted from Sánchez-Rodríguez et al. (2020), with the items rated on a 5-point Likert scale. The items were modified slightly to suit the operations of the manufacturing sector e-procurement operations. The questions focus on how manufacturing companies use information systems to facilitate procurement elements such as managing orders, providing inventory information to suppliers, product information to suppliers and providing production plans to suppliers. These elements are critical to the core business of the manufacturing sector in terms of online purchases, thus evaluating electronic procurement from this perspective.

The supply chain performance scale was adapted from Hallikas et al. (2021), measuring the output of the supply chain of the manufacturing sector in terms of flexibility, resource efficiency, cost in supply chain, delivery lead time, delivering reliability and visibility within the supply chain. The scale is a single factor rated on a 5-point Likert scale with 6 items as demonstrated in Table 13.

Table 13: Constructs, measures and sources of questionnaire items

Construct	Measures	Source of questionnaire items (Adapted from)	Number of items	Scale anchors
E-procurement	Electronic ordering to our suppliers.	Sánchez-Rodríguez et al. (2020)	5	1. No use
	Electronic payment to suppliers.	Sánchez-Rodríguez et al. (2020)		2. Slight use
	Provision of inventory information to our suppliers.	Sánchez-Rodríguez et al. (2020)		3. Moderate use
	Provision of required product specifications to suppliers.	Sánchez-Rodríguez et al. (2020)		4. Considerable use
	Provision of production planning information to suppliers.	Sánchez-Rodríguez et al. (2020)		5. Extensive use
	Maintenance of the required quality standards of the parts/materials requested.	Li et al. (2015) and Santoso and Besral, (2018).		1. Strongly disagree
	Supplying the required parts/materials at minimum possible cost.	Li et al. (2015) and Santoso and Besral, (2018).		2. Disagree

Supplier efficiency	Supplying the right quantity of parts/materials according to specification.	Li et al. (2015) and Santoso and Besral, (2018).	5	3. Neutral
	Timely supply of parts/materials according to schedule.	Li et al. (2015) and Santoso and Besral, (2018).		4. Agree
	Effective communication for transactions/continuous improvement.	Li et al. (2015) and Santoso and Besral, (2018).		5. Strongly agree
Quality of information	The information exchanged between our company and its suppliers is relevant.	Anin et al. (2020)	5	1. Strongly disagree
	The information that our company and its suppliers exchange is timely.	Anin et al. (2020)		2. Disagree
	The information that our company and its suppliers exchange is accurate.	Anin et al. (2020)		3. Neutral
	The information that our company and its suppliers exchange is confidential	Anin et al. (2020)		4. Agree
	The information that our company and its suppliers exchange is complete.	Anin et al. (2020)		5. Strongly agree
Top management support	Top management is decisive in providing the needed financial resources to implement e-procurement systems	Sánchez-Rodríguez et al. (2020)	3	1. Strongly disagree
	Top management considers the use of electronic procurement a priority in our firm.	Sánchez-Rodríguez et al. (2020)		2. Disagree
	Top management considers that our firm must adapt itself to the new IT systems in procurement.	Sánchez-Rodríguez et al. (2020)		3. Neutral
				4. Agree
				5. Strongly agree

Supply chain performance	How well has your company succeeded in achieving its goals for Supply Chain Performance			
	Flexibility	Hallikas et al. (2021)	6	1. Highly unsatisfactory
	Resource efficiency	Hallikas et al. (2021)		2. Unsatisfactory
	Costs in supply chain	Hallikas et al. (2021)		3. Neutral
	Delivery lead time	Hallikas et al. (2021)		4. Satisfactory
	Delivery reliability	Hallikas et al. (2021)		5. Highly satisfactory
	Visibility within the supply chain	Hallikas et al. (2021)		
Perceive ease of use	Learning to use e-procurement systems is easy for me.	Ramkumar et al. (2019) and Li et al. (2015)		5
	My interaction with e-procurement system is clear and understandable.	Ramkumar et al. (2019) and Li et al. (2015)	2. Disagree	
	Using e-procurement systems enhances the performance of my tasks.	Ramkumar et al. (2019) and Li et al. (2015)	3. Neutral	
	Training users of an e-procurement system is easy for our organization.	Ramkumar et al. (2019) and Li et al. (2015)	4. Agree	
	Training competent personnel to support an e-procurement system is easy for our organization.	Ramkumar et al. (2019) and Li et al. (2015)	5. Strongly agree	
Perceived usefulness	Using e-procurement systems increases my job performance.	Ramkumar et al. (2019)	3	1. Strongly disagree
	Using e-procurement systems increases my job productivity.	Ramkumar et al. (2019)		2. Disagree
	Using e-procurement systems enhances my job effectiveness.	Ramkumar et al. (2019)		3. Neutral
				4. Agree
				5. Strongly agree

4.10.4 Control variables

Control variables are used in regression analysis to measure the causal effect of a treatment on an outcome (Hünermund and Louw, 2023). Regression models include independent and dependent variables and, as with the present study, some studies introduce mediator and/or moderator variables (Atinc et al., 2012). Theoretically, the idea behind the control variable's inclusion in a model is to check for alternate causal understanding of the observed relationship (Klarmann and Feurer, 2018). That is, control variables are introduced in a model to eliminate variance related to non-focal variables (Bernerth and Aguinis, 2016).

The extant literature often refers to such variables as covariate, confounding variables, or nuisance variables. The methods of accounting for these variables are experimental design (before data collection) and the use of statistical analysis (after data collection) to escape false positive (Type 1) errors to ensure the validity of the results of the study (Nielsen and Raswant, 2018). The current study controlled for job title, years of work experience, number of employees, type of industry and educational qualification. Job title was measured by the position they occupy in the company. Years of work experience was measured by asking the participants to indicate the number of years they have worked with the organisation. Number of employees (firm size) was assessed by asking the participants to indicate the total number of workers in their company. Industry type was measured by assessing the core operation of the company. Finally, educational qualification was measured by asking the respondents to indicate their level of education.

4.11 Data analysis procedure

Data analysis is one of the key activities in research and should follow a planned and structured procedure and processes to ensure coherence and clarity. The study used the procedure presented in Table 14 as the guide for data analysis.

Table 14:Data analysis procedure

Procedure	Activity
Data cleaning	Detect missing data (level of randomness, volume of missing data), Identification of outliers, non-response bias, normality, linearity and Multicollinearity.
Analyse respondents' demographic information	Descriptive statistics of the demographic information of the respondents- percentages
Exploratory factor analysis (EFA)	Examine factor loadings of the measurement items
Reliability test	Use composite reliability to test internal consistence of the measurement items
Validity test	Compute Average variance extracted (AVE), Square root of AVEs, Inter-construct correlation, compare square root of AVEs with the inter-construct correlation, and conduct confirmatory factor analysis (CFA) of the measurement model.
Assessment of the structural/theoretical model (hypotheses)	Input the refined data in AMOS software, analyse, assess the model fit and robustness using fit indices.
Confirm or reject hypotheses	P-value Standardized coefficients T-values

4.11.1 Techniques for screening and cleansing the data

Data cleansing is the statistical activity that involves the identification and elimination of errors in a dataset (Hair et al., 2014). Data screens help researchers to identify contravention of basic multivariate analysis assumptions. Data screening begins with the assessment of missing data values (Mahmoud et al., 2022). The current study attended to two main issues relating to missing data based on the recommendations of Hair et al. (2014) and Tabachnick and Fidell (2014): the level of randomness refers to the pattern and relationships underlying the missing data and the volume of data presented in the data set. Additionally, descriptive statistics of the amount of the missing data for each variable were determined using IBM SPSS software.

Data cleansing required the identification of outliers. They are observations that are doubtful because they fall well below or above the majority of the observations (Cousineau and Chartier, 2010) and outliers are those observations with standardised scores of ≥ 3.29 . To identify potential outliers in the current study, all raw data were transformed into standardised scores (mean of 0 and a standard deviation of 1) following the recommendation from Hair et al. (2014) and Tabachnick and Fidell (2014).

Non-response bias, which includes early and late response, is also one of the means of data cleansing. Non-response bias is the error being anticipated by a researcher when determining the population characteristics using sample survey data but because of non-response, a section of the participants is not properly represented (Cheung et al., 2017). To determine potential common variance, the study employed Harman's (1976) single-factor test.

It is also prudent to examine the data for normality as a pre-condition for constructing an SEM model, especially when using the (default) estimation method of the maximum likelihood method (Xiong et al., 2015). Normality is evaluated using the Critical Ratio (CR) value of its Skewness and Kurtosis: if the CR values fall within -2.58 and 2.58 at the significance level of 1% (0.01) indicate that the data is normally distributed (Ferezagia et al., 2021).

Detecting multicollinearity was also one of the techniques for data cleaning. It refers to the presence of linear intercorrelation between explanatory in a multiple model which causes the regression analysis to produce inaccurate results (Kim, 2019). To solve this problem, the variance inflation factor (VIF) technique was employed by the current study. According to Shrestha (2020), the value of VIF is $1 < VIF < 5$, and the idea behind it is that the variables are moderately correlated to each other. A minimum value of VIF relating to the variables indicates the absence of collinearity. The final step of the data screening was the use of linearity by assessing the scatterplot matrix of variables. The linearity of the data analysis procedure is its capability to attain results that are directly or indirectly relative to the existence of an element in a sample (Ismail et al., 2014).

Scatterplots have Gaussian distributions of dots of which the Pearson correlation (r) can be explained by two sample laws: a linear Pearson correlation for discrimination and a logarithmic one for perceived magnitude (Rensink, 2017). A scatterplot is used to explain the correlation between two variables (Birant et al., 2022).

4.11.2 Assessing the Measurement Model

Assessing the measurement model involves testing the psychometric properties of the measures to determine their eligibility to measure a theory (Hair et al., 2020). The study used a covariance-based SEM reflective measurement model. In an SEM study, the accuracy of the scale is paramount, thus the validity and reliability of the measurement items are important for the results of the entire study. Exploratory factor analysis (EFA) was conducted using the varimax rotation method to ascertain the factor structure of the measurement items. According to Watkins (2018), exploratory factor analysis is part of a multivariate statistical technique that identifies factors, dimensions, latent variables, and synthetic variables that can describe the covariation observed among a group of variables. It prepares the way for validity (convergent and discriminant) and reliability tests. Furthermore, for reflective models, discriminant validity is evaluated through average variance extracted (AVE). The square root of the AVEs is compared with inter-construct correlation to establish discriminant validity.

Additionally, confirmatory factor analysis (CFA) was conducted to ascertain the factor structure of the measurement items; that is how the items load onto their respective factor (Hair et al., 2014). Using the maximum likelihood method, the robustness of the model was evaluated based on the threshold of the fit indices highlighted in Table 15.

Table 15: Model fit indexes threshold

Fit indices	Threshold	Function	Source
Bollen's Fit Index (IFI)	0-1	Measure the degree of changes in fit of the main model compared to a null model that is nested within the main model.	Widaman and Thompson (2003)
Oreskog-Sorbom's GFI Fit Index	0-1	"Measures the relative amount of variances and covariance in the empirical covariance matrix S that is predicted by the model-implied covariance matrix"	Goretzko et al. (2024) Schuberth et al. 2023)
Comparative Fit Index (CFI)	0.9-1	CFI compares the fit of a hypothesised model with baseline model, for example model with poor fit.	Hooper et al. (2008) Xia and Yang (2019)
Tucker-Lewis index (TLI)	0-1	Compare the fit of a hypothesized model with that of a baseline Model.	Widaman and Thompson (2003)
Root Mean-Square Residual (RMR)	Closer to zero	Evaluate the standardised value of the square root of the mean absolute covariance squared residual.	Dash and Paul (2021)
Standardized RMR	0.00	The square root of the difference between the residuals of the sample covariance matrix and the hypothesised covariance model	Goretzko et al. (2024) Hooper et al. (2008)
Root Mean-Square Error of Approximation (RMSEA)	0-05	Evaluate the distance between a hypothesized model and a perfect model.	Clark and Bowles (2018) Xia and Yang (2019)
Chi-square (χ^2)	Depends on sample size	The percentage of the squared deviation from the expected value divided by the expected score (test the distance between the sample covariance matrix and the model covariance matrix). A greater Chi-square statistic represents a greater deviation from the expected distribution.	Rose et al. (2017)

Conducting a chi-square test difference is another approach for testing discriminant validity. In this method, two models are constructed: constrained and unconstrained. The constrained model is compared with the original model (unconstrained) and the difference in the chi-square value must be equal to 1 - this test is a standard procedure in structural equation modelling (Rönkkö and Cho, 2022).

4.11.2.1 Evaluating the Reflective Measurement Model

With reflective indicators (where the arrows point at the construct), the construct influences the measurement of the indicators (Hair et al., 2021). The past literature shows that the reflective model is evaluated through the unidimensionality technique, and testing internal consistency, indicator reliability, convergent validity and discriminant validity to achieve the model fitness (Afthanorhan, 2014; Hanafia, 2020).

The cut-off point of outer loadings for reflective models is 0.708 and the t-value can be considered significant when higher than 1.96 and past studies recommend that reflective items require deletion when their outer loading is below 0.40 (Alzoubi et al., 2018). Additionally, one of the requirements of the reflective model is conducting confirmatory factor analysis (CFA) on the condition that the structural equation modelling involves only reflective constructs, and covariance-based SEM is the most appropriate approach for this activity (Henseler, 2017). The current thesis uses covariance-based structural equation modelling with reflective measurement. According to Zhang et al. (2021), this technique is a prevalent data analysis technique in management research. All the constructs are one-dimension, thus are single indicators and are analysed as reflective. Therefore, all the constructs were tested using the techniques recommended by the existing literature.

4.11.3 Testing the structural model

SEM has separate models for scale accuracy (measurement model) and the structural or theoretical model which tests the causal relationship between two or more variables (Madzimure et al., 2020). After testing the mathematical model, the next step is the assessment of the structural/theoretical model.

The application of the SEM tests three main structural models, namely, the direct effect, the mediating effect and the moderating effect. The models were tested using the maximum likelihood estimation method. This method is commonly used in several applications and in SEM it is used to obtain standard errors for maximum likelihood parameter estimates and assess the goodness-of-fit of the model (Hair et al., 2017). The significance of the relationships (hypotheses) between the constructs are determined by these tests statistics: p-value, Beta coefficients (standardised) and t-values.

4.11.3.1 Testing the Direct Effects Hypotheses

Direct effect is the causal relationship between the independent variable (X) and the dependent variable (Y) and relationship (Rucker et al., 2011). The purpose is to establish a direct cause between x and y (Aglar and De Boeck, 2017). The causal path between the independent variable and the dependent variable has no mediator variable influencing the relationship as illustrated in Figure 14. The magnitude of the causal effect is expressed for a specific value x and it is evaluated to a reference value x and its simple form is the total effect (TE) of $X=x$ on y given by $E[Y | x] - E[Y | x_0]$ (Schamberg et al., 2020)

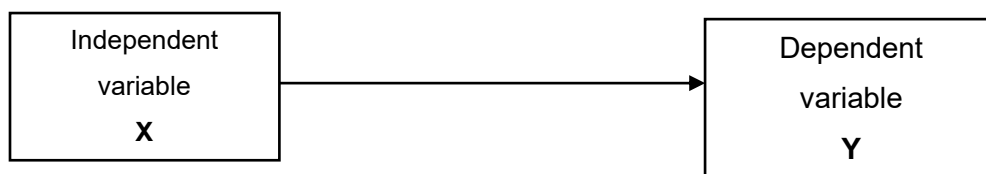


Figure 14 : Direct effect model

4.11.3.2 Testing the Indirect (moderation/mediation) effects hypotheses

Mediation analysis statistically determines the link between the independent and the dependent variables through explanatory mediating variables (Song and Lim, 2015). The concept of mediation stipulates that the mediator is always positioned in the path of a causal chain (Jung, 2021) as illustrated in Figure 15.

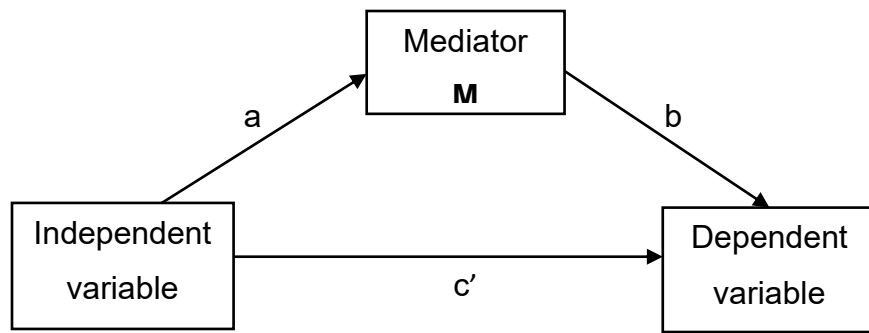


Figure 15: Conceptual model for mediation method

The causal step approach uses a series of significance tests to decide the existence of mediated effect (Rijnhart et al., 2021).

However, despite the extensive use and the confidence researchers have in mediation, it is contended and debated from diverse perspectives regarding the best and acceptable method of establishing mediation. In the early days, Baron and Kenny (1986) proposed various principles for establishing mediation; the independent variable must have an effect on the dependent and the mediator variable in a statistical model, (i.e. both a and b be statistically significant and c' must be approximately equal to zero, then M is recognised as a mediator of the link between X and Y) (Otuya, 2019). The regression coefficients define the effect and must be analysed in two separate models (Celli, 2022) and the highest degree of mediation effect is when c' is equal to zero (Pardo and Román, 2013).

However, it has been contended that the underlying statistical assumptions and estimation of the relationships between the observed variables may not produce the most accurate results to establish mediation (Laghaie and Otter, 2023). The Baron and Kenny approach to establishing mediation has been criticized for its limited contribution to theory. According to Memon et al. (2018) to analyse the path between X and Y is needless when establishing the mediation effect of M on the relationship between X and Y for the reason

that, that statistical path does not form part of the mediated effect. Thus, testing the significance of the path between X and Y is outmoded and a hindrance to theory.

According to the past literature, once the indirect effect can be established without total or direct effect indicates that depending on total or indirect effect, partial mediation, or full mediation (Rucker et al., 2011). The significance of direct effect after controlling for the mediator variable hinders research progress and theoretical links in the data may be skipped (Rucker et al., 2011). On one hand, amid this theoretical and statistical dilemma, some recent publications support determining the indirect effect using the product-of-coefficient approach or the difference-in-coefficients approach to establish mediation (Rijnhart et al., 2021). Preacher (2015) indicated that the indirect effect can be calculated in two main ways in three-variable mediation models; the product coefficients are represented by $(a \times b)$ and the difference in coefficients is estimated as $(c - c_{_})$.

However, based on other statistical assumptions, some studies suggest that it is unnecessary to calculate the indirect effect using the product coefficients approach. Nonetheless, using the traditional approach, the indirect effect can be estimated by employing modern Structural Equation Modelling (SEM) software that can simultaneously analyse different kinds of variables in a single model. Currently, one of the most dominant methods for examining complex models in social science is SEM. Therefore, determining the direct and indirect effects as well as the mediating effect simultaneously is considered a basic step for examining a complex structural model (Song and Lim, 2015). Statistically, SEM produces limited standard errors and provides broader and deeper theoretical insight due to its ability to capture and estimate relationships efficiently (Iacobucci, 2012).

The mediator models can be analysed by ordinary least squares (OLS) regression or fitted structural equation modelling (SEM) framework (Shi et al., 2023). Using SEM for mediation analysis could be carried out in two major ways: the segmentation approach or the transmitted approach (Memon et al., 2018). With regards to the segmentation method, three hypotheses must be formulated (i.e. X affects M, M affects Y and M mediate the relationship between X and Y). The transmitted approach relies on the formulation of a single hypothesis, (i.e. M mediate the relationship between X and Y), the effect of X on M

and the effect of M on Y is not considered in this mediation analysis method (Rahman et al., 2018).

Based on the research model of the current study, the segmentation approach was adopted to perform the mediation analysis because each of the relationships between the independent variable (X), the mediator (M) and the dependent variable (Y) are important for the theoretical and practical contribution of the study. According to Rahman et al. (2018), the importance of the mediation model in a study is based on the design decisions that are considered during the pre-study period. Based on the previous literature, the link between electronic procurement and supply chain performance is influenced by factors such as supplier efficiency, quality of information and other factors. Therefore, understanding these dynamics in manufacturing in Ghana is good for theory and practice.

Moderation method

From a statistical perspective, moderation represents an idea which postulates that the link between an independent and dependent variable changes in response to the magnitude of a moderator variable. Theoretically, moderators explain “when” and for whom the magnitude of a variable describes better or influences an outcome variable (Memon et al., 2019). The concept of moderation is the act of determining whether a variable has an effect (Hayes and Little, 2018).

For categorical moderator variables (e.g. firm type), the traditional data analysis method of sub-grouping analysis is employed; that is to say, comparing correlations/regressions coefficients in the different subgroups. For continuous variables (e.g. firm resources), usually, studies use moderated multiple regression to create a regression model to predict the outcome of the predictor which contains information on the effect of the moderator Z on the relationship between X and Y (Aguinis et al., 2016). Figure 16 illustrates the concept of moderation; X is the independent variable, Y is the dependent variable and M is the moderator variable.

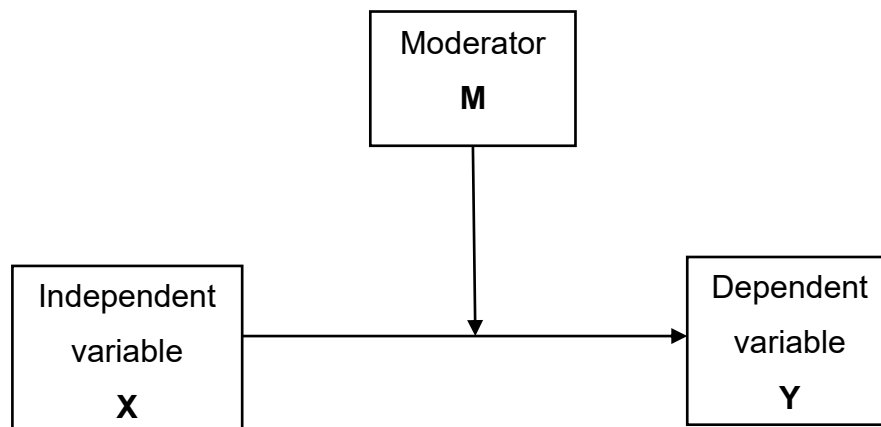


Figure 16: Moderation model

According to the prior literature, moderation analysis must meet certain conditions: (i) X occurs before Y, (ii) MO maintains a causal relationship with Y, (iii) MO plays the same function as X, and (iv) MO does not have any correlation with X (Namazi and Namazi, 2016). One of the dynamic areas of moderation analysis is the choice of method for a research design. Most of the common moderation analysis methods are multi-group, mean, corrected mean, factor score, product indicated and latent product (Pieters et al., 2022).

4.11.4 Structural Equation Modelling

SEM is a multivariate statistical framework that works better for the assessment of complex links between direct and indirect observed variables. It is a general framework capable of solving systems of linear equations simultaneously, involves measurement and structural models and contains statistical techniques such as factor analysis, path analysis and regression (Phiakoksong et al., 2013).

SEM functions through a theorized group of correlated regression equations to determine the links among connected latent and observed variables. Latent variables cannot be quantified but observed variables are measurable, for instance, survey responses can be used to perform diverse regression models in mediation analysis using SEM (Ballen and

Salehi, 2021). SEM comprises of techniques such as regression, factor analysis, path analysis and latent growth curve modelling (Stein et al., 2012).

The two main approaches to SEM are covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM also referred to as PLS path modelling). The CB-SEM is used to accept or reject theories and their hypothesis. CB-SEM determines the hypothesis by looking at the theoretical model's ability to produce the covariance matrix for an observed sample dataset. On the other hand, PLS is a causal-predictive method to SEM which explains the variance of the dependent variable in a model (Hair et al., 2021).

The current study employed covariance-based structural equation modelling with reflective measurement. According to Zhang et al. (2021), CB-SEM with reflective measurement estimates constructs as common factors with the assumption that they cause their indicators and is the most commonly used approach in organisational and management research and flexible to use. The five logical steps for performing SEM identified by Fan et al. (2016) were followed to perform SEM in this study: (i) model specification, (ii) identification, (iii) parameter estimation, (iv) model evaluation and (iv) model modification.

4.11.4.1 Overview and rationale for using SEM

Structural equation modelling is now one of the main techniques for testing and analysing relationships among latent variables (Deng et al., 2018) and its usage in management research continues to increase at a significant pace (Zakrzewska-Bielawska et al., 2022). SEM is flexible and its framework can contain multiple measurements by examining complex designs, multi-groups and the like (Verdam et al., 2021). SEM provides reliable measurement models that researchers use to assess relationships among constructs in the observed indicator variables and examine theoretical links of interest instead of observed relationships full of biased measurement errors (Zyphur et al., 2022). Based on the reliable and valid data analytical capabilities and results offered by SEM, the users of the research presented in this thesis are offered a valid and robust contribution for theory building and practice.

4.12 Research Ethics

Demonstrating integrity in research means acting in response to ethical principles. Some of the ethical principles in science are honesty, openness, due care, fair credit, respect for peers, and students, research subjects and the law and social responsibility (Resnik, 2013). Mostly, using the right research methodology and methods to adhere to ethical considerations in carrying out research (Fleming, 2018). One of the ethical issues of research is the use of human participants, the human volunteers must voluntarily take part in a study when they have been properly educated about the study. Therefore, research that involves human and animal participants requires ethical clearance and it's a strict requirement (Sivasubramaniam et al., 2021).

The current research obtained ethics approval from the ethics committee of Brunel University, London. Participants of this study were informed about the purpose of the study and were asked for their voluntary participation (see appendix 7). The data collection process adhered to the Right to Information Act, 2019 (Act 989) of Ghana which allows citizens to have access to information. Moreover, the Data Protection Act, 2012 (Act 843) of Ghana guided the collection, use, disclosure and care of your data or information by a data controller or processor. Based on this Act, the researcher should maintain research ethical standards not disclosing any information or data that has been provided through the questionnaire to any third party except the supervisors of the thesis.

4.13 Summary

This chapter has elaborated the research paradigm in which various ideologies and pillars of research were discussed in detail, followed by research approaches which focus on deductive and inductive reasoning. Data collection methods, tools and analysis procedures are accounted for were presented and discussed. The chapter closes with the justification of using the various approaches, techniques and tools including ethical considerations which concern respondents' voluntary participation and the duty of the researcher to protect information gathered from leaking to unapproved sources.

CHAPTER 5

DATA ANALYSIS AND INTERPRETATION

5.1 Introduction

The previous chapter explained the methodology adopted to collect the study data. This chapter presents the findings of the data analysis. The chapter proceeds as follows. Section 5.2 presents the characteristics of the study sample. Section 5.3 elaborates the demographic information and the descriptive statistics of the study variables. Section 5.4 explains the process of cleansing the data, which included examining missing data and test for randomness, identification of outliers, common method bias, early and late response bias, test for normality, test for linearity and collinearity test. Section 5.5 offers the Kaiser-Meyer Olkin (KMO) test, 5.6 is the assessment of the reliability and validity of the measurement scale. Section 5.7 focuses on the evaluation of the measurement model, 5.8 explains the construction and evaluation of the structural model, which is followed by summary of the chapter presented in section 5.9.

5.2 Study Sample

The research sample comprised of 600 employees selected from 30 manufacturing companies within the manufacturing sector in Ghana. These companies engage in the production of general goods, food and beverage/drinks, Pharmaceuticals, rubber/plastics, non-metallic manufacturing, Metals and metal products, electronic/electrical manufacturing, machinery/equipment, furniture manufacturing and are located in Greater Accra and Ashanti regions in Ghana. Specifically, the president, managing director, CEO, operations/production manager/senior officer, manufacturing manager/senior officer, procurement manager/senior officer, supply chain/logistics managers/senior officer, information technology manager/senior officer and other senior managers/deputy managers were purposively selected to answer the questionnaire. Accordingly, 20 employees were selected from each company to receive the questionnaire.

Through electronic mail, questionnaires were distributed to the 600 employees working in the thirty manufacturing companies. Out of the 600 questionnaires, 439 participants answered representing a response rate of 73.16%. The response rate was compared to response rate of Mishra et al. (2013) 21.2%, Yu et al. (2015) 20% and Alnuaimi et al. (2021) 70% who conducted studies on electronic procurement and supply chain performance. Compared to these studies, the response rate of the current study is high, it is however attributed to the assurance of keeping the responses confidential, the laws in Ghana regarding right to information and data protection. Additionally, based on Frohlich (2002) the respondents were encouraged at the initial stage by explaining the importance of the study to the manufacturing and other sectors

5.3 Demographic Information

Table 16 presents the profile of the sample in terms of the participant's position (job title), their years of work experience, industry sector, level of education, and firm size. The results show that supply chain/logistics managers/senior officers constituted the largest group of the respondents (n= 121, representing 27.6%). The next highest number of responses were provided by manufacturing managers/senior officers (n=100, 22.8%), then procurement managers (n=79, 18%), followed by operations/production managers/senior officers (n=62, 14.1%) and information technology managers (n=53, 12.1%). President/managing director/CEO/ senior officers represented (n= 18, 4.1%) and "other" comprising of two (2) managing partners, one (1) senior account manager and three (3) quality assurance managers (n=6, 1.4%) of the sample. In terms of years of work experience, the highest percentage (55.8%, n=245) fell within the range of 3-6 years. Work experience of 7-10 years was the next largest range (N=135, 30.8%). Participants with more than 10 years of experience constituted 4.6% (n=20). Work experience of less than 3 years was reported by less than one tenth of the sample (n=39, 8.9%). Regarding industry type, food and beverage/drinks manufacturing is the highest (n=157, 35.8%). The next highest is Pharmaceuticals (n=103, 23.5%), followed by chemical, rubber, plastics, non-metallic manufacturing 13% (n=57).

Metals and metal products constituted 10% (n=44), next is electronic/electrical manufacturing reported 9.1% (n=40) and machinery, equipment, furniture manufacturing employees participated were 8.7% (n=38). Considering the firm size in terms of employees, the highest percentage (55.6%, n=244) was within the range of 101-500 employees. Companies with the number of employees from 501-1000 was the next largest group (n=141, 32.1%). Participants who are in companies with less than 100 employees reported 9.8% (n=43) and companies with more than 1000 employees constituted 2.5% (n=11). Finally, about level of education, Bachelor's degree holders are the largest group of the participants (n=220, 50.1%), followed by those with Master's degree (n=160, 34.4%). Participants with Diploma constituted 12.8% (56) and Doctorate degree were 0.5% (n=2) and respondent with other education degrees was (n= 1, 0.2%).

Table 16: Respondent's demographic information

Indicators	Categories	Frequency	Percentage (%)
Job title	President/Managing Director/ CEO	18	4.1
	Operations/Production manager/senior officer	62	14.1
	Manufacturing manager/Senior officer	100	22.8
	Procurement manager/Senior officer	79	18
	Supply chain/Logistics manager/Senior officer	121	27.6
	Information technology manager/Senior officer	53	12.1
	Others	6	1.4
	TOTAL	439	100
Years of work experience	Less than 3 years	39	8.9
	3-6 years	245	55.8
	7-10 years	135	30.8
	More than 10 years	20	4.6
	TOTAL	439	100

Industry type	Electronic/Electricals manufacturing	40	9.1
	Food and Beverage, Drinks manufacturing	157	35.8
	Pharmaceuticals	103	23.5
	Metals and metal products manufacturing	44	10
	Chemical, Rubber, Plastics, Non-metallic manufacturing	57	13
	Machinery, Equipment, furniture manufacturing	38	8.7
	TOTAL	439	100
Level of education	Diploma	56	12.8
	Bachelor's degree	220	50.1
	Master's degree	160	36.4
	PHD (Doctorate degree)	2	0.5
	Others	1	0.2
	TOTAL	439	100
Number of employees (Firm's size)	Less than 100	43	9.8
	101-500	244	55.6
	501-1000	141	32.1
	More than 1000	11	2.5
	TOTAL	439	100

This section discusses the mean, standard deviation, skewness and kurtosis of the independent variable (electronic procurement), mediating variables (supplier efficiency and quality of information), moderators (perceived ease of use, perceived usefulness and top management support) and the dependent variables (supply chain performance). Five out of the seven variables were measured on 5-points Likert scale ranging from strongly disagree to strongly agree (supplier efficiency, perceived ease of use, perceived

usefulness, quality of information and top management support). Electronic procurement was assigned responses ranging from no use to extensive use while supply chain performance responses began with highly unsatisfactory to highly satisfactory.

5.3.1 Descriptive statistics of the independent variable

The study sought to examine the effect of electronic procurement on supply chain performance in the manufacturing sector in Ghana. Electronic procurement is the independent variable and it reflects five key procurement practices that are delivered through electronic means to suppliers as electronic ordering, payment, inventory information, product specification and product planning information. Electronic procurement was evaluated with five indicators (EP1, EP2, EP3, EP4, and EP5). The descriptive statistics of the independent variable is presented in table 17.

Table 17: Descriptive statistics of the dependent variable

Construct	Mean	Std. deviation	Skewness	Kurtosis
Electronic procurement				
EP1 Electronic ordering to our suppliers	4.21	0.92	-1.16	0.82
EP2 Electronic payment to suppliers	4.17	0.75	-0.93	1.59
EP3 Provision of inventory information to suppliers	4.10	0.86	-0.75	0.13
EP4 Provision of required product specifications to suppliers	4.07	0.84	-0.86	0.62
EP5 Provision of production planning information to suppliers	4.18	0.82	-0.87	0.54

The descriptive statistics indicate that ‘electronic ordering to our suppliers’ and ‘provision of production planning information to suppliers’ have the highest score of 4.21 and 4.18 respectively. This is the most implemented electronic procurement practices among the manufacturers and probably can be attributed to frequency of usage, access to timely information and efficiency of the electronic ordering system. This is followed by ‘electronic payment to suppliers’ and ‘provision of inventory information to suppliers with mean

scores of 4.17 and 4.10 respectively. Finally, the less implemented practice was ‘provision of required product specifications to suppliers’ with mean score of 4.07. This can be probably attributed to the efficiency and urgency of getting access to product specifications from the manufacturers.

5.3.2 Descriptive statistics of the mediating variables

The study intended to examine the mediating role of supplier efficiency and quality of information on the relationship between electronic procurement and supply chain performance. The participants were asked to declare their intention on availability of quality of information and how suppliers’ ability to perform their roles effectively can coordinate e-procurement practices and supply chain performance. Accordingly, supplier efficiency were measured with five (5) indicators (SE1, SE2, SE3, SE4 and SE5), and quality of information was evaluated with five (5) indicators (QI1, QI2, QI3, QI4, and QI5). Table 18 presents descriptive statistics on supplier efficiency and quality of information.

Table 18: Descriptive statistics on the mediating variables

Construct	Mean	Std. deviation	Skewness	Kurtosis
Supplier Efficiency				
SE1 Maintenance of quality standards of materials for processing	4.00	0.98	-0.79	-0.33
SE2 Supply of materials at minimum possible cost	4.02	0.79	-0.52	-0.10
SE3 Supply of right quantity of materials for processing	4.05	0.83	-0.77	-0.57
SE4 Timely supply of materials according to specifications	4.00	0.86	-0.69	-0.02
SE5 Effective communication to supplies for continuous improvement	4.17	0.85	-1.04	1.24
Quality of information				
QI1 The information exchanged between our company and its suppliers is relevant	4.37	0.76	-1.14	1.12

Q12	The information that our company and its suppliers exchange is timely	4.22	0.80	-0.91	0.54
Q13	The information that our company and its suppliers exchange is accurate	4.15	0.76	-0.84	0.04
Q14	The information that our company and its suppliers exchange is confidential	4.14	0.81	-0.77	0.25
Q15	The information that our company and its suppliers exchange is complete	4.33	0.74	-0.69	0,10

For quality of information construct, the results indicate that 'information exchanged between our company and its suppliers is relevant' has the highest mean of 4.37 and followed by 'information that our company and its suppliers exchange is complete with second mean score of 4.33 and then information that our company and its suppliers exchange is timely 4.22. These values suggest that information exchange between the company and suppliers electronically is key to improving the tie between electronic procurement and supply chain performance in the manufacturing sector. The information that our company and its suppliers exchange is accurate has a mean score of 4.15 and the information that our company and its suppliers exchange is confidential is 4.14 was the less enhanced practice. Though these scores are above the scale average score, probably, the parties to the procurement have a challenge with how the manufacturers handle business related information.

Under supplier efficiency construct, 'effective communication to suppliers for continuous improvement' obtained the highest mean of 4.17, followed by 'supply of right quantity of materials for processing' mean score of 4.05. These two dimensions are the most enhanced practices, indicating that informing suppliers about improvement in products and services and providing right materials for production are key to bridging the link between electronic procurement and supply chain performance among the manufacturers. Supply of materials at minimum possible cost scored 4.02, maintenance of quality standards of materials for processing 4.00 and timely supply of materials according to specifications 4.00 have low mean score but above the average scale mean. These three dimension have not received greater consideration, therefore the suppliers

are reminded to give close attention to quality standards, timing and cost associated with materials.

5.3.3 Descriptive statistics of the moderating variables

One of the key objectives of the study is to examine the moderating effect of perceived ease of use, perceived usefulness and top management support on the relationship between electronic procurement and supply chain performance. Perceived ease of use reflects five (5) indicators (PEU1, PEU2, PEU3, PEU4 and PEU5), perceived usefulness three (3) indicators (PU1, PU2 and PU3), and top management support three (3) indicators (TM1, TM2, and TM3). Table 19 provides a descriptive statistic on the indicators of perceived ease of use, perceived usefulness and top management support.

Table 19: Descriptive statistics of the moderating variables

	Construct	Mean	Std. deviation	Skewness	Kurtosis
	Perceived ease of use				
PEU1	Learning to use e-procurement systems is easy for me	3.48	1.19	-0.15	-1.40
PEU2	My interaction with e-procurement system is clear and understandable	3.70	0.98	-0.45	-0.22
PEU3	Using e-procurement systems will enhance the performance of my procurement tasks	3.73	1.03	-0.77	0.06
PEU4	Training users of an e-procurement system will be easy for our organisation.	3.74	0.99	-0.49	-0.55
PEU5	Training competent personnel to support an e-procurement system will be easy.	3.94	0.93	-0.85	0.50
	Perceived usefulness				
PU1	Using e-procurement systems increases my job performance	3.68	1.13	-0.45	-1.14
PU2	Using e-procurement systems increases my job productivity	3.73	1.01	-0.54	-0.15
PU3	Using e-procurement systems enhances my job effectiveness	3,79	1.12	-0.82	-0.07
	Top management support				

TM1	Top management is decisive in providing the needed financial resources to implement e-procurement systems	3.94	1.11	-0.66	-0.67
TM2	Top management considers the use of electronic procurement a priority in our firm.	3.89	0.94	-0.76	0.28
TM3	Top management considers that our firm must adapt itself to the new IT systems in procurement.	3.98	0.94	-0.89	0.44

The results indicate that, perceives ease of use indicator ‘training competent personnel to support an e-procurement system will be easy has the highest mean score of 3.94, next highest is training users of an e-procurement system will be easy for our organisation 3.74. This is followed by using e-procurement systems will enhance the performance of my procurement tasks is 3.73. My interaction with e-procurement system is clear and understandable is 3.70 and learning to use e-procurement systems is easy for me 3.48.

Perceived usefulness indicator ‘using e-procurement systems enhances my job effectiveness’ is the most observed practice with mean score of 3.79 and the next enhanced practice is using e-procurement systems increases my job productivity 3.73. Using e-procurement systems increases my job performance item is low enhanced practice with mean score of 3.68. Regarding top management support construct, top management considers that our firm must adapt itself to the new IT systems in procurement is higher than the scale average score of 3.98. Top management is decisive in providing the needed financial resources to implement e-procurement systems is 3.94 and top management considers the use of electronic procurement a priority in our firm is 3.89. These items mean scores are higher than the scale average score, indicating that the activities of top management is recognised by the parties of the electronic procurement system and supply chain activities of the manufacturing companies.

5.3.4 Descriptive statistics of the dependent variable

The study sought to determine the effect of electronic procurement on supply chain performance. The dependent variable (supply chain performance) reflects six indicators (SCP1, SCP2, SCP3, SCP4, SCP5, and SCP6) that represent practices for determining

the level of productivity of the supply chain of the manufacturing companies. Respondents were asked to affirm their intention on the indicators through 5-points Likert scale ranging from highly unsatisfactory to highly satisfactory. Table 20 presents the descriptive statistics of the independent variable.

Table 20: Descriptive statistics of the dependent variable

Construct		Mean	Std. deviation	Skewness	Kurtosis
Supply chain performance					
SCP1	Increased flexibility	3.68	1.03	-0.40	-0.88
SCP2	Increased resource efficiency	3.73	1.02	-0.54	-0.57
SCP3	Decreased costs in supply chain	3.77	1.05	-0.54	-0.49
SCP4	Reduced delivery time	3.79	0.99	-0.49	-0.66
SCP5	Increased delivery reliability	3.85	0.99	-0.64	-0.27
SCP6	Increased visibility	3.92	0.98	-0.74	0.06

The results show that ‘increased visibility’ and ‘increased delivery reliability’ obtained mean score of 3.92 and 3.85 respectively. This is followed by ‘reduced delivery time’ with mean score of 3.79. The next indicator is ‘decreased costs in supply chain scored 3.77, increased resource efficiency is 3.73 and increased flexibility is 3.68. The mean score of all the indicators are above scale average scores, showing that the supply chain practices of the manufacturing companies are observed above average by the parties of the supply chain.

5.4 Data Cleansing

Based on Podsakoff et al. (2003), Tabachnick and Fidell (2013) and Hair et al. (2014), to achieve a valid and reliable results, eight (8) key statistical approaches were employed to clean the data (1) data coding and screening (2) missing data evaluation (3) identification of outliers (4) non-response bias test (5) common method bias test (6) test for normality univariate (7) linearity test (8) collinearity test. These operations were performed using SPSS version 29.

5.4.1 Data coding and screening

Using the Pallant (2013) approach of data coding, three steps were followed. (Step 1) a code book was prepared to assist in transporting the field data into the data window. The variables were defined, labelled and numerical code (1-5) were assigned to the answers categories (strongly disagree to strongly agree, no use to extensive use, highly unsatisfactory to highly satisfactory) for each question of the survey. (Step 2) the original data file was crosschecked with the copy of the data file in the data window to make sure there were no discrepancies as recommended by Tabachnick and Fidell (2014). (Step 3) descriptive statistics was used to examine the statistical features of the observations of the variables (demographics, electronic procurement, perceived ease of use, perceived usefulness, supplier efficiency, quality of information, top management support and supply chain performance) based on Tabachnick and Fidell (2014).

5.4.2 Missing data evaluation and test for randomness

The data cleansing process began with detecting for the presence of missing data. Missing data refers to the unavailability of information on a subject but other information about this same variable is present and it happens when participants respond to some of the questions and ignore others (Hair et al., 2014). Accordingly, two key issues connected to missing data were investigated: pattern of missing data (level of randomness) and volume of the missing data (Hair et al., 2014). The present study took steps to identify missing data to: (1) find the pattern and relationships underlying the missing data (level of randomness) to maintain the original distribution of the data. For randomness, the intension was to detect missing at random (MAR) and missing completely at random (MCAR) (Hair et al., 2010). (2) Avoid limited sample size and biased results (Hair et al., 2014). A randomly distributed missing through a data set indicates minimum issues whereas dispersed non-random missing data leads to biased results (Hair et al., 2014). The descriptive statistics indicated, however, that there are no missing data demonstrated in Table 21. Accordingly, it was not necessary to calculate the pattern/volume statistics (level of randomness). The absence of missing data is attributed to measures that were taken at the questionnaire design stage. Based on Patton (2014) respondent fatigue

which influences them to skip and fail to complete the questions was minimised by designing short questions and they were informed that short time was needed to complete it. Additionally, technical jargons were removed to make it simple for respondents to understand the questions without difficulty.

Table 21: Missing data statistics

Constructs	Valid		Cases missing		Total	
	N	Percent	N	Percent	N	Percent
E-procurement	439	100%	0	0%	439	100%
Supplier efficiency	439	100%	0	0%	439	100%
Perceived ease of use	439	100%	0	0%	439	100%
Perceived usefulness	439	100%	0	0%	439	100%
Quality of information	439	100%	0	0%	439	100%
Top management support	439	100%	0	0%	439	100%
Supply chain performance	439	100%	0	0%	439	100%

5.4.3 Identification of outliers

Outliers are observations that are doubtful because they fall below or above majority of the observations (Cousineau and Chartier, 2010). According to Tabachnick and Fidell (2014), outliers are those observations with standardised scores of ≥ 3.29 . According to Hair et al (2014) outliers can happen as a result of coding and entry mistakes. Based on Pallant (2013), a code book was prepared to assist in transporting the raw data into SPSS. The present thesis tested and identified outliers to avoid Type I and II errors which can potentially lead to false negative or false positive when confirming the hypotheses (Tabachnick and Fidell, 2014),

To detect for potential outliers, all raw data was transformed into standardised scores (mean of 0 and a standard deviation of 1) (Hair et al., 2014: Tabachnick and Fidell, 2014). The results in Table 22 shows no presence of outliers because all the values of the constructs fall between 2.733 and -1.801.

Table 22: Z-scores for outliers

Construct	Z-score high values	Z-score low values
E-procurement	2.405	-1.080
Supplier efficiency	2.487	-1.598
Perceived ease of use	2.733	-1.105
Perceived usefulness	1.838	-1.512
Quality of information	2.071	-1.801
Top management support	1.848	-1.694
Supply chain performance	2.729	-1.017

5.4.4 Non-response bias test

Non-response bias occurs when the respondents who complete a questionnaire differ from those who received it but chose not to participate (Collis and Hussy, 2014; Groves, 2006; Lynn, 2012). This bias can impact the ability to generalize findings from the sample to the broader population (Bryman and Bell, 2015; Heffetz and Reeves, 2019). To investigate non-response bias, the study employed the successive waves method proposed by Armstrong and Overton (1977), which is useful when responses come in waves due to an external stimulus. This method assumes that later respondents are more similar to non-respondents since they may have been motivated to answer by an increased stimulus.

Following a follow-up email, the responses of late participants were compared to those of early respondents regarding E-procurement ($p=0.07$) and quality of information ($p=0.31$), indicating that non-response bias was not a concern in this study. Additionally, demographic data was analyzed to compare job roles, job experience, and educational qualifications between respondents and non-respondents. The t-test results showed no significant differences in job role ($p=0.50$), job experience ($p=0.38$), and educational qualifications ($p=0.12$) respectively between the two groups, further confirming that non-response bias was not an issue. Overall, the findings suggest that the results can be generalized to large manufacturing firms in Ghana.

5.4.5 Common method bias

Common method variance happens when there is a variation in the responses due to the use of common scaling technique on measures obtained from a single factor source leading to measurement errors (Fuller et al., 2016). Based on Podsakoff et al. (2003) at early stage of questionnaire development, measures were taken to minimise common method bias when experts examined content validity of the instrument: (1) the scale items were improved by removing ambiguous and unfamiliar statements. (2) The questions were kept simple, concise, specific and complex syntax were avoided. (3) Double-barreled and vague questions were completely eliminated.

The present thesis examined common bias to avoid measurement errors that can impact the validity, conclusions and the relationships between the measures (Podsakoff et al., 2003). Accordingly, Harman's single-factor test was applied to determine if a single factor dominates the factor analysis or one of the factors account for the majority of the covariance among the measures (Harman, 1967). Due to the multiple constructs of the study, the responses were computed as variables and the principal component axis and unrotated factor solution were utilised. Among the seven constructs, e-procurement accounted for only 39.689 of the variance among the construct's contrary to the basic assumptions of the presence of common method bias shown in Table 23. According to Crick (2024) if a component accounts for approximately 50% of the total variance, common method bias is likely to be present. Based on this, there is absence of common method bias since no single factor accounted for majority of the variance.

Table 23: Harman's single test for common method bias

		Initial eigenvalues		Extraction sum of squared loadings		
		% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.312	47.318	4.318	2.778	39.689	39.689
2	1.154	16.491	63.809			
3	0.860	12.282	76.091			
4	0.534	7.624	83.715			
5	0.460	6.570	90.285			
6	0.384	5.487	95.772			
7	0.296	4.228	100.000			

5.4.6 Test for normality univariate

In multivariate analysis, one of the key issues is normal distribution (Gaussian distribution) of data of which if not properly tested can possibly lead to wrong statistical test (Hair et al., 2014) and one of the procedures is normality test. According to Tabachnick and Fidell (2014), normality assumes that the data for each variable is distributed and the linear combination of variables is distributed, thus normality of data can be tested at univariate level (single item-level) and multivariate (combination of many items-level). Accordingly, if conditions of normality of the items are met at multivariate level, it shows that the assumption of univariate has been met (Hair et al., 2014). The current study tested the field data for extreme non-normality to reduce the standard errors attained from the bootstrapping process as recommended in Hair et al. (2014).

Normality was examined by calculating the values of Skewness and kurtosis to determine if the data is normally distributed. Kurtosis shows the peak and flatness of the distribution whereas skewness represents the height and describes the balance of the distribution (Hair et al., 2014). The kurtosis value for normal distribution is 0 with observation gathered at the centre, the peak of positive kurtosis is higher than normal distribution with

observation shifted to the left. A distribution with negative kurtosis is flatter with the distribution shifted to the right with fewer observation gathered in the centre (Collis and Hussey, 2014).

The literature indicates that the threshold values of kurtosis and Skewness is determined by the sample size: thus, sample size above 300 kurtosis values should fall between -7 and +7 and Skewness values should fall between -2 and +2. Thus, absolute values larger above 2 for Skewness and absolute kurtosis greater than 7 represent non-normality (Kim, 2013). Based on this, using descriptive statistics default in SPSS, Skewness and kurtosis values of the data were examined (Collis and Hussey, 2014). The results in table 24 indicate that all the variables were positively skewed to the left. This shows a lower value than the average score of the scale. The results further indicate that all the variables scored negative kurtosis values except perceived ease of use (0.244) and supply chain performance (0.911).

The negative kurtosis value portrays a flatter distribution when compared to the normal distribution. The positive kurtosis values of perceived ease of use and supply chain performance on the other hand indicate a peak distribution of the data. Therefore, the absolute values of kurtosis and Skewness of the present data are within the acceptable range, indicating that the data is normally distributed.

Table 24: Test for normality

CONSTRUCT	SKEWNESS		KURTOSIS	
	Statistic	Std. error	Statistic	Std. error
Electronic procurement	0.223	0.117	-0.352	0.233
Supplier efficiency	0.482	0.117	-0.304	0.233
Perceived ease of use	0.918	0.117	0.244	0.233
Perceived usefulness	0.240	0.117	-0.969	0.233
Quality of information	0.382	0.117	-0.433	0.233
Top management support	0.006	0.117	-0.994	0.233
Supply chain performance	1.428	0.117	0.911	0.233

5.4.7 Test for linearity

The data cleansing exercise proceeded with testing the linearity of the data to determine the correlation and pattern of the data using scatterplot matrix. Linearity is the presence of straight line that define the relationship between two variables (Tabachnick and Fidell, 2014). A scatterplot matrix shows pair wise variables of all the characteristics in a matrix of panels (Nguyen et al., 2020). The evaluation of correlation between the variables is used in this study as foundation for factor analysis (Harman, 1967) and structural equation modelling (Hair et al., 2014). According to Tabachnick and Fidell (2014) determining the linearity between variables is relevant because correlations will not be calculated for unforeseen nonlinear relationships and ignoring linear relationship results in limited estimation of strength of relationships. The results of the scatterplot was assessed by three parameters: the direction, form and strength of the correlation between the variables. In figure 17 the slop of the scatterplot reveals a significant positive association between the constructs: e-procurement, supplier efficiency, perceived ease of ease, perceived usefulness, quality of information, top management support and supply chain performance. These variables are paired on the vertical and the horizontal lines.

However, the slope of the line between top management support and quality of information is straight, showing a weak correlation between them. The number of these associations constitute small part of the entire relationships in the scatterplot while majority are strong and positive. Therefore, the degree of correlation between the constructs confirms a good pattern in the data.

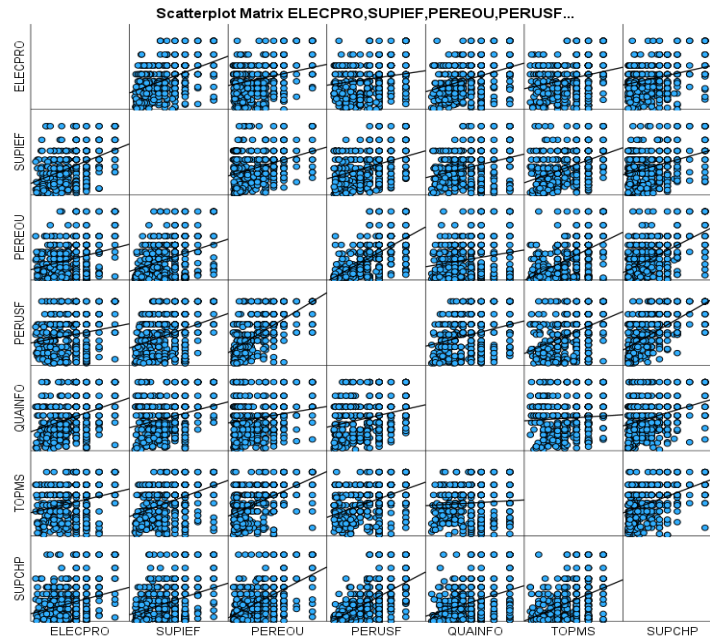


Figure 17: Test for linearity

5.4.8 Multicollinearity test

The final stage of the data cleansing focused on testing for multi collinearity by looking at tolerance and Variance Inflation Factor (VIF). According to Hair et al. (2014) multicollinearity is the presence of unusual high correlations among the exogenous variables. It is the degree at which one variable can be explained by the other variable in the analysis (Hair et al., 2010).

The current thesis tested collinearity because its existence between two variables can unnecessarily increase the size of standard errors for the regression coefficients, lead to Type II error and interpretational challenges (Hair et al., 2021). Variance inflation factor measures the degree of the variance of the estimated regression coefficient inflation when the independent variables are correlated and tolerance is the inverse of the variance inflation factor (Shrestha, 2020). Tolerance measures the degree at which the coefficient of determination between variables weight is close to 1 or 0 (Oke et al., 2019). Also, $VIF \geq 5$ indicate that there is a higher possibility of presence of serious collinearity, $VIF = 3-5$

raises minimum collinearity problem and $VIF < 3$ represent absence of collinearity (Hair et al., 2021). Therefore, VIF values and coefficients of tolerance in Table 25 Shows that the variables are moderately correlated, thus collinearity is not a challenge.

Table 25: Multicollinearity test

Independent variables	Collinearity statistics	
	Tolerance	VIF
E-procurement	0.717	1.395
Supplier efficiency	0.665	1.504
Perceived ease of use	0.470	2.127
Perceived usefulness	0.505	1.980
Quality of information	0.792	1.263
Top management support	0.624	1.603

5.5 Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity

To fulfill a statistical assumption before factor analysis, it was important to examine the presence of adequate sample in order to generate correlation matrix (Hair et al., 2014).

As a result, the adequacy of the observed variables used tested through Kaiser-Meyer-Olkin (KMO) (Kaiser, 1974). According to Tabachnick and Fidell. (2014), KMO shows the total of squared correlations to the sum of squared correlations added to the sum of squared partial correlations. Kaiser (1974) suggested that KMO value varies between 0 and 1, higher value shows that the sample is adequate for testing correlation matrix and further recommended that KMO of 0.50 or higher indicates adequacy of the observed variables. Based on this threshold, the KMO value of 0.80 in Table 26 suggests that the observed variable correlates adequately. Therefore, the results can be used as a basis to perform further analysis to understand whether the correlation among the observed variables are adequate factor analysis.

Table 26: KMO test and Bartlett's Test of Sphericity

TEST	Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.80
Approx. Chi-Square	1038.85
Bartlett's Test of Sphericity df	21
Sig.	<.001

The determine the presence of adequate amount of correlation among the observed variables to carry out factor analysis, Bartlett's (1954) test of Sphericity was employed based on Hair et al., (2014). Before the analysis, it is important to note that Bartlett's test of Sphericity is more sensitive to determining the correlation among the variables when the sample size is large (Hair et al 2010). Also, Tabachnick and Fidell (2014) recommended to use Bartlett's test of Sphericity when the observations are less than 5 for each variable. This provides the basis for the current study to use Bartlett's test of Sphericity to determine whether the null hypothesis which postulates that the observed variables are not correlated in the population should be accepted or rejected.

Bartlett's test of Sphericity significant at ($p \leq 0.05$) indicate that the null hypothesis is not correct and the observed variables are correlated in the population. Contrary, the observed variables are not correlated in the population if the test is not significant at ($p > 0.05$) (Tabachnick and Fidell, 2014). Based on these recommendations, the results indicate that the p-value (<0.05) confirming that the present study meets both statistical and theoretical assumptions of factor analysis, thus the data is suitable for data analysis.

5.6 Assessment of validity and reliability of the scales (measurement model)

Scale reliability and validity was carried out through exploratory factor analysis (EFA), Cronbach's alpha, squared factor loadings, composite reliability, average variance extracted (AVE) and square root of AVEs.

To determine validity and reliability of the constructs, factor analysis was performed at the initial stage. Factor analysis is used to handle large sets of data to find new variables that represent what the original variables have in common (Forina et al., 1988). Specifically, exploratory factor analysis (EFA) was carried out to assess the linkages among the measurement items and how they load onto their respective factor (Tabash et al., 2024). EFA is part of the multivariate statistical methods that reveal the association between hypothetical constructs and its dimensions that can explain the covariation observed among a cluster of observed variables (Watkins, 2018). EFA was conducted after the data had fulfilled conditions of randomness, linearity, normality, missing data test as recommended by Watkins (2018).

Accordingly, Varimax rotation method in SPSS was used to determine the factor structure of the items. Varimax was used because it is the renowned orthogonal factor rotation method that has the ability to simplify the columns in a factor matrix and it is considered as superior to the rest of the orthogonal factor rotation methods to attaining a simplified factor structure (Hair et al., 2010). Rotation is the process of manipulating the factor axes to attain a simple and more meaningful factor solution (Hair et al., 2010). Rotation is important for interpretation of the factors by making the structure simple by increasing the significant loadings of the variable on a single factor (Hair et al., 2010). A low level cutoff point of 0.32, 0.40 and 0.45 are recommended by different studies (Howard, 2016) and Hair et al (2010) recommend values above 0.40.

The current thesis tested seven (7) constructs with thirty-two (32) items using 95% as significance level. According to Hair et al. (2010) the significance level should be selected in the process to allow easy interpretation. The extraction method employed was principal component analysis (PCA) in SPSS. PCA takes into consideration the total variance and extract factors that contain small proportions of unique variance and, in some cases error variance (Hair et al., 2010). Under PCA, the area of interest was correlation matrix, unrotated factor solution and the eigenvalue greater than 1 was accepted under extract (Collis and Hussey, 2014). All the seven constructs were single factor (one-dimensional) without multiple indicators. Consequently, through Varimax rotation each construct was

rotated separately to determine their factor structure and values below 0.60 were suppressed. The rotated component matrices in Table 27 indicate that most of the items loaded above 0.60 and items that loaded below 0.60 were deleted. Thus, electronic procurement item 3, supplier efficiency item 2, perceived ease of use item 5 and supply chain performance item 6 were removed and twenty-eight (28) items were maintained for meeting the required threshold.

Table 27: Validity and reliability test

Construct	Indicator	Factor Loadings	Squared Factor Loadings	Alpha	Cr	Ave	Square Root Ave
E-procurement	EP1	0.749	0.561				
	EP2	0.674	0.454				
	EP4	0.717	0.514				
	EP5	0.698	0.487	0.705	0.802	0.504	0.710
Supplier efficiency	SE1	0.766	0.586				
	SE3	0.685	0.468				
	SE4	0.653	0.426				
	SE5	0.630	0.400	0.667	0.779	0.470	0.685
Perceived ease of use	PEU1	0.813	0.660				
	PEU2	0.786	0.617				
	PEU3	0.649	0.421				
	PEU4	0.754	0.568	0.769	0.839	0.567	0.753
Perceived usefulness	PU1	0.844	0.712				
	PU2	0.817	0.667				
	PU3	0.805	0.649	0.759	0.862	0.676	0.822
Quality of information	Q11	0.677	0.458				
	Q12	0.655	0.432				
	Q13	0.667	0.444				
	Q14	0.714	0.509				
	Q15	0.655	0.429	0.699	0.806	0.454	0.674

Top management support	TM1	0.816	0.665				
	TM2	0.761	0.579				
	TM3	0.745	0.555	0.665	0.818	0.600	0.775
Supply chain performance	SCP1	0.729	0.531				
	SCP2	0.764	0.583				
	SCP3	0.718	0.515				
	SCP4	0.686	0.470				
	SCP5	0.694	0.481	0.782	0.842	0.517	0.719

5.6.1 Reliability

Reliability is the ability of a scale to produce accurate and the same results if the research is repeated (Collis and Hussey, 2014). According to Hair et al. (2021) reflective models require two reliability tests: squared loadings (indicator reliability) and composite reliability. However, Cronbach's alpha is important and the most widely used measure (Hair et al., 2010) and as a result was included in the reliability analysis.

Squared loading is the indicator's explained variance by squaring the indicator loading which represents bivariate correlation between the indicators and construct (Hair et al. 2021). Squared factor loadings of the items were used as a reliability measure to confirm indicator reliability of the constructs and its recommended value should be above 0.708 (Hair et al., 2021). The current thesis calculated the indicator reliability matrices by squaring the factor loadings and the values of the squared loadings fell between 0.40 and 0.71. The indicators' with values within this range should only be considered for deletion if it can maximize the internal consistency reliability or convergent validity of the scales though the recommended cutoff point is 0.708 (Hair et al., 2021), Based on this, the items were maintained because convergent validity and internal consistency of the constructs will be disturbed upon deletion. The internal consistency test was carried out by calculating the reliability of the composite of all the measurement items using the factor loading (Hair et al 2021).

Composite reliability (ρ) is the ratio of the squared sum of the indicators' standardised loadings to the squared sum of the indicators' standardised plus the sum of their variance of the measurement error (Bagozzi and Yi, 1988). The current thesis tested composite reliability to measure the degree of association of the items measuring the same construct to help avoid inflated correlations in the error terms of the indicators (Hair et al., 2021). The recommended values between 0.60 and 0.70 are considered acceptable, higher values between 0.70 and 0.90 represent satisfactory to good and values above 0.90 to 0.95 is a problem because it indicate that the items are redundant, thus reduce construct validity (Hair et al., 2021), The composite reliability values in Table 28 indicate that the lowest value is 0.779 and the highest is 0.862 confirming good internal consistency of the scale.

Cronbach's alpha of the measurement items were estimated as one of the means of the reliability of the measurement instruments. Cronbach's alpha is the statistical estimate of the reliability that uses the correlations among the observed indicator (Hair et al., 2021). It was used to test internal consistency of the measurement items, and its value falls between 0 and 1 (Hair et al., 2010). However, the acceptable alpha value for reliability has attracted diverse views (Bonett and Wright, 2015). Some previous studies suggest a threshold between 0.80 and 0.90 alpha values. (Collis and Hussey, 2014). However, the agreed low cutoff point is 0.70 but can decrease to 0.60 in exploratory research and it is also affected by number of items (Hair et al., 2010). Based on these suggested cutoff points, the alpha values of the present study fall between 0.665 and 0.782, confirming internal consistency of the measurement items of all the constructs.

5.6.2 Validity

Validity is the degree at which a measure or group of measures is the representative of concept of a study (the level at which the measurement does not contain nonrandom error) (Hair et al., 2010). Construct validity is the degree at which a group of measured variables are representative of the theoretical latent construct they are programed to measure (Hair et al., 2010). Construct validity is important for the interpretation of results, thus valid steps are required to make sure the measurement models achieve what it is

designed to measure (Henseler et al., 2015). Based on this, construct validity was established through content, convergent and discriminant validity.

5.6.2.1 Content validity

Content validity is the extent to which association between the items selected forms a summated scale and its theoretical definition (Hair et al., 2010). Content validity of the constructs were examined from two main perspectives: first, based on Hair et al. (2014) the items were selected from previous studies through literature search. The scales have been used in previous and have demonstrated high content validity (Li et al., 2015; Santoso and Besral, 2018; Babatunde et al., 2021; Anin et al., 2020; Ramkumar et al., 2019; Hallikas et al., 2021; Sánchez-Rodríguez et al., 2020). Second, the items were piloted by subjecting it to expert judgment, thus scholars from the field of electronic procurement and supply chain management performed the content validity by ensuring that the items are worded properly and are capable of using it in the domain of the study field.

5.6.2.2 Convergent validity

Convergent validity is the degree to which the construct correlates to explain the variance of the indicators (Hair et al., 2021). To test convergent validity, average variance of the standardised factor loadings were extracted (Hair et al., 2014). Average variance extracted (AVE) measures the total mean value of the standardised squared loadings of all the variables (Hair et al., 2010). Factor loadings show the interrelations between construct and its indicators. If standardised loadings are high, it means that statistically, the indicators and the construct share common characteristics (Hair et al., 2014). AVE is calculated as the sum of the squared loadings divided by the number of indicators (Hair et al., 2021). The recommended cutoff point value is higher than 0.50 (Hair et al., 2021; Khuzainey et al., 2020). Though, the value of AVE should normally be greater than 0.50, it is acceptable to use 0.40 (Huang et al., 2013). The AVE values in Table 28 are all above 0.50 except 0.470 for supplier efficiency and 0.454 for quality of information but these values are close to 0.50.

Therefore, all the constructs converge to explain the variance of their indicators, confirming convergent validity of the measurement instruments.

5.6.2.3 Discriminant validity

Discriminant validity uses matrices to evaluate the degree at which the construct is statistically different from each other construct in the structural model (Hair et al., 2021). Discriminant validity was tested to confirm how the variables are empirically different in measuring a problem of interest that other variables in the model do not (Henseler et al., 2015). Lack of discriminant validity means the constructs influences the variation beyond the observed variables to which they are conceptually associated. This leads to a situation where the results of the structural model become difficult to establish whether the results obtained is valid or due statistical inconsistencies (Henseler et al., 2015).

To test discriminant validity, Fornell-Lacker (1981) technique and Heterotrait-monotrait (HTMT) ratio (Henseler et al., 2015) were employed. At first stage, the Fornell-Lacker criteria require the estimates of the shared variance in the constructs (Fornell-Lacker, 1981). The second stage of the Fornell-Lacker criterion compares the square root of AVEs with the inter-constructs correlations and the square root of the AVEs must be higher than the inter-constructs correlations (Fornell-Lacker, 1981). Based on this, the square root of the AVEs were calculated and compared with the inter-construct correlation matrices. The square root of AVEs in diagonal in Table 28 are higher than the inter-construct correlations. Based on Fornell-Lacker criteria, the constructs have discriminant validity to produce valid structural model results.

Table 28: Discriminant validity analysis based on Fornell-Lacker criterion

	EP	SPE	PEU	PU	QI	TM	SCP
Electronic procurement	<i>0.710</i>						
Supplier Efficiency	.376**	<i>0.685</i>					
Perceived Ease of Use	.257**	.286**	<i>0.753</i>				
Perceived Usefulness	.182**	.290**	.682**	<i>0.822</i>			
Quality of Information	.326**	.220**	.180	.279**	<i>0.674</i>		
Top Management Support	.236**	.399**	.539**	.452**	.069	<i>0.775</i>	
Supply Chain Performance	.221**	.259**	.602**	.634**	.323**	.458**	<i>0.719</i>

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Numbers in italics are square root of AVE's

The second method of validity test is Heterotrait-monotrait (HTMT) ratio recommended by (Hair et al., 2021). HTMT was basically introduced to handle discriminant validity issues in variance-based SEM like Partial Least Square structural equation modeling (PLS-SEM) which can produce higher factor loadings that can increase the AVE values (Henseler et al. (2015). The overestimation of the factor loadings and its impact on the AVE can influence capabilities of Fornell and Larcker's technique to reveal discriminant validity violations (Voorhees et al., 2016). However, Fornell and Larcker's technique and HTMT are efficient in identifying violation, thus using these techniques together can provide most rigorous assessment of discriminant validity (Voorhees et al., 2016). The HTMT approach involves the estimation of a ratio of the average correlations of the measurement items across constructs to the means of the average correlation of the items within construct (Henseler et al., 2015). The key statistical requirement to fulfil discriminant validity through this method is that the interrelations of the indicators of the construct should be stronger than the indicators across the constructs (Henseler et al., 2015). The HTMT method suggests that HTMT ratios higher than 0.85 represent lack of discriminant validity (Henseler et al., 2015).

Based on this recommended HTMT ratio limit, the results in table 29 show that all the values are below 0.85, confirming discriminant validity of the constructs.

Table 29: Discriminant validity analysis based on HTMT approach

	EP	SPE	PEU	PU	QI	TM	SCP
Electronic procurement							
Supplier Efficiency	.432**						
Perceived Ease of Use	.154**	.281**					
Perceived Usefulness	.147**	.309**	.693**				
Quality of Information	.358**	.224**	.137**	.237**			
Top Management Support	.228**	.422**	.507**	.442**	.057		
Supply Chain Performance	.141**	.217**	.602**	.653**	.246**	.426**	

5.7 Evaluation of the measurement model

Confirmatory factor analysis (CFA) was conducted to further test discriminant validity of the measurement model (Hair et al., 2010) using the remaining items that were confirmed and maintained at EFA.

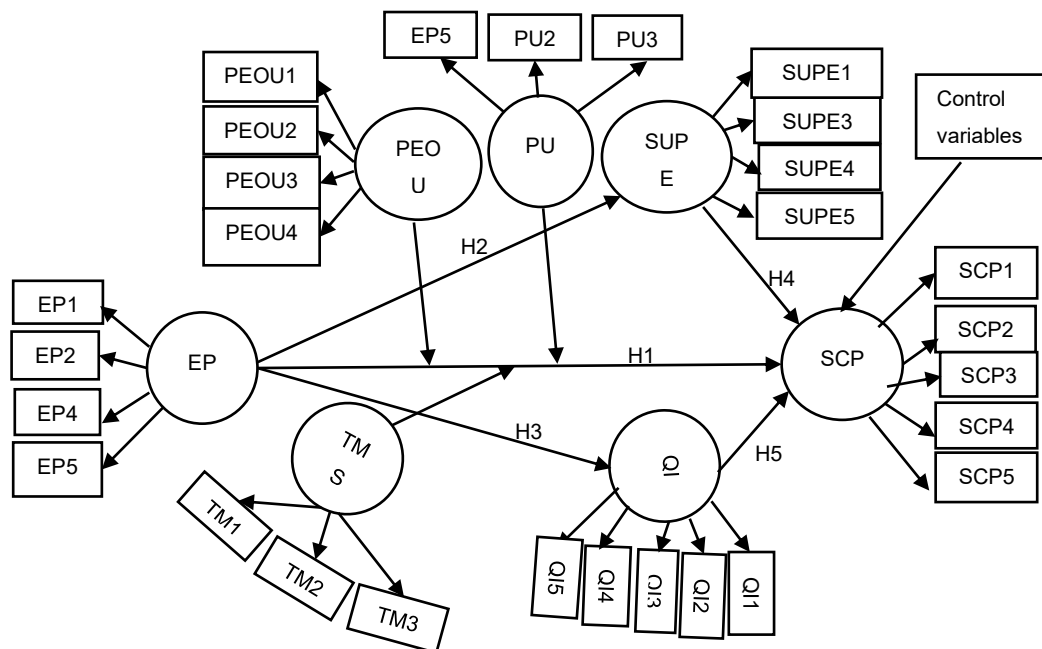


Figure 18: Measurement model

Accordingly, CFA was conducted to test how appropriately the data fitted the proposed structural model (Tavakol and Wetzel, 2020), (see appendix 2). The evaluation proceeded in three steps: model specification, parameter estimation and fit. Figure 18 depicts the measurement model

Step 1. Model specification: Confirmatory factor analysis starts with formal specification of the measurement model (Hoyle, 2004). Firstly, as a reflective model incorporating single factor (vs multi-factor) constructs, the factors were hypothesised to reflect the items (Hair et al., 2021).

Step 2. Model parameter estimation: For parameter estimation, maximum likelihood (ML) estimation was employed because it works better for multivariate normal data (Kyriazos and Poga-Kyriazou, 2023). Moreover, it is the most used estimation method in CFA due to its efficient statistical properties such as unbiasedness, normality, consistency, high effectiveness and assist in avoiding possible parameter estimation violations (Li, 2016).

Step 3. Evaluation of model fit: The model fit was assessed to confirm the internal validity, external validity, adequateness and effectiveness of the measurement model (Peugh and Feldon, 2020). The fit of the measurement model was evaluated using the fit indexes proposed by the previous literature. According to Hair et al. (2012) at least three model fit indices should be employed and it is appropriate to report one test statistics from the three groups of model fit indexes (absolute, incremental and parsimonious). To ensure comprehensiveness, the following were examined: chi-square (χ^2), Root mean square error of approximation (RMSEA), Goodness-of-fit Index (GFI) for absolute fit category, Comparative fit index (CFI), Tucker-Lewis Index (TLI), incremental fit index (IFI) for the incremental fit category and Normed Chi-square (χ^2/df) for parsimonious fit indexes category. As noted above, maximum likelihood was used for the model parameter estimation, thus the results of the CFA indicate that Root Mean-Square Residual (RMR) is the square root of the difference between the residuals of the sample covariance matrix and the hypothesised covariance model (Hooper et al., 2008). The RMR was 0.054 close to zero, suggesting a good fit (Goretzko et al. 2024).

Root mean square error of approximation (RMSEA) was 0.051 not extremely higher than 0.050 cutoff point recommended by Hair et al. (2010). The model chi-square (χ^2) is 689.46 and the degree of freedom (d/f) is 324. As part of the model evaluation, the chi-square should be divided by degree of freedom and the recommended ratio, and the p-value should be <0.05 and GFI denotes the overall degree of fit (Carvalho and Chima, 2014). The results show that the $\chi^2/d/f$ is 2.128 not exceeding the cutoff value of ≤ 3.0 (Waziri et al., 2017) and the probability value is 0.00 and GFI is 0.893, very close to 0.90, thus indicating a good fit of the model.

Comparative fit index (CFI) compares the perfect model to the baseline model (Shi et al., 2020) and was 0.90 less than the recommended cutoff point of 0.95 recommended in Hair et al. (2010). The standardised root mean square residual (SRMR) was 0.062, indicating a good fit of the model as it falls between 0 and 1 (Hair et al., 2010). Finally, incremental fit index (IFI) was 0.901 showing a good fit because the acceptable cut-off point is value equal to or greater than 0.80 (Hooper et al., 2008) and the Tucker-Lewis index (TLI) was 0.883, falls between 0 and 1, indicating acceptable fit of the model (Widaman and Thompson, 2003) as demonstrated in Table 30.

Table 30: Fit indexes of the CFA model

Indicators	RMR	RMSEA	CFI	IFI	TLI	χ^2	d/f	GFI	$\chi^2/d/f$	SRMR	P-value
Fit indices	0.054	0.051	0.900	0.901	0.883	689.46	324	0.893	2.128	0.062	0.00

5.8 Testing the structural model (Hypothesis testing)

As indicated by Schuberth (2021), model specification, model identification, model estimation and model assessment are the four key steps for constructing a structural model. Having evaluated the measurement model (specification, identification and estimation, and assessment (Fit), based on the measurement model, the structural model was constructed to test the direct effects. mediation and moderation. Amos software version 29 was used to estimate the structural model.

5.8.1 Structural models for direct effects

Testing the structural model involved examining the individual hypotheses (Hair et al., 2014). The structural model began with estimating the direct effect of electronic procurement on supply chain performance (H1), supplier efficiency (H2) and quality of information (H3). The second model analysed the direct effects of supplier efficiency and quality of information on supply chain performance (H4) and (H5) respectively (see appendix 3). To understand how the hypothesised model 1 structure fitted the empirical data (Hair et al., 2021), the parameters used were RMSEA, CFI, IFI, TLI, χ^2 , d/f , GFI, $\chi^2/d/f$, RMR and P-values. The acceptable thresholds/ranges were presented in section 5.3 (Step 3) above. The respective values in Table 31 indicate good fit of the structural model.

Table 31: Fit indices for structural model 1

Indicators	RMSEA	RMR	CFI	IFI	TLI	χ^2	d/f	GFI	$\chi^2/d/f$	P-value
Fit indices	0.053	0.056	0.905	0.907	0.887	283.24	128	0.935	2.213	0.00

The same parameters were used to evaluate the fitness of the structural model 2, (see appendix 4), namely RMSEA, CFI, IFI, TLI, χ^2 , d/f , GFI, $\chi^2/d/f$, RMR and P-values. The values in Table 32 indicate good fit.

Table 32: Fit indices for structural model 2

Indicators	RMSEA	RMR	CFI	IFI	TLI	χ^2	d/f	GFI	$\chi^2/d/f$	P-value
Fit indices	0.054	0.043	0.927	0.929	0.905	158.66	70	0.953	2.267	0.00

5.8.2 Model results

The significance of the path coefficient was examined to confirm or reject the predictions (hypotheses). The results are presented in Table 33. The results show a statistically significant effect of electronic procurement on supply chain performance ($\beta = 0.225$, $t = 2.754$, $p = 0.006$), confirming hypothesis 1. The effect of electronic procurement on supplier efficiency is significant ($\beta = 0.518$, $t = 5.563$, $p = 0.00$), hence acceptance also of hypothesis 2. Electronic procurement shows a significant positive effect on quality of information ($\beta = 0.403$, $t = 5.460$, $p = 0.00$), supporting hypothesis 3.

The prediction that supplier efficiency has significant positive effect on supply chain performance is not supported ($\beta = 0.131$, $t = 1.593$, $p = 0.111$), thus providing the basis to reject hypothesis 4. Finally, the results show a significant positive effect of quality of information on supply chain performance ($\beta = 0.649$, $t = 4.770$, $p = 0.00$). Accordingly, hypothesis 5 is accepted.

Table 33: Model results

Hypotheses	Path coefficients (Standardised solution)	t-values	p-values	Observation
H1 (EP→SCP)	0.225	2.754	0.006	Accepted
H2 (EP→SEF)	0.518	5.563	0.000	Accepted
H3 (EP→QI)	0.403	5.460	0.000	Accepted
H4 (SEF→SCP)	0.131	1.593	0.111	Rejected
H5 (QI→SCP)	0.649	4.770	0.000	Accepted

Before mediation analysis the control variables (Job title, years of work experience, number of employees, type of industry and educational qualification) were introduced in the baseline model to examine their influence on the dependent variable. The results in Table 34 indicate that statistically, the control variables have no significant influence on the dependent variable (Supply chain performance).

Table 34: The influence of control variables

Control variables	β	T-values
Job Title	0.012	0.569
Years of work experience	-0.067	-1.434
Number of employees (firm size)	-0.044	-0.938
Type of industry	0.035	1.650
Educational qualification	0.060	1.339

5.8.3 Mediation analysis (indirect effect)

The study predicted that supplier efficiency (H 6) and quality of information (H7) will both mediate the relationship between e-procurement and supply chain performance (see appendix 5). The indirect effect of the mediators were calculated (Hair et al., 2010). Accordingly, the mediation model was specified by introducing the two mediators (supplier efficiency and quality of information) into the structural model to examine their indirect effect while controlling for demographic information (job title, years of work experience, industry type, level of education, and firm size). Based on bootstrap technique (5000 samples) and bias-corrected bootstrap at 95% confidence interval – as recommended by Hair et al (2014).

5.8.4 Mediation model results

Two main activities were performed: examining the robustness of the model, and the statistical significance of supplier efficiency and quality of information on the relationship between electronic procurement and supply chain performance (see appendix 6). The model fitness was examined using RMSEA, CFI, IFI, TLI, χ^2 , d/f , GFI, $\chi^2/d/f$, and p-value. The fit indices, as shown in Table 35 all indicate that the fitness of the model is good.

Table 35: Fit indices for the mediation model.

Indicators	RMSEA	RMR	CFI	IFI	TLI	χ^2	d/f	GFI	$\chi^2/d/f$	P-value
Fit indices	0.046	0.041	0.929	0.930	0.914	242.116	126	0.944	1.922	0.00

The results of the mediation analysis indicate that the control variables have no confounding effect on the mediator variables (supplier efficiency and quality of information) and the outcome variable (supply chain performance) because most of the paths are not statistically significant. Furthermore, supplier efficiency is a significant mediator on the relationship between electronic procurement and supply chain performance as the indirect effect is statistically significant at ($\beta = 0.134$, $p = 0.003$), confirming hypothesis 6. Therefore, the effect of e-procurement on supply chain performance depends upon supplier efficiency in the manufacturing sector in Ghana. Similarly, quality of information is a significant mediator between electronic procurement and supply chain performance ($\beta = 0.296$, $p = 0.00$), supporting hypothesis 7. Thus, the effect of electronic procurement on supply chain performance depends upon quality of information in the manufacturing sector in Ghana as shown in Table 36.

Table 36: Mediation analysis results (indirect effect)

Hypotheses	Indirect effect			P-values	Observation
	β	Lower	Upper		
EP→SEF→SCP	0.134	0.161	0.522	0.003	Significant
EP→QI→SCP	0.296	0.134	0.047	0.000	Significant

5.8.5 Moderation analysis

The study predicted that perceive ease of use will moderate the relationship e-procurement and supply chain performance (H8). It also predicted that perceived usefulness will moderate the link between e-procurement and supply chain performance (H9). Furthermore, the study predicted that top management support will moderate the relationship between electronic procurement and supply chain performance (H10). Employing the mean centering technique, mean of the independent and moderators variables were centralized to create a new variable. Though, the previous literature suggests that the data in its raw form and mean centering data have minimum difference in results, the advantage of mean centering data is the ability to minimise collinearity

issues and make interpretation less challenging (Dawson, 2014). The interaction term of perceived ease of use, perceived usefulness and top management support were created and a path from the interaction variable and the moderator variable was included in the model. There is an interaction when the effect of the independent variable on the dependent variable varies across the levels of a moderating variable (Andersson et al., 2014).

The moderation structural model was constructed, and according to Hair et al. (2021) it is not required to examine the measurement model of the interaction term because it represents an auxiliary measurement different from a unique theoretical entity. Accordingly, perceived ease of use, perceived usefulness and top management support were projected to moderate the relationship between electronic procurement and supply chain performance. A significant positive relationship between the variables is not a necessary condition for establishing moderation (Edwards and Konold, 2020).

The results of the moderation was obtained and explained based on criteria proposed in Memon et al. (2019b): first, determine the statistical significance of the moderating effect (Z), determine the significant relationship between the moderating effect (Z) and the dependent variable. Second, calculate the effect size (f^2) and how it influences R^2 as a function of the moderator. Third, report a slope plot for visual examination of the direction and magnitude of the moderating effect.

Before the moderation analysis, a direct effect of electronic procurement was tested without the inclusion of the moderation effect (EP*PEU, EP*PU, EP*TMS), the R^2 for supply chain performance 0.010. This indicates that 1% change in supply chain performance is accounted for by perceived ease of use, perceived usefulness, electronic procurement and top management support. When the interaction terms were included in the model, the R^2 increased to 0.491 (49%), indicating that 49% in variance explained in supply chain performance. Regarding the statistical significance of the interaction, the results reveal that the interaction of perceived ease of use positively and significantly facilitates relationship between E-procurement and supply chain performance ($\beta = 0.010$, $t = 1.919$, $p = 0.055$), confirming hypothesis 8.

This indicates that with increase in moderation effect of perceived ease of use, the relationship between electronic procurement and supply chain performance becomes stronger. The interaction effect of perceived usefulness on supply chain performance is not significant ($\beta = 0.016$, $t = 0.827$, $p = 0.408$), providing no support for hypothesis 9. Thus, perceived usefulness offers no support to the relationship between electronic procurement and supply chain performance. The interaction of top management support was tested on supply chain performance and the results show that the interaction of top management is not statistically significant ($\beta = -0.017$, $t = -0.909$, $p = 0.363$), thus hypothesis 10 is not accepted. Top management support plays no significant moderating role on the relationship between electronic procurement and supply chain performance as illustrated in Table 37.

Table 37: Results of moderation analysis

Relationship	Beta	t-values	p-values	Observation
EP→SCP	0.180	1.071	0.284	Not significant
EP*PEU→SCP	0.010	1.919	0.055	Significant
EP*PU→SCP	0.016	0.827	0.408	Not significant
EP*TMS→SCP	-0.017	-0.909	0.363	Not significant

Regarding the interaction effect size, the f^2 effect size reveals the degree of contribution of the moderation to the explanation of the dependent variable. The formula for calculating the effect size is

$$f^2 = \frac{R^2_{\text{included}} - R^2_{\text{excluded}}}{1 - R^2_{\text{included}}}$$

$$1 - R^2_{\text{included}}$$

$$R\text{-sq. excluded} = 0.010$$

$$R\text{-sq. included} = 0.491$$

$$F\text{-sq.} = (0.491 - 0.010) / (1 - 0.491)$$

$$F\text{-sq.} = 0.481 / 0.509$$

$$F\text{-sq.} = 0.945$$

The effect size can be evaluated as 0.02 being small, 0.15 being medium and 0.35 representing large. (Hair et al., 2021). Based on this cut-off points, the f-sq. size was 0.945 representing a large moderation effect, confirming that there is a large positive moderation effect of perceived ease of use. It is concluded that perceived ease of use significantly strengthens the relationship between electronic procurement and supply chain performance. The effect size of perceived usefulness and top management support were not calculated because they showed no statistical significant moderation effect.

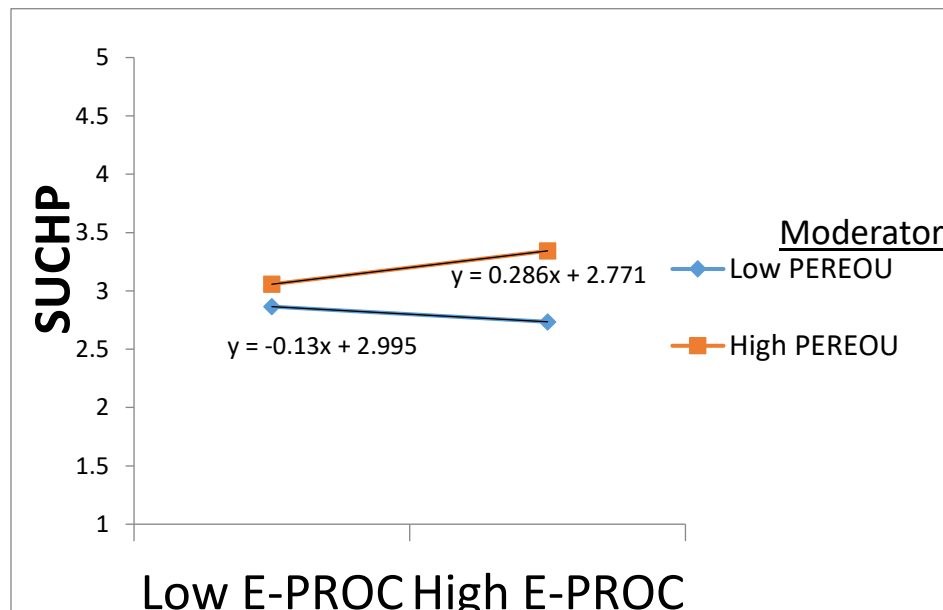


Figure 19: James Gaston plot showing the interaction effect of perceived ease of use on supply chain performance.

To better understand the type of the moderating effect of perceived ease of use, a simple slope analysis was conducted using the James Gaston plot technique which helps to visualize the linear relationship, in this case between electronic procurement and supply chain performance across low and high perceived ease of use as illustrated in Figure 19. The plot indicates that the line is steep for low perceived ease of use, indicating that at low level of perceived ease of use, the impact of electronic procurement is weakened. However, at higher perceived ease of use, the line is straight, showing that at higher perceived ease of use, the increase in electronic procurement does lead to the change in

supply chain performance. Therefore, higher perceived ease of use strengthen the effect of electronic procurement on supply chain performance.

The simple plot in Figure 20 shows the nature of moderation effect of perceived usefulness. The line is weak, plays no significant positive moderating role on the relationship between electronic procurement and supply chain performance. At low or high level of perceived usefulness, the link between electronic procurement is not affected. In conclusion, at high or low level of perceived usefulness, change in electronic procurement does not affect supply chain performance.

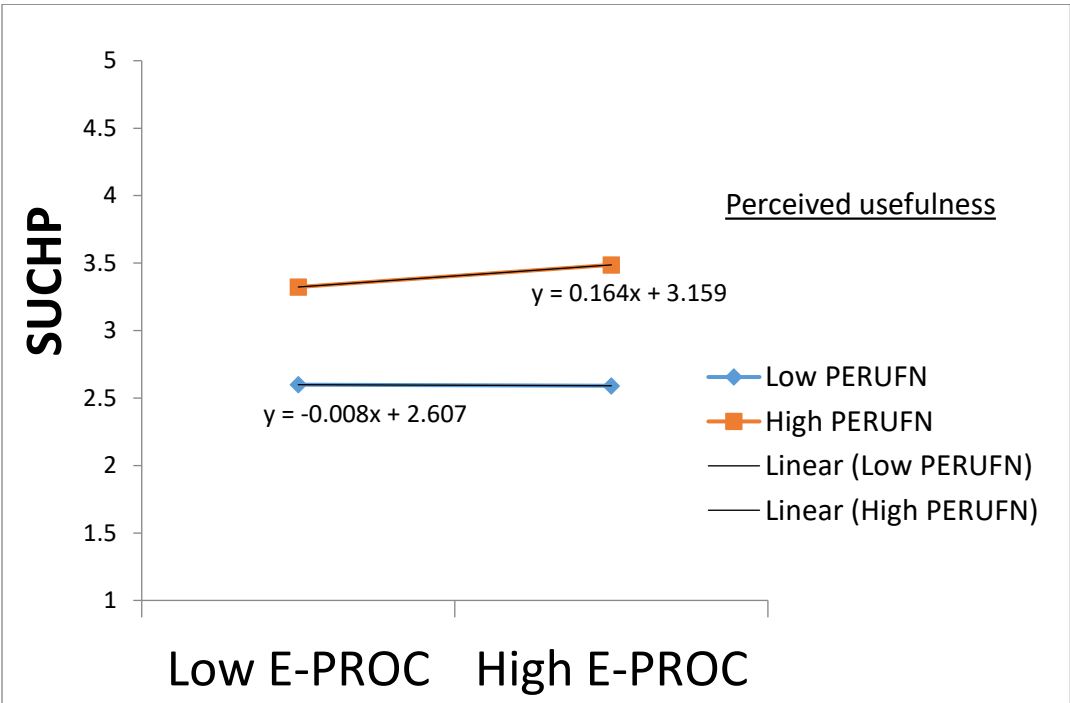


Figure 20: James Gaston plot showing the interaction effect of perceived usefulness on supply chain performance

To enhance the visuals of the moderating effect of top management support on the relationship between electronic procurement and supply chain performance, the James Gaston simple plot is presented in Figure 21. The plot shows that the steep of the slope showing both high and low moderating effect of top management support are minimal, indicating that at low or high level of the moderating effect of top management support

exert no influence on the relationship between electronic procurement and supply chain performance.

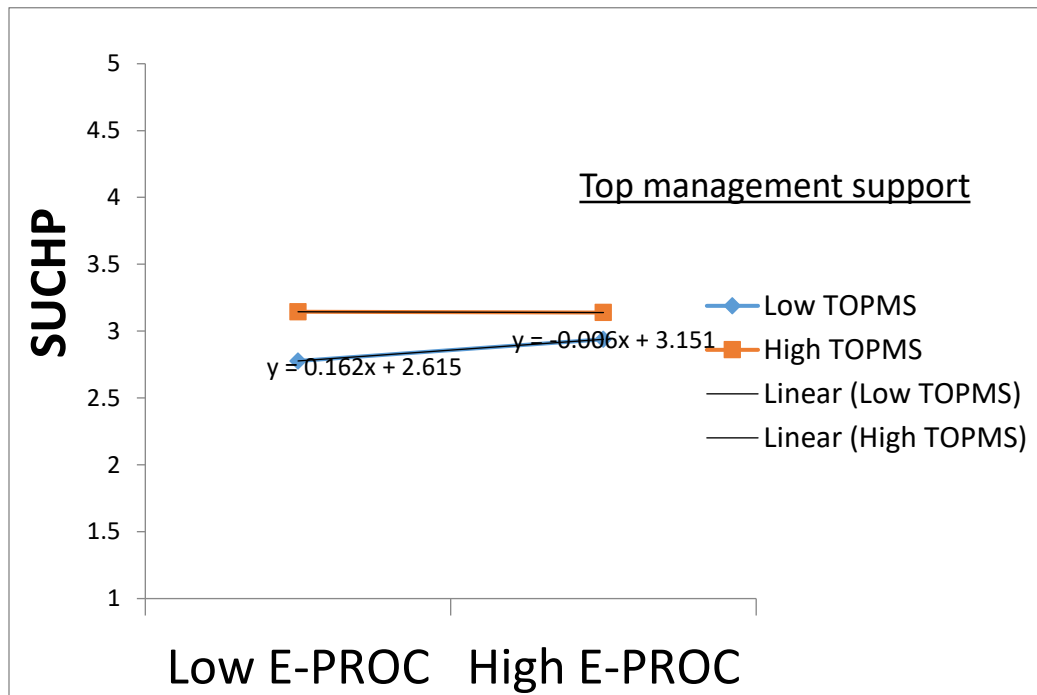


Figure 21: James Gaston plot showing the interaction effect of top management support on supply chain performance

5.9 Summary

The chapter has elaborated the data analysis procedure, process and results. The data analysis included four main stages: the analysis began with profile of respondents and descriptive statistics of the variables, followed by data cleaning, then assessment of the measurement model and finally the structural model (hypotheses testing). The respondents' profile covered their job title, years of work experience, industry type, level of education and number of employees (firm size). The data cleaning stage captured Data cleansing, Missing data evaluation, Identification of outliers, non-response bias test, Common method bias, Test for normality univariate, Test for linearity, Multicollinearity test, Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity,

The third stage evaluated the measurement model by testing the reliability and validity (convergent and discriminant) of the measurement items and constructs. To confirm these tests, exploratory factor analysis (EFA) was conducted to confirm the factor structure of the items. For reliability test, indicator reliability, composite reliability and Cronbach's alpha were estimated. Then, to evaluate convergent validity, average variance extracted (AVE) was determined. Discriminant validity measures were square root of AVEs compared with inter-construct correlations and Heterotrait-monotrait (HTMT). Confirmatory factor analysis (CFA) was final activity performed at this stage to assess validity of the measurement model.

The third stage captured the structural model assessment which focused on hypotheses testing. First, three direct effects models were constructed including direct effects of electronic procurement on supply chain performance. Before mediation analysis, control variables were included in the base line model to ascertain their influence on the dependent variable. Then mediation analysis was performed to test the mediation effects of supplier efficiency and quality of information on the relationship between e-procurement and supply chain performance. Finally, the interaction effects of perceived ease of use, perceived usefulness, and top management support were tested on the relationship between e-procurement and supply chain performance.

CHAPTER 6

DISCUSSIONS AND CONCLUSIONS

6.1 Introduction

The previous chapter focused on analysis of empirical data and reported on the results of the proposed hypotheses. This chapter provides the summary, interpretation and discussion of the results. The chapter further draws conclusions and elaborates the theoretical and practical implications of the research. Finally, it presents the limitations of the study and provides directions for future research.

6.2 Discussion

The study sought to examine the effect of e-procurement on supply chain performance in the manufacturing sector in Ghana. The study further examined the mediating role of supplier efficiency and quality of information on the relationship between e-procurement and supply chain performance. Finally, the study examined the moderating effect of perceived ease of use, perceived usefulness and top management support on the link between electronic procurement and supply chain performance. The tests of these hypothesised relationships based on the empirical data collected in Ghana showed mixed findings.

The discussion of the results is presented in three key sections. The first section (6.2.1) offers discussion on the direct effects, firstly (6.2.1.1) of electronic procurement on supply chain performance. It then discusses the effects of electronic procurement on supplier efficiency (6.2.1.2) and quality of information (6.2.1.3). The final aspect provides a discussion on the effect of supplier efficiency (6.2.1.4) and quality of information (6.2.1.5) respectively on supply chain performance. The second section (6.2.2) elaborates the results on the mediation roles: of supplier efficiency (6.2.2.1) and quality of information (6.2.2.2) respectively, on the relationship between electronic procurement and supply chain performance. The final section of the discussion (6.2.3) focuses on the moderating effects: of perceived ease of use (6.2.3.1), of perceived usefulness (6.2.3.2), and of top

management support (6.2.3.3) respectively, on the link between electronic procurement and supply chain performance.

6.2.1 Direct effects

6.2.1.1 The effect of electronic procurement on supply chain performance

The study predicted a positive effect of electronic procurement of supply chain performance (H1). The data supports this prediction. When the manufacturing companies use electronic medium to handle purchases, it enhances the performance of their supply chains. The result is similar to Lee et al. (2024) whose study reveals a significant positive effect of e-procurement determinants on supply chain performance in the manufacturing sector. Similarly, Mutangili (2019) found that e-procurement positively influences supply chain performance at Kenya airways, although not in the manufacturing context. This finding concurs with Gunasekarana and Ngai (2008) who found that implementation of electronic procurement enhances supply chain management and customer satisfaction, reduces operational tasks and processing time, and limits transaction costs. Similarly, Bayazit (2014) found that implementation of electronic procurement assists in building collaboration between purchasing staff and suppliers, and allows information based supply decisions built on visibility, accuracy, accelerated order placement, security and policy awareness. Likewise, Abubakar (2024) uncovered that e-procurement implementation influences supply chain performance by facilitating processes, reducing costs, improving transparency and strengthening supplier relationships. The results corroborate those of Pattanayak and Punyatoya (2019) who reported that e-procurement assists organisations to coordinate supply chain, reduce procurement costs, promote stronger collaboration among clients, contractors and sub-contractors, and promote cordial relationships among supply chain partners. Contrarily, the findings of the current study differ from Madzimure et al (2020) who reported that electronic procurement dimensions: e-sourcing, e-evaluation and e-informing exert no significant influence on supply chain performance in SMEs in South Africa.

6.2.1.2 The effect of electronic procurement on supplier efficiency

The study postulated that electronic procurement would have a positive influence on supplier efficiency (H2). This assertion was supported - according to the results e-procurement exerts a significant positive effect on supplier efficiency in the manufacturing sector in Ghana. This result is consistent with Piotrowicz and Irani (2010) whose study showed that the electronic procurement system contains data that allows companies to compare suppliers and select them based on standards and assists in minimizing possible problems, thus enhancing efficiency because of availability of rich data about suppliers which is obtained through request for quotation (RFQ) process. In a similar vein, Rai et al. (2006) concluded that instituting sound standards for electronic interaction with suppliers assists in organising catalogue management, order management, fulfillment and reverse auctions. The result is also in agreement with Mishra et al. (2007) who found that when suppliers use the internet for order initiation it enriches their skills, knowledge and experience to share information and use the internet to perform procurement tasks effectively. The results also align with Tai et al. (2010) who concluded that supplier performance is enhanced when they exchange information with buyers through web-based procurement solutions. The findings corroborate with Smart (2010) who reported that purchasing firms employ electronic procurement as a mechanism to decrease the number of suppliers and influence their volumes in price-competitive market. The finding is however at odds with Chang et al. (2008), who found that the relationship between some of the Chinese suppliers and their Taiwanese original equipment manufacturers (OEMs) were in doubt, thus, suppliers could not be trusted to provide standardised products.

6.2.1.3 The effect of electronic procurement on quality of information

The study investigated the effect of electronic procurement on quality of information (H3). The results provide empirical support to the assertion that electronic procurement enhances quality of information accessible to partners of the procurement system and the supply chains of the manufacturing companies. The finding is consistent with Pattanayak and Punyatoya (2019) who found that using IT technologies for purchases makes it easy for information integration, information visibility and real time information sharing among

supply chain members that enhances their interaction and assists in boosting the supply chain. The finding corresponds to Quesada et al. (2010) who found that electronic procurement technologies provide the means of gathering information, and improving supplier contact, contracting, intelligence and analysis practices. Vaidyanathan and Devaraj (2008) also, for example, found that integrated and automated business processes that use enterprise resource planning systems ensure information flow between suppliers which leads to reduction in delivery time and accuracy rate improvements. Similarly, Shu-Hsien Liao et al. (2003) reported that employing network transmission operations to calculate the floor price can minimise possible information inaccuracies at the time of document delivery. On the other hand, the results contrast with Teo and Lai (2009) who found that electronic procurement usage produces high volume of information exchange and as a result reduces internal efficiency of the firm.

6.2.1.4 The effect of supplier efficiency on supply chain performance

The research examined the effects of supplier efficiency on supply chain performance (H4). The findings revealed that if suppliers are efficient, supply chain performance in Ghana's manufacturing sector will not be influenced. The result is similar to that of Tai et al. (2010), whose study revealed that supplier operational performance had no significant positive effect on buyer and organisational performance. The result is however different from Madzimure et al. (2020), who found that supplier integration significantly contributes to supply chain performance. Likewise, Albinkalil (2021) found that supplier relationships positively influence supply chain performance. The non-significance of supplier efficiency on supply chain performance might be attributable, at least in part, to the caliber of suppliers the manufacturing companies use to source their goods in the supply chain. For instance, according to Angeles and Nath (2007), some buyer companies engage suppliers who are not mature, even though many other tier-one suppliers are advanced in technology adoption. Moreover, supplier partnership is one of the major predictors of supply chain performance, but a supply chain management strategy, if it is not incorporated properly into supply chain management practices, it cannot fully contribute to supply chain performance (Sukati et al., 2012).

6.2.1.5 The effect of quality of information on supply chain performance

The study explored the effects of the quality of information on supply chain performance (H5). The results show that availability and access to information positively and significantly influence the supply chain performance of the manufacturing companies in Ghana. The outcome of the analysis concurs with Amelia et al. (2024), who found that information sharing positively contributes to supply chain outcomes, namely integration. The results also agree with Setak et al. (2018), whose simulation study revealed that full information dissemination benefits the members of the supply chain and allows retailers to disclose their cost information to manufacturers. Thus, sharing accurate information is related to supplier performance of building buyer trust (Kotcharin et al., 2024) and through appropriate information technologies, supply chain agility is built (Qureshi et al., 2023). The results are consistent with Baba et al. (2021), who found that sharing accurate information drives collaboration across the supply chain network and relevant information positively influences supply chain performance. Similar to this finding, Busse et al. (2017) reported that managing information processing needs significantly improves buying firms' sustainable supply chain management practices. The outcome of the analysis agrees with Croom (2000), who found that the electronic MRO in the supply database comprises accurate and comprehensive information about authority levels for those who place orders, supplier details, product or service details, and price scheme agreements for efficiency gains.

The finding differs from Zaid et al. (2025), who found that information exchange does not affect supply chain performance among supply chain professionals working in supply chain companies. Nevertheless, as noted by Fawcett et al. (2011), information sharing culture leads to operational performance and is related to supply chain collaboration. The quality of information (current, accurate, complete, consistently defined and easy access) has a positive association with the collaborative planning process of the supply chain (Petersen et al., 2005). Companies in the manufacturing sector are therefore encouraged to provide reliable information to all parties in their supply chain for optimal performance, as providing the right information assists in achieving real-time transmission

processing of information needed for supply chain decision making (Liu et al. 2016), and information transparency is relevant for enhancing supply chain coordination (Kumar and Ganguly, 2021).

6.2.2 The mediating effects

6.2.2.1 The mediating effect of supplier efficiency on the relationship between electronic procurement and supply chain performance

The results confirm the assertion that supplier efficiency mediates the relationship between e-procurement and supply chain performance in the manufacturing sector in Ghana (H6). The findings align with Smart's (2010), who reported that using internet technologies to promote collaboration between suppliers and customers allows them to report their demand and inventory status through supplier portals and hence improve their efficiency, and in turn use this information to fine-tune their supply chain transactions. This is a practice used widely in the automotive industry, where manufacturers provide information on their demand and inventory status through supplier portals (Puschmann and Alt, 2005). The findings agree with Rai et al. (2006), who found that electronic procurement technologies that promote digital interaction with suppliers and enhance digitalisation of key procurement transactions positively influence procurement productivity. The outcome of the analysis also aligns with Madzimore et al. (2020) who reported that electronic dimensions: e-design, e-sourcing and e-negotiation make a significant contribution to supplier integration, whereas supplier integration positively influences supply chain performance. E-procurement is important for an organisation's supply chain (Asif et al., 2024), and effective collaborative planning initiatives with suppliers contribute to supply chain performance (Petersen et al., 2005). Therefore, supply management professionals are encouraged to reconsider their supplier management practice from a supply chain perspective as an initial intervention for improving supply chain performance (Park and Hartley, 2002).

6.2.2.2 The mediating effect of quality of information on the relationship between electronic procurement and supply chain performance

The study predicted that quality of information positively mediates the relationship between e-procurement and supply chain performance in the manufacturing companies in Ghana (H7). The data supports this prediction. The findings are similar to those of Chang (2013), whose study revealed that information sharing is a mechanism through which electronic procurement can make a significant contribution to supply chain performance. Similarly, Pattanayak and Punyatoya (2019) reported that blending diverse supply chain technologies enhances real-time integration of information within the supply chain partners, encourages interaction, enhances the quality of information, and in turn assists in boosting supply chain performance. Thus, implementing electronic procurement offers the advantage of receiving a high quantity and quality of information processing (Essig and Arnold, 2001). For instance, suppliers are interested in getting information about users of their system, mainly expenditure profiles, as a way of developing their database marketing abilities, whereas customers prefer to have the same information for control and audit (Croom, 2000).

Despite the challenges associated with the role of information, Teo et al. (2009) found that information sharing is more relevant when the company has already adopted the online purchasing method and is taking steps to ensure business sustainability. Therefore, the findings indicate that accurate, reliable, valid and timely information about procurement and the supply chain should be disseminated across all departments in the company to boost efficiency and performance. The findings of the study indicate that the key role of proper information is indispensable to better utilisation of the internet-based buying system and the supply chain of the manufacturing sector.

6.2.3 The moderation effects

6.2.3.1 The moderation effect of perceived ease of use on the relationship between electronic procurement and supply chain performance

The study discovered that perceived ease of use significantly moderates the relationship between electronic procurement and supply chain performance in the manufacturing sector in Ghana (H8). This is consistent with Gamal (2010), who reported that users exhibit an attitude toward electronic procurement when it is confirmed as a useful mechanism in the supply practice. Perceived ease of use is a significant enhancer of e-procurement (Nandankar and Sachan, 2020), exerts a direct positive effect on employee attitude on behavioural intention (Junejo et al., 2024) and real-time supply chain visibility adoption and performance (Carton et al., 2022). However, Gamal (2010) concluded that e-procurement usage is likely to be difficult for inactive users who lack the required competence and learning abilities. Companies need to offer greater attention to protect online purchasing technology users from encountering access challenges such as system crashes, dropouts, service delays and system breakdowns. Perceived ease of use facilitates the link between e-procurement and supply chain performance, thus, manufacturing companies should train the parties of the supply chain to develop a positive mindset towards e-procurement usage to achieve optimal performance of the supply chains.

6.2.3.2 The moderating effect of perceived usefulness on the relationship between electronic procurement and supply chain performance

The results show that perceived usefulness has no significant positive effects on the link between e-procurement and supply chain performance in the manufacturing sector in Ghana (H9). The results concur with Daud et al. (2013), who found that perceived usefulness of e-procurement has no significant influence on e-procurement usage. The result differs from Gamal (2010), who observed that users develop attitudes towards the e-procurement system when it is confirmed as a useful tool to practice, and suppliers can get the opportunity to obtain strategic benefits when the e-procurement system is used. The non-significance, potentially, can be attributed to how the manufacturers perceive the

value of electronic procurement and how it affects the effective and efficient functioning of the supply chains. However, electronic procurement technologies are making substantial changes to how purchasing is conducted and can potentially provide support for purchasing practices (Chang et al., 2004). Nevertheless, the result of the present study indicates that manufacturing companies may indeed not need to be overly concerned with emphasizing value on the perceived usefulness of e-procurement technologies in purchasing transactions by the parties of the supply chains.

6.2.3.3 The moderating effects of top management support on the relationship between electronic procurement and supply chain performance

The analysis, surprisingly, found that top management support is not a significant moderator of the relationship between electronic procurement and supply chain performance in the manufacturing sector in Ghana (H10). Nevertheless, this finding is consistent with Kagande et al. (2022), who found that top management in the procuring entities provided no company vision that improves supply chain management and continuous efficiency. Likewise, Wu et al. (2007) found that top management support does not play a significant role in facilitating the adoption of electronic procurement in companies. While surprising, and while the reasons are not immediately clear, the non-significance of top management support may be attributed, in part, to the fact that building top management support comes with costs (Rotchanakitumnuai, 2013). For instance, although not in the manufacturing context, Johnson (2012) reported that electronic procurement and electronic market were not a top priority for local authorities in the public sector in the UK because they considered it too early for it to produce any significant benefits to local authorities to guarantee their participation in them. The finding is also out of alignment with the argument proposed that if top managers appreciate the importance and value of the online purchasing method and prioritise it, others in the company would be encouraged to make it a priority (Gunasekaran et al., 2009). Furthermore, the finding is also at odds with the argument that top management offers important support to minimise resistance that accompanies organisational technological innovation (Rai et al., 2009) and, for example, ensures collaboration between suppliers and customers in the green supply chain (Lee and Joo, 2020). Moreover, it has been reported that top

management support assists organisations to adopt and use technological innovations that improve the effectiveness of supply chain management (Pratama et al., 2024). Further research is needed to understand better this non-significant result.

6.3 Research conclusions and implications

The study aimed at examining the direct effects of electronic procurement on supply chain performance in the manufacturing sector in Ghana. The effects of e-procurement on supplier efficiency and quality of information were also determined, and the final stage of direct effect analysis focused on supplier efficiency and quality of information respectively on supply chain performance. The research also sought to test the mediation effects of supplier efficiency and quality of information, and whether perceived ease of use, perceived usefulness and top management support moderate the link between e-procurement and supply chain performance. The results revealed that electronic procurement and quality of information have a significant positive effect on supply chain performance but supplier efficiency proved otherwise. The findings indicate that electronic procurement makes a significant contribution to supplier efficiency and quality of information. Regarding the mediation effects, both supplier efficiency and quality of information were found to be significant mediators between e-procurement and supply chain performance. Finally, the study uncovered that perceived ease of use facilitates the link between e-procurement and supply chain performance, but the interaction effects of perceive usefulness and top management support made no significant contribution on this relationship.

In conclusion, the results reveal that the model has explanatory power and confirms its robustness with strong empirical support that contributes to the understanding of the influence of electronic procurement on supply chain performance, the mediating and moderating mechanisms that affect their relationship. Other scholars, practitioners and policy makers are the beneficiaries of the outcome of the study, and the following sections elaborate the theoretical (6.3.1) and the managerial (6.3.2) contributions of the research.

6.3.1 Contribution of the study

The research makes a significant theoretical contribution to electronic procurement and supply chain management literature in several ways.

6.3.1.1 Contextual contribution

First, the study makes a significant contribution to existing literature by analysing the direct effects of electronic procurement on supply chain performance in the manufacturing sector in a developing economy. The research adds a deeper understanding to the existing procurement literature by enabling scholars, practitioners and policy makers to access exclusive information to boost their understanding about the direct influence of e-procurement on supply chain performance in Ghanaian context, which has received limited attention in the mainstream procurement and supply chain management literature.

Second, the literature on what specific factors enable or facilitate the relationship between e-procurement and supply chain performance lacks evidence from developing economy perspective. Hence, the present research has responded to this by testing the mediating effects of the particular factors that influence the link between e-procurement and supply chain performance in the manufacturing sector in Ghana. The study further deepens the understanding on the deepen knowledge of factors that bridges the gap between e-procurement and supply chain performance in the manufacturing sector in Ghana, where this research has not been conducted before.

Third, the previous procurement and the supply chain management literature highlights the moderating role of other factors including the TAM acceptance factors (perceived ease of use, perceived usefulness) and top management support in other economies. The limited evidence in this area of research in the context of manufacturing sector in a developing economy is motivation for the current thesis. Therefore, researchers, managers, policy makers and other consumers of the findings of the thesis are offered unique insight into the interaction effects of these factors from Ghanaian private manufacturing perspective.

6.3.1.2 Theoretical contribution

First, the direct effects of e-procurement on supply chain performance has been articulated by the previous literature (Kothari et al., 2005; Tai et al., 2010; Essig and Arnold, 2001; Chang et al., 2013). However, this area of research remains a study gap as knowledge about it is limited in Ghana. Anchored in TAM, the thesis demonstrate user acceptance of e-procurement technologies and its usage to enhances the speed of the supply chain. Through the findings of the current research, scholars are offered unexplored knowledge about the direct contribution to supply chain performance from area which has not received any significant attention among scholars.

Second, many studies have examined the link between e-procurement and activities of suppliers (e.g. Varajão et al., 2012; Chang et al. 2008; Purchase and Dooley, 2010). However, the direct effects of electronic procurement on supplier efficiency have not been strongly advocated in the previous studies that investigated this subject matter, particularly in the manufacturing sector. The current research reveal that when the manufacturing companies interact with suppliers through the e-procurement technologies it enhance their ability to perform better. Through the TAM acceptance factors (perceived ease of use and perceived usefulness) (Ma and Liu, 2005) suppliers use the e-procurement technologies to perform the purchasing transactions. The current model allows academia to access deeper understanding about the positive contribution of e-procurement to supplier efficiency in the manufacturing firms.

Third, the research tested the direct effects of electronic procurement on quality of information. The previous literature focused on how information contributes to the success of electronic procurement but the present study analysed how the automated purchasing system contributes to producing enabling information to the parties involved in a procurement transaction. Therefore, scholars are offered understanding on different views of how information is acquired and used in relation to electronic procurement. Moreover, researchers can use this insight to inform the construction of future models that seek to explain phenomenon in the SCM field that incorporates e-procurement and quality constructs.

Fourth, the study makes a new contribution to knowledge on the effects of supplier efficiency on supply chain performance. Although, supplier contribution to the effectiveness and efficiency of the supply chain has been highlighted in the supply chain management literature (Chang et al. 2008; Rai et al., 2009; Smart, 2010), most of these studies did not focus on the direct effects of supplier efficiency on supply chain performance. Therefore, the current research produces original theoretical information through TAM by providing a valuable insight on the direct influence of supplier efficiency on supply chain performance.

Fifth, the research contributes to knowledge by determining the effects of quality of information on supply chain performance. Specifically, the research presents a deeper knowledge on how information free from defects enhances speed and better delivery of the supply chain. Although, some studies (e.g. Madzimore et al. (2020), Panayiotou et al. (2004) and Knudsen (2003)) have made recognizable attempts to reveal the significance of information flow to the supply chain. Furthermore, the research makes a valuable theoretical contribution through TAM by revealing how the manufacturing sector access right information through the e-procurement technologies to boost the performance of the supply chains, providing new insight for theory building.

Sixth, most of studies have focused on the direct effect of e-procurement on supply chain performance across different fields of study (Gunasekarana and Ngai 2008; Pattanayak and Punyatoya 2019; Madzimore et al. 2020). However, the current research analysed how supplier efficiency influences the relationship between electronic procurement and supply chain performance. The study therefore provides scholars with deeper insight into how other factors influence the link between these variables. This area of research has received very limited attention in the procurement and the supply chain management literature making it a unique contribution. Researchers can further build on this idea to extend and create better understanding of the links among these three constructs (e-procurement, supplier efficiency and supply chain performance).

Seventh, the current research offers a significant contribution to the extant literature by testing the mediating effects of quality of information on the link between electronic

procurement and supply chain performance. Through this study the academic community gets a better understanding of the role of quality of information between the online purchasing method and performance of the supply chain. Although previous research has done extensive work on e-procurement and supply chain management (Essig and Arnold 2001; Dai and Kauffman 2006; Garrido et al. 2008; Vaidyanathan and Devaraj 2008), factors that influence their link has received limited attention. Therefore, the current research advances knowledge by demonstrating that quality of information provides support for the relationship between electronic procurement and supply chain performance.

Eighth, the research further provides more theoretical insight on the moderating role of perceived ease of use on the relationship between electronic procurement and supply chain performance. For theory building, deeper knowledge is uncovered through the analysis of the interaction effect TAM acceptance factor (perceived ease of use). Furthermore, although the technology acceptance model has received considerable attention in the procurement literature (Purchase and Dooley, 2010), studies that analysed perceived ease of use in relation to e-procurement and supply chain performance are rare. Therefore, the current research makes an addition to the procurement literature by using the technology acceptance model in unique environment which offers fresh theoretical understanding to researchers.

Ninth, the moderating effect of perceived usefulness between electronic procurement and supply chain performance was one of the themes of the current research. Studies in the field of manufacturing that have tested the interaction effect of TAM acceptance factor (perceived usefulness) between the automated purchasing system and supply chain performance are rare. The research community is provided with knowledge on the apparent lack of importance of the role of perceived usefulness in strengthening the effect of e-procurement on supply chain performance.

Tenth, finally, a unique contribution in understanding of the role of top management support's influence on the link between electronic procurement and supply chain performance is provided. Although an unexpected finding, this gives researchers valuable

understanding about the interaction effects of top management support on the relationship between the online buying method and supply chain performance, from a different environment where this study has not been conducted before. While other studies have argued for a significant role of top management in supporting e-procurement and supply chain performance relationship (Bandara and Athapaththu, 2024; Begombe et al., 2024; Kagande et al., 2022; Presutti, 2003) the current research proved otherwise. Scholars can build on this unique knowledge to extend the understanding of the interaction among electronic procurement, top management and supply chain performance, and test the relationship across other diverse fields of study. Thus, top management support can theoretically demonstrate different results as a moderator between e-procurement and supply chain performance.

6.3.2 Managerial implications

Electronic procurement has been shown to be a key contributing factor determining the success of manufacturing firms, and in the context of this study, Ghana, and arguably the next related most important issue is how to send and receive goods through a reliable supply chain after purchasing. Thus, blending procurement with supply chain management is one of the difficult tasks for managers in the manufacturing sector, particularly the developing nations. The current research has analysed the effects of electronic procurement on supply chain performance and the factors that influence their relationship. Based on this, the present study has several managerial implications for managers in the procurement and supply chain management fields.

First, the study shows that e-procurement is statistically significant on supply chain performance of the manufacturing sector. The online purchasing system contains important technologies and user interface that allow users to interact with the system to perform relevant activities to enhance the procurement process. This can in turn speed up delivery through the supply chain once the transaction has been concluded. Therefore, efficient communication network becomes critical to allow users of the system to stay connected with proper systems installed. To this end, providing integration in transactions enhances advanced control, better inventory management and can help ensure smooth

workflow in the supply chains of the manufacturing companies (Katu, 2020). For decision making, if managers want to improve lead-time, on-time delivery, product quality, lower inventory, faster order fulfilment and enhance order accuracy they can do so by automating the procurement system (Yu et al., 2015).

Second, the manufacturing companies are offered valuable information that supplier efficiency plays a significant mediating role between electronic procurement and the performance of the supply chain. So, managers are informed to recognise the importance of suppliers when electronic procurement is targeted at speeding up the supply chain. Using electronic catalogues, managers and buyers for instance can exchange useful information from suppliers about the availability of products and services (Panayiotou et al., 2004). E-procurement applications assist supply management professionals to be more efficient in executing traditional purchasing activities such as identifying supply sources and collecting bids from suppliers (Wu et al., 2007). The current study recognises the key role of suppliers and thus reminds managers that the procurement function can be sustained by making sure that managers have the needed skills to partner with suppliers to develop forward thinking to foresee the effects of procurement decisions (Khan and Hinterhuber, 2024). Furthermore, inaccurate delivery schedules can be minimised by corresponding supplier responsiveness and encouraging suppliers to use proactive measures to manage time and promote capacity, flexibility and safety stocks (Jonsson et al., 2024). Due to the significant role of suppliers, the manufacturing companies should train them on how to utilise the procurement technologies and build their capabilities to speed up the delivery of goods.

Third, the study shows that quality of information plays a significant role between e-procurement and supply chains of the manufacturing sector. The managers of the manufacturing companies are informed that the internet-based purchasing process enable the industry players to access defect free information at the right time which minimise risks and uncertainty associated with the purchasing transaction (Garrido et al., 2008). Further, the information should be accurate and suitable for distribution (Jonsson et al., 2024). However, managers should be aware that where the electronic procurement

process is highly intensive, the risk of leaking sensitive information is high because information can be lost in transit, stolen, compromised and grievous errors can be committed due to interaction with many other departments (Vaidyanathan et al., 2012). Therefore, practitioners and managers are encouraged to employ information technology to cater for the diverse information processing requirements between buyers and suppliers in the buying process (Wu et al., 2007). Additionally, managers should prioritize the use of electronic procurement technologies as a mechanism for continuously enhancing information gathering, supplier contracting, knowledge and analysis practices (Quesada et al., 2010). Through accurate information, e-procurement can boost the performance of the supply chain of the manufacturing sector.

Fourth, managers are informed that perceived ease of use was statistically significant between e-procurement and supply chain performance. Accordingly, when suppliers, buyers and employees of the company find it easy to use electronic procurement technology, it boosts their enthusiasm to patronise the system to achieve positive results to increase productivity. In view of this, user-friendly e-procurement technologies should be installed including training to assist them acquire deeper knowledge and develop the required capabilities to handle the system with ease. Through user-friendly interfaces, errors associated with pricing, contracts, orders, delivery time, customer specifications, transportation can be minimised to achieve efficiency in the supply chain.

Fifth, for strategic decision making, the manufacturing companies are informed that perceived usefulness was not statistically significant between e-procurement and performance of the supply chain of the manufacturing sector. Possibly, this is as a result of how they perceive the relevance of using the online purchasing system and its positive effects on their abilities to perform their duties as employees in the manufacturing environment. It is important for the practitioners to appreciate the fact that digitalisation induced change (as is not being seen powered by industry 4.0 revolution) is a challenging transformation that managers are required to understand how change is understood by the employees and their attitude towards the change (Van Dun and Kumar, 2023). The employees may appreciate the usefulness of the online purchasing system but may feel

challenged and perceive the system as a source of stress, thus affecting their positive attitudes towards its usage. It follows that the users of the system can develop a positive attitude towards the online purchasing system when they receive support and education to boost their understanding about how the system can contribute to their performance.

Sixth, the practitioners in the field of procurement and supply chain management are informed that top management support was not confirmed to play a major facilitation role between electronic procurement and supply chain performance in the manufacturing sector in Ghana. The findings reveal that the decisions and actions of top management may not support the adoption and implementation of the internet-based buying system and the activities of the supply chain (Kagande et al., 2022). The stream of literature indicates that sometimes the aim of e-procurement is not achieved and it is seen as unsuccessful venture that produces limited results (Piotrowicz and Irani, 2010). This knowledge can influence the decision of top management to make limited efforts to invest in electronic procurement if some factors like lack of financial resources, expertise in modern technology, employee commitment and the like are within the company. In response to these factors, top management may need specific development training to better understand the nuances of their influence in the context of new technologies such as e-procurement having a positive effect on supply chain outcomes and performance.

Seventh, policy makers are offered information on the need to give attention to the implementation of electronic procurement in the manufacturing sector (public and private) to boost supply chains in the developing nations. The developing nations should encourage and support the private sector to build efficient telecommunication networks to facilitate the online purchasing system to reduce costs and increase the speed of the supply chain for effective distribution of goods and services in the manufacturing sector. Industrial policies should be made to encourage the adoption and implementation of electronic procurement to enhance their supply chains.

Finally, the key findings of the study point to a future intervention that nations can use to help the manufacturing sector in the developing countries to boost productivity to increase their Gross Domestic Product (GDP). For example, the European Union, since 2005, has

adopted electronic procurement as a strategic policy (Costa et al., 2013). The Ghanaian government could likewise augment the efforts of the manufacturing sector by introducing interventions such as providing education in the use of modern technologies to the populates to minimise the costs of acquiring and training the human capital.

6.4 Limitations and direction for future research

The study makes a significant contribution to knowledge in the field of electronic procurement and supply chain management; however, the limitations of the research must be recognised. First, the study was conducted in the context of manufacturing companies in Ghana. Although this sample context significantly contributes to knowledge, it nevertheless limits the ability to generalize the results, due to manufacturer's specific mission and purposes as compared to the other sectors (e.g. health, transport, agriculture, finance, and mining, amongst others). In view of this, future research can examine this study's model, or an adjusted model based on the findings, in different sector contexts to extend the understanding of the current research. Furthermore, the research focused on product manufacturing organisations, the conceptual model developed here can be tested in service organisations in future research, whose work processes are also known often to have different characteristics and features to those of manufacturers (Moeller 2010; Srihadi and Setiawan, 2015).

Second, the previous literature highlights several challenges of implementation of electronic procurement and supply chains in the developing economies. However, the often-significant challenges confronting the manufacturing organisations in the developing nations were not the main theme of the current research. Future research is recommended to uncover the challenges confronting the adoption and implementation of electronic procurement and supply chains in the manufacturing sector in the developing countries. Moreover, though the advanced countries have made substantial progress in the online purchasing and supply chain management, further research will be important to uncover their challenges to enhance knowledge. Furthermore, the public sector can be targeted in future research to unveil their challenges regarding implementation of the internet-based procurement method and supply chain management.

Third, in terms of methodology, the current study employed quantitative methods in data collection and analysis to generalize the findings. However, quantitative research has its limitations that qualitative approach can deal with. Based on this, future research is recommended to employ qualitative methods to test the impact of electronic procurement on supply chain performance in the manufacturing sector. Furthermore, though the current research used SEM method, the theories were tested at the organisational level, thus future study is recommended to use multilevel structural equation modeling to test electronic procurement at the individual and organisational level. Moreover, covariance based structural equation modeling (CB-SEM) was used for the data analysis, future study can employ a partial least square structural equation modelling (PLS-SEM) to extend the understanding of this topic.

Fourth, the current research analysed quality of information and supplier efficiency as mediating factors that influence the relationship between electronic procurement and supply chain performance in the manufacturing sector. The study further tested the interaction effect of perceived ease of use, perceived usefulness and top management support on the link between e-procurement and supply chain performance. The test was limited to these factors affecting the relationship; therefore, future study is recommended to identify other factors (e.g. supplier commitment, supplier knowledge in IT, and firm resources) and test their influence on the relationship between the internet-based purchasing method and supply chain performance in the manufacturing sector, and in both advanced and developing economies.

APPENDIX 1- Research Questionnaire

E-procurement and supply chain performance in emerging economies: A study of the manufacturing sector in Ghana

Dear Colleagues,

I am Michael Gyabaah, a Brunel Doctoral Researcher and I am currently undertaking research on the topic “E-procurement and supply chain performance in emerging economies: A study of the manufacturing sector in Ghana”. The research seeks to explore the effects of electronic procurement on supply chain performance, and how other important factors such as supplier efficiency, quality of information, perceived ease of use, perceived usefulness and top management support can enhance or affect this relationship. The research will therefore develop a deeper understanding of the direct effects of e-procurement on supply chain performance, and other factors that could help to maximize the benefit to companies operating in a developing economy.

I would appreciate your voluntary participation by spending a few minutes of your time to complete this survey. You have been chosen to participate in the survey due to your knowledge of the research area, and your insight is considered very important for the development of a better understanding. Your company has given permission for its and your inclusion in this study. All information gathered from you and your company will be treated confidentially and used purely for academic purposes. Answers provided by you will be aggregated with those provided by other respondents and only these aggregated responses will be reported. No reference to you or other participants by name will be made. I humbly request you to respond to the questions as honestly as possible.

With thanks,

Michael Gyabaah

Please do not hesitate to contact me on **0242171265** or **2001576@brunel.ac.uk** for any clarifications.

PARTICIPANT INFORMATION SHEET

Study title

E-procurement and supply chain performance in emerging economies: A study of manufacturing Sector in Ghana

Dear Respondent,

This research is conducted in fulfilment of the award of Doctor of Philosophy at Brunel University, London. I would appreciate if you could spend a few minutes of your time to participate in this survey. Your answers are very important for the proper analysis of the research. I would like to state that, all information gathered from your company will be treated with high confidentiality and are purely for academic purposes. Answers provided by your company will be grouped with other employees in other companies and will not make reference to your names or single out any information with reference to specific individual. I humbly request you to respond to the questions as honestly as possible.

What is the purpose of the study?

The study seeks to find out the effects of electronic procurement (e-procurement) on supply chain performance in the manufacturing sector in Ghana. It is interesting to understand how the introduction of information technology (e-procurement) is influencing the output of supply chain of the manufacturing sector in Ghana which is responsible for production of goods and services critical for national interest.

Why have I been invited to participate?

Your response is needed to enrich the findings of the study to understand how e-procurement contributes to the performance of the supply chain of manufacturers. You and other co-workers will be purposely selected to participate in answering the questions because you have the needed information to assist the researcher to achieve the purpose of the study.

Do I have to take part?

You are under no obligation to take part in the survey but if you agree to join, a consent form will be provided for you to sign and upon request, a copy of this information will be given to you to keep as well. Moreover, you can withdraw from the exercise at any time while the survey is underway (anticipated end before December 2023), and your right to withdraw from the exercise has no adverse effect on the study. Lastly, you have no opportunity to withdraw when your responses have already been recorded because your responses will be aggregated with the other respondents and confidential.

What will happen to me if I take part?

You are expected to answer the questions which is the main purpose of this survey. Once your responses are grouped with the other respondents, protection of the information supplied is assured.

Are there any lifestyle restrictions?

There are no lifestyle restrictions associated with this questionnaire and study. You are free to answer the questions as you are an employee of the company that has provided permission and you have purposely been selected.

What are the possible disadvantages and risks of taking part?

There are no anticipated disadvantages/risks associated with answering the survey questions.

What are the possible benefits of taking part?

If you take part, the researcher can realise acceptable number of responses in the data collection and provide new knowledge as comprehensive and generalisable analysis can be provided on this field of study.

What if something goes wrong?

If you experience any issues with the questionnaire, I have made available my supervisor's contact details whom you may contact: Prof. David Gallear, David.gallear@brunel.ac.uk.

Will my taking part in this study be kept confidential?

Yes. Your data will be anonymous, we will not link you to your responses and we will not contact you for any follow-up information or questions. All information collected for the purpose of this research will be treated in the strictest confidence. In any event where the findings are communicated, they will be communicated on an aggregate basis, and hence all information will be anonymous.

Will I be recorded, and how will the recording be used?

No, you will not be recorded, as all the information required from you will be collected through the questionnaire.

What will happen to the results of the research study?

The data collected through the questionnaires from the participants during this study will be used to complete a doctoral research thesis which is scheduled to be completed by 31st of March, 2025.

Who is organising and funding the research?

This study is being organised by the researcher in conjunction with Brunel Business School, College of Business, Arts and Social Sciences, Brunel University London. No external funds are being provided.

What are the indemnity arrangements?

There is an insurance cover from Brunel University London for any research which has received ethical approval.

Who has reviewed the study?

This study has been reviewed by my supervisor and the College of Business, Arts and Social Science's Research Ethics Committee.

Research Integrity

Brunel University London is committed to compliance with the Universities UK Research Integrity Concordat. You are entitled to expect the highest level of integrity from the researchers during the course of this research

Contact for further information and complaints

Researcher name and details:

Michael Gyabaah (2001576@brunel.ac.uk)

Supervisor's name and details:

Prof. David Gallear (david.gallear@brunel.ac.uk)

For complaints, Chair of the Research Ethics Committee via cbass-ethics@brunel.ac.uk

Section A. Demographic Characteristics of Respondents

1. Please indicate your current job title by ticking the appropriate option below, or specifying at 'Other':

- a. President / Managing Director/ CEO ()
- b. Operations/Production Manager/Senior Officer ()
- c. Manufacturing Manager/Senior Officer ()
- d. Procurement Manager/Senior Officer ()
- e. Supply Chain / Logistics Manager/Senior Officer ()
- f. Information Technology Manager/Senior Officer ()

g. 'Other' senior manager / deputy manager/officer (please specify):

2. For how *long* you have been in this position?

- a. Less than 3 years () b. 3 – 6 years ()
 c. 7 – 10 years () d. More than 10 years ()

3. How many *employees* do you have in your company?

- a. Less than 100 () b. 101 – 500 ()
 c. 501 – 1000 () d. more than 1000 ()

4. Please indicate the *industry* in which your company is working.

- a. Electronic/Electricals manufacturing ()
 b. Food and beverages/drinks manufacturing ()
 d. Pharmaceuticals ()
 e. Metals & metal products manufacturing ()
 f. Chemicals, rubber, plastics, non-metallic product manufacturing ()
 g. Machinery, equipment, furniture manufacturing ()

5. Please indicate your highest educational qualification:

- a. Diploma () b. Bachelor's Degree () c. Master's Degree ()
 d. PHD (Doctorate) Degree () e. Others ()

Section B. **Electronic procurement**

Business to business purchasing practice that utilises electronic commerce to identify potential source of supply to purchase goods and services, to transfer payment, and to interact with suppliers.

Please indicate to what extent your company uses information technology tools in managing each of the following purchasing activities (using the scale: 1. No use, 2. Slight use, 3. Moderate use, 4. Considerable use, 5. Extensive use).

Statements	1	2	3	4	5
a) Electronic ordering to our suppliers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Electronic payment to suppliers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Provision of inventory information to our suppliers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Provision of required product specifications to suppliers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Provision of production planning information to suppliers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

C. **Supplier efficiency**

Supplier efficiency is the ability of suppliers to effectively utilise available procurement systems to facilitate the procurement process in order to ensure fast and effective supply chain transactions.

Please indicate how you would rate your main suppliers' efficiency for each of the items in the table below (using the scale of 1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly agree).

Statements	1	2	3	4	5
a) Maintenance of the required quality standards of the parts/materials requested.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Supplying the required parts/materials at minimum possible cost.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Supplying the right quantity of parts/materials according to specification.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

d)	Timely supply of parts/materials according to schedule.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e)	Effective communication for transactions/continuous improvement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D. Perceived ease of use, and Perceived usefulness

Perceived ease of use is the perception of the user that an electronic system/application can be easily used without extra effort, in order to achieve meaningful results.

Perceived usefulness is the person's acceptance of an electronic system/application framework that can boost their performance at the workplace.

Please indicate how you would rate your experience of 'Perceived ease of use' and 'Perceived usefulness' with e-procurement for each of the items shown in the table below (using the scale 1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly agree.):

Statements	1	2	3	4	5
Perceived ease of use					
a) Learning to use e-procurement systems is easy for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) My interaction with e-procurement system is clear and understandable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Using e-procurement systems enhances the performance of my tasks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Training users of an e-procurement system is easy for our organisation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Training competent personnel to support an e-procurement system is easy for our organisation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perceived Usefulness					
a) Using e-procurement systems increases my job performance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Using e-procurement systems increases my job productivity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Using e-procurement systems enhances my job effectiveness.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E. Quality of Information

Quality of information refers to the accuracy, completeness, relevance, timeliness and reliability of the data and information exchanged with suppliers.

Please indicate how you would rate the Quality of information exchanged with suppliers for each of the items in the table below (Using the scale 1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly agree).:

Statements	1	2	3	4	5
a) The information exchanged between our company and its suppliers is relevant.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) The information that our company and its suppliers exchange is timely.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) The information that our company and its suppliers exchange is accurate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) The information that our company and its suppliers exchange is confidential	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) The information that our company and its suppliers exchange is complete.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section F. Supply Chain Performance

Supply chain performance refers to the output of all the activities (flow of raw materials to companies and finished goods to the final consumer) which are performed in a company's supply chain function.

Please indicate how you would rate your firm's supply chain performance for each of the items in the table below (using the scale of 1. Highly unsatisfactory, 2. Unsatisfactory, 3. Neutral, 4. Satisfactory, 5. Highly satisfactory).

Statements	1	2	3	4	5
How well has your company succeeded in achieving its goals for Supply Chain Performance					
a) Flexibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

b)	Resource efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c)	Costs in supply chain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d)	Delivery lead time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e)	Delivery reliability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f)	Visibility within the supply chain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section G. **Top management support**

Top management support refers to senior management providing the necessary support, resources and guidance to enable the smooth and effective running of business processes.

*Please indicate how would rate your firm's Top management support for each of the items in the table below (using the scale 1. **Strongly disagree**, 2. **Disagree**, 3. **Neutral**, 4. **Agree**, 5. **Strongly agree**).*

Statements	1	2	3	4	5
a) Top management is decisive in providing the needed financial resources to implement e-procurement systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Top management considers the use of electronic procurement a priority in our firm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Top management considers that our firm must adapt itself to the new IT systems in procurement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION H (GENERAL): Digital Capability

Please indicate your level of agreement with the following statements as they apply to your organisation: *(using the scale 1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly agree).*

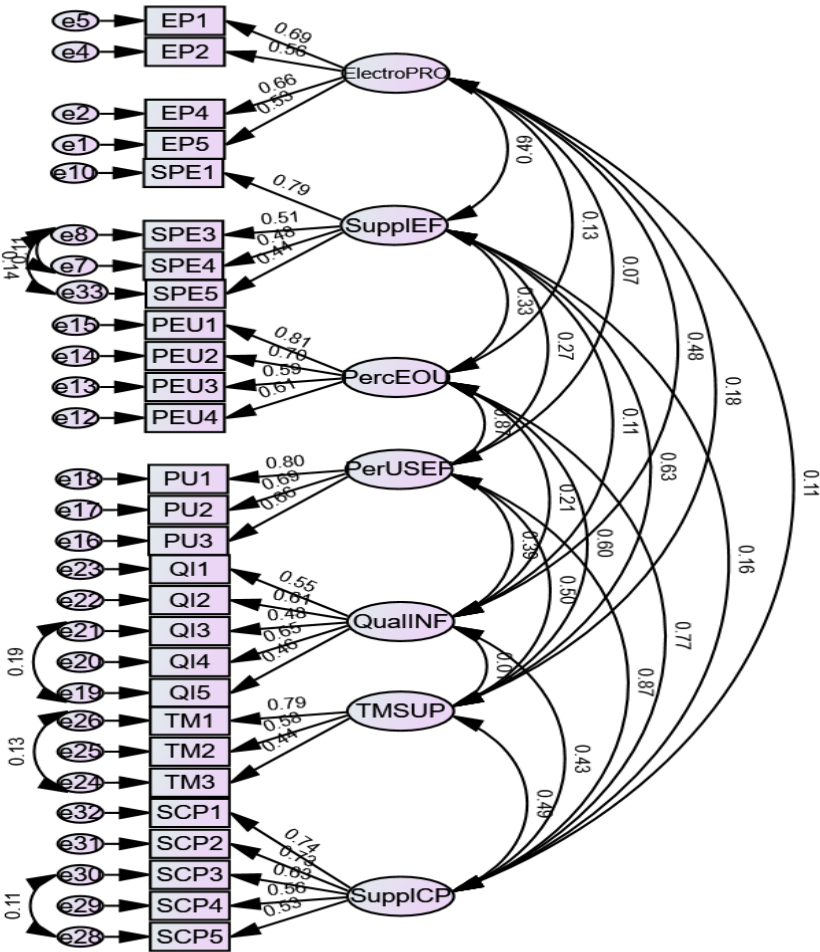
Statements	1	2	3	4	5
a) We have invested in digital competencies training for employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) We scan the market for new digital/web-based solutions of value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) We have an operational plan for digital/web-based application adoption implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) We have cross-functional teams for digital/web-based application projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) We have multiple collaborations in the field of digital/web-based application opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OPT IN:

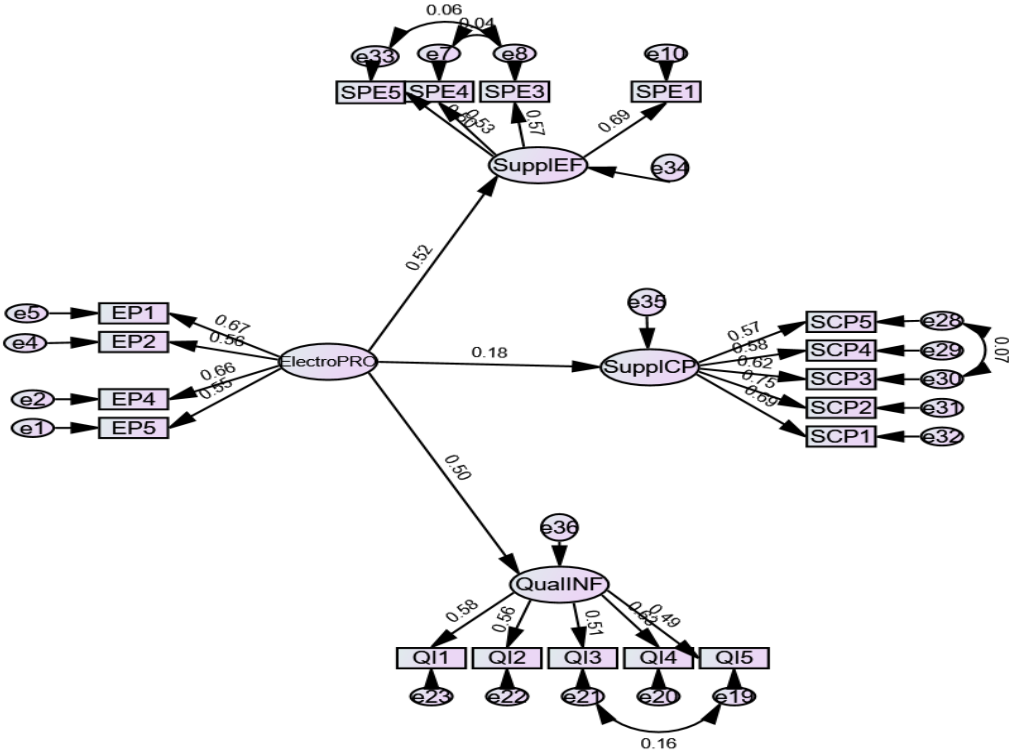
If you would like to receive a Summary of the result of the study, please give your name and your company email address:

Thank you for Participating in this Survey.

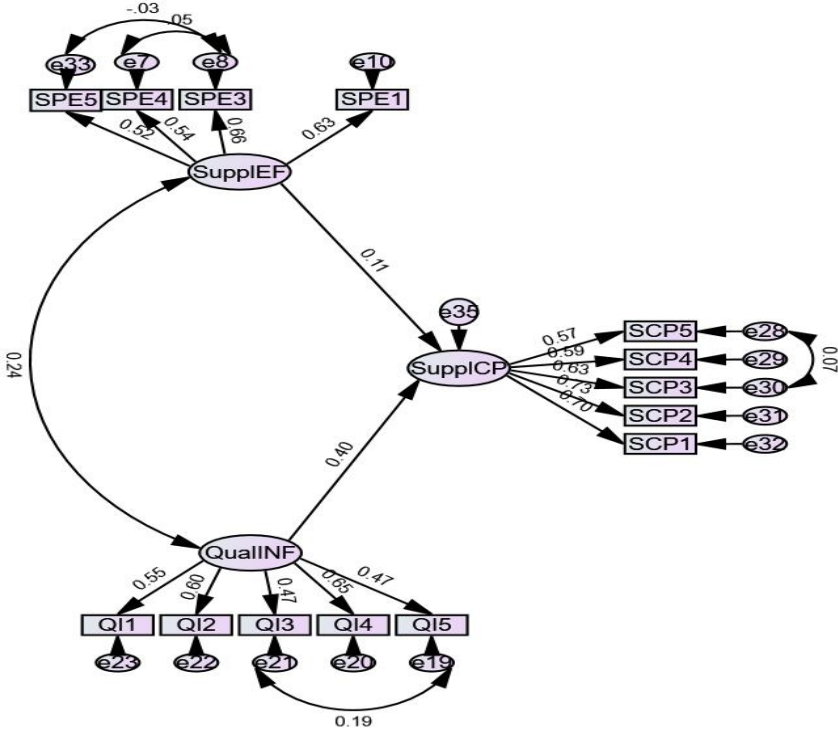
Appendix 2 - CFA Model



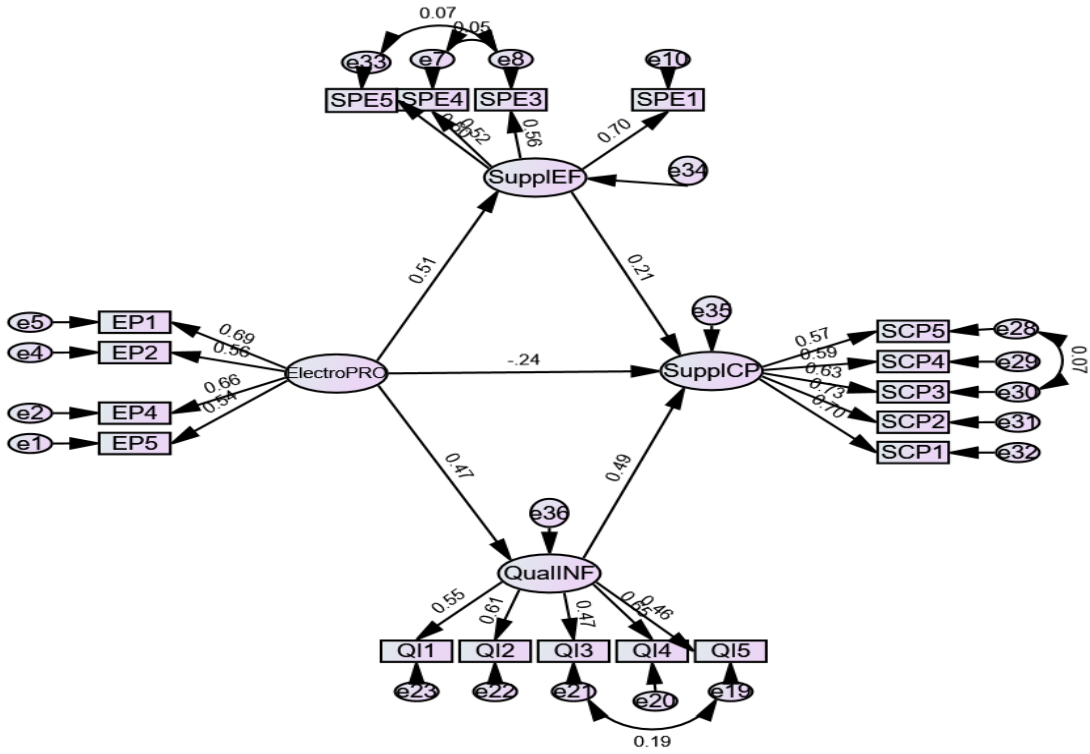
Appendix 3 - Direct Effect (model 1)



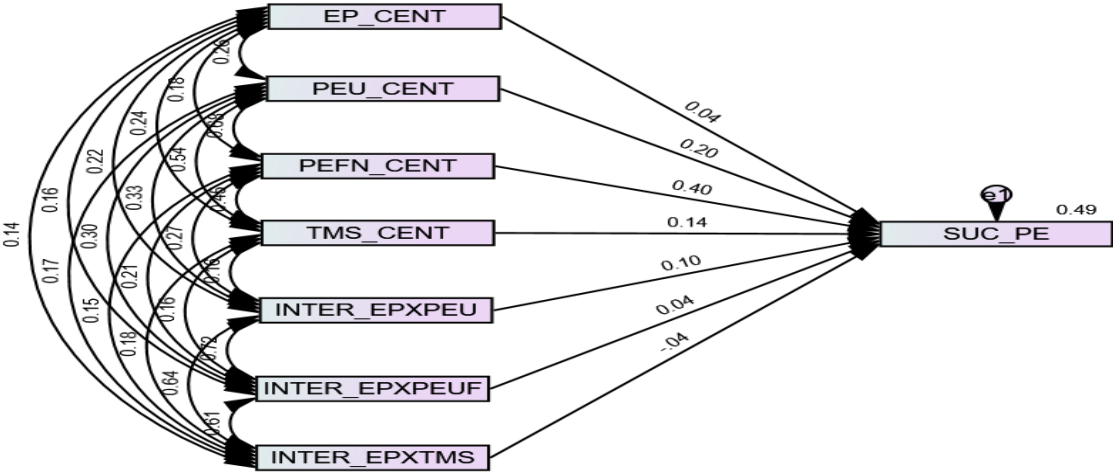
Appendix 4: Direct effect (model 2)



Appendix 5 – Mediation model



Appendix 6 - Moderation model



Appendix 7 - Ethical Approval



College of Business, Arts and Social Sciences Research Ethics Committee
 Brunel University London
 Kingston Lane
 Uxbridge
 UB8 3PH
 United Kingdom
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1 June 2023

LETTER OF APPROVAL

APPROVAL HAS BEEN GRANTED FOR THIS STUDY TO BE CARRIED OUT BETWEEN 01/06/2023 AND 31/03/2025

Applicant (s): MR MICHAEL GYABAAH

Project Title: Electronic procurement and supply chain performance in emerging economies: A study of manufacturing Sector in Ghana

Reference: 42525-LR-May/2023- 45012-3

Dear MR MICHAEL GYABAAH

The Research Ethics Committee has considered the above application recently submitted by you.

The Chair, acting under delegated authority has agreed that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that the conditions of approval set out below are followed:

- The agreed protocol must be followed. Any changes to the protocol will require prior approval from the Committee by way of an application for an amendment.
- Please ensure that you monitor and adhere to all up-to-date local and national Government health advice for the duration of your project.

Please note that:

- Research Participant Information Sheets and (where relevant) flyers, posters, and consent forms should include a clear statement that research ethics approval has been obtained from the relevant Research Ethics Committee.
- The Research Participant Information Sheets should include a clear statement that queries should be directed, in the first instance, to the Supervisor (where relevant), or the researcher. Complaints, on the other hand, should be directed, in the first instance, to the Chair of the relevant Research Ethics Committee.
- Approval to proceed with the study is granted subject to any conditions that may appear above.
- The Research Ethics Committee reserves the right to sample and review documentation, including raw data, relevant to the study.
- If your project has been approved to run for a duration longer than 12 months, you will be required to submit an annual progress report to the Research Ethics Committee. You will be contacted about submission of this report before it becomes due.
- You may not undertake any research activity if you are not a registered student of Brunel University or if you cease to become registered, including abeyance or temporary withdrawal. As a deregistered student you would not be insured to undertake research activity. Research activity includes the recruitment of participants, undertaking consent procedures and collection of data. Breach of this requirement constitutes research misconduct and is a disciplinary offence.

Professor David Gallear

Chair of the College of Business, Arts and Social Sciences Research Ethics Committee

Brunel University London

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