The Effects of Electronic Procurement on Building Construction Projects in Rivers State, Nigeria

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ABSTRACT

This study examined the effects of electronic procurement on building construction projects in Rivers State, Nigeria. The objectives were to assess the level of adoption of e-procurement, identify barriers to its adoption, and develop strategies to overcome these barriers. A mixed-methods approach was employed, involving descriptive statistics, relative importance index, severity index analysis, factor analysis. surveys, principal component analysis (PCA) and correlation analysis to analyze data from 180 respondents in the construction industry. This research found out that there is a high Relative Importance Index analysis (RII) for awareness to the tune of (0.734) and system integration to the tune of (0.776), which suggests that while there is a strong understanding of e-procurement's benefits and its integration with existing systems, its actual usage is somewhat less frequent showing a relative importance index of (RII= 0.689[]. However, significant barriers were identified, using Severity Index analysis, the result revealed that the cost security concerns (73.6%), lack of expertise (67.2%), and technical challenges (66.6%[]. Resistance to change, while notable, has a lower severity index (61.0%[]. The high cost and security concerns are major hurdles for adoption. PCA results indicated that change management and cost management are the most significant factors influencing e-procurement adoption, followed by technical support and security measures. The correlation analysis revealed significant relationship between efficiency, cost and time metrics in both systems. Recommendations include enhancing training and education programs, implementing cost management strategies, addressing security concerns, providing technical support, and fostering change management, which aims to overcome the identified barriers and fully leverage the benefits of e-procurement systems in the construction industry.

Key words: Building Construction, Cost Saving, Efficiency, Electronic Procurement, Implementation.

1. INTRODUCTION

The construction industry is a fundamental pillar of economic growth and development, particularly in developing regions such as Rivers State, Nigeria. This sector not only contributes significantly to the economic growth and development of a country but also plays a crucial role in infrastructure development and job creation. Despite its importance, the construction industry in Nigeria faces numerous challenges, including inefficiencies, corruption, project delays, and cost overruns. These persistent issues often result in low quality project delivery, thereby distorting economic and social development goals [34].

Electronic procurement in building construction projects refers to the use of electronic systems and platforms to manage the entire procurement process in the building construction project. E-procurement system is web technology-based purchasing solutions aimed at simplifying commercial transactions within and between organizations and information technology solutions for ordering, logistics and handling systems as well as for payment systems [40]. [19], in similar view posits that e-procurement is the use of electronic communication technologies and transaction processes to buy services, goods, and works or conduct tendering for construction works.

[17], made a different observation where he explained that various business concerns found it appropriate to embrace the use of internet facilities for enhancing performance of different project tasks. [42], also believe that E-procurement has become an avenue for integrating communities and countries into a global market economy over the past few decades.

Going by the discuss of the previous authors, it is viewed that the benefits of e-procurement in the construction industry are manifold. Firstly, it promotes transparency and accountability by creating a digital trail for all transactions. This increased visibility makes it easier to track and audit procurement activities, thus [17] specified that this increased visibility makes it easier to track and audit procurement activities thereby reducing opportunities for corrupt practices, during procurement contract execution. Secondly, e-procurement enhances efficiency and cost savings by automating procurement tasks, which reduces the time and resources required to complete them. This improved efficiency translates

into cost savings that can be allocated to other critical areas of construction projects [25]. Thirdly, e-procurement facilitates better vendor management by enabling improved communication and collaboration with suppliers. This ensures that materials and services are delivered on time to meet quality standards, thereby enhancing overall project performance [46]. Lastly, e-procurement provides access to real-time data and analytics, allowing project managers to make informed decisions swiftly, which exhibits essential capability in the dynamic environment of construction projects [1].

Rivers State, located in the Niger Delta region of Nigeria, is a hub of construction activities due to its strategic importance in the nation's oil and gas industry. This has led to substantial infrastructure development, including the construction of roads, bridges, and buildings [36]. However, the construction sector in Rivers State is viewed as plagued by bureaucratic inefficiencies and corruption that often result in project delays and cost overruns. The adoption of e-procurement in this context holds significant potential to address these challenges and improve on successful project execution.

Despite the promising benefits, the adoption of e-procurement in Rivers State is still in its early stage. Encouragingly, several construction firms and government agencies are beginning to recognize the advantages of digital procurement and are investing in the necessary infrastructure and training in the area of e-procurement. However, this widespread adoption faces barriers such as resistance to change, limited technological infrastructure, and lack of skilled personnel [45]. These setbacks have necessitated procurement reforms in Nigeria through the implementation of the e-procurement systems [3], [4]. It is against this backdrop that this study aims at examining the effects of e-procurement on building construction project in Rivers State.

Statement of the Problem

The construction industry in Rivers State, Nigeria, is a critical driver of economic development, contributing significantly to the region's infrastructural development, and better employment opportunity. However, this sector faces numerous challenges that impede its efficiency and effectiveness. The key issues include project delays, cost overruns, substandard project quality, and pervasive corruption.

E-procurement has the potential to significantly improve project performance in the construction sector by creating a transparent and efficient procurement environment. However, despite its potential benefits, the adoption of e-procurement in Rivers State's construction industries is still in its infancy, facing several barriers such as resistance to change, inadequate technological infrastructure, and shortage of skilled personnel [37], [45].

The potential of e-procurement to address these issues presents a compelling case for its adoption. However, realizing this potential requires a comprehensive understanding of the current procurement landscape, the effects of e-procurement on building construction projects, and the barriers to its implementation. This study aims to explore these dimensions, providing a robust foundation for improving procurement practices and enhancing the overall performance of building construction projects in Rivers State.

Objectives of the Study

The aim of this study is to examine the effects of electronic procurement on building construction projects in Rivers State, Nigeria. The specific objectives are to:

1. Assess the level of adoption of electronic procurement on building construction projects in Rivers State.

2. Identify the barriers of electronic procurement systems on building construction projects in Rivers State.

3. Develop strategies of overcoming the barriers of electronic procurement systems on building construction projects in Rivers State.

Research Questions

In order to achieve the purpose of this study, the following research questions are adopted:

1. What is the level of adoption of electronic procurement on building construction projects in Rivers State?

2. What are the barriers to the adoption of electronic procurement systems on building construction projects in Rivers State?

3. What strategies can be developed to overcome the barriers to the adoption of electronic procurement systems on building construction projects in Rivers State?

Research Hypotheses

The research hypotheses used for this study are stated in the following null form

H01: There is no significant level of adoption of electronic procurement on building construction projects in Rivers State.

H02: There are no significant barriers to the adoption of electronic procurement systems on building construction projects in Rivers State.

H03: There are no effective strategies for overcoming the barriers to the adoption of electronic procurement systems on building construction projects in Rivers State.

2. LITERATURE REVIEW

Concept of Electronic Procurement

Electronic procurement, also known as e-procurement or supplier exchange, is the process of requisitioning, ordering

and purchasing goods and services online. It is a business-to-business process, [22]. Unlike e-commerce, e-procurement utilizes a supplier's closed system and is only available to registered users. E-procurement facilitates interactions between preferred suppliers and customers through bids, purchase orders and invoices. Electronic procurement (e-procurement), which implies the automation of an organization's procurement of goods and services through web-based applications, has been noted for its potentials to rationalize organizational expenditure, reduce administrative costs, and stimulate efficiency in operations [20]. Typically, procurement is one of the most important areas in organizational cost structure, and public sector organizations applying e-procurement for contracts could generate several benefits depending on the context of its implementation [30].

Types of E-Procurement

Hosseini (2019) classifies e-procurement into the seven categories: the first is Web-based ERP (Enterprise Resource Planning). This deals with creating and approving purchasing requisitions, placing purchase orders and receiving goods and services by using a software system based on Internet technology. The second category is E- MRO (Maintenance, Repair and Operations) which deals with creating and approving purchasing requisitions, placing purchase orders and receiving non-product related MRO supplies. The third type is E-sourcing, which involves Identifying new suppliers for a specific category of purchasing requirements using Internet technology. The fourth type is E-tendering that involves sending requests for information and prices to suppliers and receiving the responses of suppliers using Internet technology. E-reverse auctioning is another type of e-procurement. This makes use of Internet technology to buy goods and services from several known or unknown suppliers. The sixth type is E-informing which involves gathering and distributing purchasing information from internal and external parties using Internet technology. The last type of e-procurement, according to [26], is E-market sites that enables the buying communities to access preferred suppliers' products and services, add to shopping carts, create requisition, seek approval, receipt purchase orders and process electronic invoices with integration to suppliers' supply chains and buyers' financial systems.

E-Procurement Implementation in Construction Projects

The Rivers State Government is on track to introducing e-procurement for tendering and online registration of businesses and companies via the State Bureau of Public Procurement [16]. This e-procurement will be able to streamlines government activities with the aim of improving the quality of services it renders. Suppliers and construction firms could easily participate in the government tendering procedures by subscribing to the e-procurement system, as the system not only eliminates the traditional procurement procedures, but also provides reliable outcomes in a complex environment like government establishments [40]. As such, the e-procurement

helps the businesses to simplify regulatory processes and cuts red-tapism. It also assists the government in online business, especially in such areas like e-marketing strategies. Again, [9] noted that e- procurement system is a useful tool in government to business, by improving the quality of communication and transactions with business. Also, it improves accountability and transparency in government contracts and projects.

The e-procurement procedure allows government contracting authorities to procure goods and services from their suppliers electronically, by transforming the hitherto manual procurement procedure into an electronic, internet-based system. Suppliers, in turn, benefit from being able to present their products on the World Wide Web. They (suppliers) are able to receive, manage and process government purchase orders, and receive payment from government agencies online by using the e-procurement system. With the automation of the entire procurement cycle in e-procurement system, suppliers benefit significantly from the opportunity to reach a broader base of buyers than ever before coupled with lower operating costs, shorter turnaround time, additional revenue and increased customer satisfaction. Evidence from the extant literature reveals important benefits of e-procurement implementation in the government sector [35].

Overview of Construction Industry

Construction has been defined as a sector of an economy which through effective planning, construction design, constructions work, alterations, maintenance and operation will transform information, finance, human and material resources over time into constructed facilities through effective project management [27]. The construction industry and its project are the commonly recognized project-based industry both in developing and developed nations due to its unique output that transform social economic growth and development of the society.

Construction projects are time-consuming undertakings, which are considered successful if delivered on time, to an appropriate budget and to a quality desired by the owner [21]. However, in recent times, apart from the above-mentioned indicators of project success, health and safety, and environmental performance have also become important aspects of project performance. Many literatures and studies on the construction industry have analyzed projects and tried to identify factors affecting project performance. Though the factors found are numerous, a lot of the studies indicated that procurement related factors have significant effects on construction project performance [33].

In a study, [8] noted that countries all over the world are always besets with various political and socio-economic problems at one time or the other. Constant efforts are often being made by the various governments to find solutions to such problems. This is usually through administrative reforms, whereby a policy option is made to halt a named political, educational or

socio-economic problem. [39] further stressed that the due process policy is a package of policy measures, and like any other policy, it has set goals, which it aimed at achieving. Thus, the institution of the reform measures presupposes the existence of some administrative deficiencies. The rectification of the flows in the administrative machinery depends on the satisfactory implementation of the reform goals [7].

According to [33], despite the numerous social economic roles played by the construction industry in the growth and development of the society the construction industry is still plagued by numerous challenges such as:

Poor Cost management and performance

Poor Time management and performance

Inadequate Quality performance

Low level of professionalism

Poor implementation of existing statutes and codes

Obsolete governing legislations and codes of practice

Inadequate work opportunities

Administrative bottlenecks in planning approvals and administration

Resource insufficiency

Institutional weakness.

Barriers to Implementing E-Procurement in the Construction Industry

There are several tangible and not-so-tangible risks that have led to the relatively slow uptake of e-procurement in construction. These barriers can largely be divided into technical, human, and organizational impediments.

Technical barriers present a major concern for many within the construction industry. Simple issues such as lack of high-speed internet and incompatible software systems are cited as a reason for reluctance for many. Another major barrier seems to be the perceived difficulty of integrating e-procurement systems with existing internal processes. Still, more contractors are concerned with the security aspect and worry that integrating new IT systems could lead to an uptick in system vulnerabilities. Cyber security concerns are valid but the procurement industry takes its responsibilities seriously and with adequate training, staff will be able to spot potential problems ahead of time. Technical challenges such as limited high-speed internet access, incompatible software systems, and integration difficulties with existing processes hinder e-procurement adoption. Cybersecurity concerns are another major issue, as contractors fear increased vulnerabilities. However, with proper training and awareness, these risks can be mitigated [38].

Human barriers: may be less obvious but are no less impactful. Management may feel they have limited resources to implement such a fundamental change and then provide the necessary training for staff. Coupled with this, a simple resistance to change and fear of the unknown, and we see low levels of implementation within construction [10].

Organizational barriers can arise when the implementation of a new system could lead to the transformation of an organization's existing structure or when long-held business relationships may be affected.

According to [2] some of the perceived barriers to E-Procurement adoption and implementations are:

Inadequate Information Technology Infrastructure

Top Management Support

Organizational Policies

Leadership Support

Legality of the system

Cost of Implementation

Inadequate knowledge and skills of E-Procurement

Lack of business relationship between suppliers and clients

Security of Transactions

System Compatibility

Similarly, [6] also pose that the challenges facing the low adoption of E-Procurement in developing nations like Ghana, Kenya, South African and Nigeria etc. are:

Insufficient Support from Project Stakeholders

Resistant to Adoption of New Technology

Security and Authentication issues

Unavailability of Supporting Infrastructure and Facilities

Benefits of Practicing E-procurement

Adopting E-procurement system has brought great benefits to governments and it has been noted as a way by which governments can save management cost and become more efficient in procurement of goods online. The main advantage that e-procurement can deliver include cost reduction, process re-organization, improved contract fulfillment, among other benefits. The significant cost saving of e-procurement to the government is in the reduction of cost and efforts of processing the purchase order, which can be manipulated electronically, and reduction in inventory costs and decrease in order fulfillment. [14] identified four types of cost saving from using e-procurement system. These include, order cost, administrative cost, lead-time order cost and opportunity cost of capital. E-procurement system offers more effective and

efficient procurement process in line with the country's transformation to the knowledge-based economy. It is a way for the government to promote the widespread adoption of e-Business in the country. E-procurement helps provide latest product information and pricing to the government which is available online. The system is supposed to be up to date with the latest information that will help the buyer to make a more accurate procurement decision

Main benefits of the e-procurement are: Cost savings and subsequent increase in return-on investment; upgrade of store network productivity by giving ongoing information with respect to item accessibility, stock level, shipment status, generation prerequisites; assistance of collective arranging among store network accomplices by sharing information on request figures and generation plans that direct production network exercises; intense linkage of customer demand information to upstream SCM (stock system organization) limits, while in like manner empowering compel SCM operations [12].

Theoretical Literature

Technology Acceptance Model (TAM) and Diffusion of Innovations Theory are adopted as the theoretical justification for this study.

Technology Acceptance Model

The Technology Acceptance Model (TAM) proposed by [11] provides a theoretical foundation for understanding stakeholders' acceptance and adoption of technology. In the context of electronic procurement in construction projects in Rivers State, this model can help assess the factors influencing stakeholders' willingness to adopt digital platforms (Davis, 1989[]. According to TAM, technology acceptance is a three-stage process, whereby external factors (system design features) trigger cognitive responses (perceived ease of use and perceived usefulness), which, in turn, form an effective response (attitude toward using technology/intention), influencing use behaviour [11].

TAM represents the behavior response, as the outcome predicted by perceived ease of use, perceived usefulness and behavioural intention. Perceived ease of use and perceived usefulness capture the expectations of positive behavioural outcomes and the belief that behaviour will not be labour-consuming [11]. According to a follow-up study, behavioural intention can be substituted by the attitude toward behaviour, which is an affective evaluation of the potential consequences of the behaviour [5]. The higher the affective response, the higher is the likelihood that the behaviour will take place. The effect of perceived usefulness on actual use can be direct, which underscores the importance of the variable in predicting behaviour. Although perceived ease of use does not affect use behaviour directly, it underpins the effect of perceived usefulness. The model implies that if an application is expected to be easy to use, the more likely it is that it will be considered useful for the user and the more likely it is that this will stimulate the acceptance of the technology. The application of the technology acceptance model to this study can be applied to assess the willingness of various stakeholders, such as contractors, suppliers, and project managers, to embrace electronic procurement systems.

Diffusion of Innovations Theory

Diffusion of Innovations Theory developed by [41] explains how an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. This theory helps in understanding how new technologies are adopted and diffused among different segments of the industry [41]. The end result of this diffusion is that people, as part of a social system, adopt a new idea, behaviour, or product. Adoption means that a person does something differently than what they had previously (i.e., purchase or use a new product or technology, acquire and perform a new behavior, etc. The key to adoption is that the person must perceive the idea, behaviour, or product as new or innovative. It is through this that diffusion is possible. Adoption of a new idea, behavior, or product (i.e., "innovation") does not happen simultaneously in a social system; rather it is a process whereby some people are more apt to adopt the innovation than others. Researchers have found that people who adopt an innovation early have different characteristics than people who adopt an innovation later.

Diffusion of Innovations Theory is relevant to this study in the following ways:

Adopter Categories: The Diffusion of Innovations Theory classifies individuals into adopter categories based on their readiness to embrace new technologies. In the context of electronic procurement in construction projects in Rivers State.

Innovators: These are the early adopters of electronic procurement systems. Understanding the characteristics and motivations of innovators can provide insights into the initial stages of technology adoption in the construction sector.

Early Adopters: These are the opinion leaders and influencers within the industry. Identifying early adopters can help in creating targeted strategies to promote the adoption of electronic procurement among key stakeholders.

Early Majority, Late Majority, and Laggards: Understanding the dynamics of the early majority, late majority, and laggards is crucial for assessing the overall diffusion process. It helps in identifying potential barriers, challenges, and tailoring adoption strategies to different groups.

In essence, Diffusion of Innovations Theory highlights the role of communication channels in spreading information about innovations. The most effective channels for communicating the benefits and features of electronic procurement can optimize the dissemination of information and offers a comprehensive framework for understanding the complexities of technology adoption.

Empirical Review

[24] investigated the factors that influenced the adoption of e-Procurement in building projects delivery using online questionnaire survey involving 603 stakeholders in the South African construction industry. The three most widely used e-Procurement technologies were e-mail, websites and portals, which were used for communication, exchange of bill of quantities, CAD drawings and project specifications. Findings revealed that the characteristics of e-Procurement technology, size of firms, and the influence of firms outside the building industry were among the key factors that influenced the use of e-Procurement in the delivery of building projects. The study did not identify the leading adopters of e Procurement and the organizational factors that have significant influence on its adoption.

[44] examined a questionnaire survey of 93 respondents in the South African construction industry. Findings revealed that the factors that constituted barriers to the adoption of e-Procurement in sourcing construction materials were the lack of awareness, resistance to change, (c) high cost of installation and operation and Internet fraud. The study focused only on the use of e-Procurement in the procurement of construction materials; and thus, neglecting other uses of e-Procurement in construction. In addition, the study did not identify the specific type of e-Procurement technologies and application used.

[6] investigated the use of e-Procurement in selected construction firms in Oyo state, Nigeria. The data were derived using a well-structured questionnaire survey involving 104 respondents. Descriptive statistical and correlation analyses were used to analyze the data. Findings show that the use of electronic procurement in the selected construction firms for carrying out procurement function is high with majority of the professionals affirming the use of the system, the four categories of e-Procurement used were e-mail, static websites, web.2.0 technologies and portals that have capabilities of supporting the execution of functions limited to intra and inter firm communication and exchange of project information and data. Consequently, between 84 percent and 76 percent of the respondents used these e-Procurement technologies for communication of information, exchange of bill of quantities, project reports, CAD drawings and project specifications. Consequently, factors with the highest positive impacts on the use of these technologies in the firms were the speed of transactions, lower transaction cost and ease of use.

[2] evaluated the critical success factors (CSFs) for e-Procurement adoption in the Nigerian construction industry. The study was carried out in the six geo-political zones in Nigeria using a survey research design. Construction stakeholders were selected using purposive and random sampling techniques. The study also revealed that construction stakeholders perceived the availability of reliable, affordable, and fast Internet services as the most critical success factor for the adoption of e-Procurement technologies. The critical

success factors (CSFs) were further classified into management support for physical infrastructure, and human factors and characteristics of the technology. The study showed that these critical success factors (CSFs) are crucial for the adoption of e-Procurement systems in the Nigerian construction industry. The study recommended that there is still a need for increased awareness of the e-Procurement tools and technologies and the benefits that are accrued from their use among public sector construction participants.

[34] examined the potential of e-procurement in reducing corrupt practices in public procurement using quantitative research approach. Questionnaires were self-administered to government officers in Ministries, Departments and Agencies (MDAs) where construction works are mostly being procured. Fifty-six (56) valid questionnaires were returned which was analyzed using descriptive statistics and factor analysis. The findings revealed that unjustified use of exceptions and illicit fragmentation of the procurement practice are major causes of corruption, while the best anti-corruption strategy is to reduce lithographic works and physical contacts. The study concludes that effective implementation of e-procurement will assist in reducing unethical practices in the procurement process.

[16] examined the Impact of Sustainable Procurement of Construction Materials on Projects Delivery in Nigeria using structured questionnaire, relative importance index and average mean score, the study revealed that the success factors of sustainable procurement have positive impact on construction materials procurement for project delivery in Nigeria as factors such as organizational strategy, contract management, user satisfaction, technological parameters and government policies are the most important factors influencing sustainable procurement of construction materials on project delivery which is guided by the rules and regulations of the public procurement Act 2007. The study recommended that efforts should be made to control the relevant constraints/challenges by all stakeholders involved in the procurement process of a project.

[29] examined the implementation of e-procurement in public building construction projects in the Federal Capital Territory. The study adopted quantitative approach. A total of 145 questionnaires were administered using stratified sampling method. A total of 143 questionnaires was returned and found valid for analysis. The collected data were analyzed using Percentages, frequency, Mean Item Score (MIS), Relative Importance Index (RII) and Skruskal Wallis test. The study found that lack of technical expertise, unreliable power supply, inadequate government support, poor ICT and internet facilities, and high costs of implementation are the main barriers to e-procurement uptake in FCTA. Good governance in reduction of collusion among the bidders, and transparency and openness in public procurement, are the leading prospects to e-procurement implementation in the FCTA. Inadequate financial resources and backing, and inadequate technological

infrastructure of tenderers are the challenges of implementing e-procurement by the public. It was found that the prominent strategies for effective implementation of e-procurement in public sectors are; assessing and documenting the current procurement process, review and select the optimal e-procurement solution provider for your needs. It is recommended that appropriate legislations should be put in place by the government to encourage the uptake and adoption of e-procurement in the Federal Capital Territory Administration secretariat.

[15] analyzed a questionnaire survey of 483 participants of the UK construction industry. A majority of the procurement activities was done electronically on write-once CD. E-Procurement adoption rate across the UK construction industry was found to be around 27%; while the private sector was found to be lagging behind the public sector in the e-Procurement use in construction. The study identified the type of organization as the only organizational factor that influenced the adoption of e-Procurement in construction.

3. METHODOLOGY

Research Design

Research design is a master plan or structure that provide a road map for the research to collect, arrange, measure and analyze data with the aim of providing answers or solutions to the problems or questions under investigation [26]. This research made use of both quantitative and qualitative methods. This quantitative method involved the use of primary data via questionnaire distribution while the qualitative method will was with the use of focus group discussion.

Population

Population refers to the entire group of persons or elements under investigation. Mugenda and Mugenda (2003) define the target population as a complete set of individuals, case or objects with the same common observable characteristics. The population for this study was the registered stakeholders from the selected companies which comprised of project manager, project clients, civil engineers, procurement officers, quantity surveyors, architects, contractors and sub-contractors.

Sample Size and Sampling Techniques

The sample size is a selected proportion of the population intended as to represent the population [29]. The sample size should be adequate enough to answer the research questions and for the findings to be used to judge the whole [46]. This study employed purposive sampling and snow balling sampling in reaching respondents for the study. Structured questionnaires were administered to these research respondents, namely project manager, project clients, civil engineers, procurement officers, quantity surveyors, architects, contractors and sub-contractors working in the different selected construction companies in Rivers State. 60 copies of the questionnaires

were returned for analysis from each of the senatorial district in Rivers State making up a total number of 180 copies of the questionnaires used as the sample size for the analysis.

Also, the researcher used probability (stratify random sampling) and non-probability (purposive/judgmental) sampling techniques. The stratified random sampling was utilized in this study. This was done by segmenting the internal stakeholders of the firm based on their job status ranging from skilled and unskilled manpower, top managers, strategic managers, operational managers in various functional departments. This technique is appropriate in order to ensure that every element in the sampling frame has an equal opportunity of being selected to express their view on the effect of electronic procurement on building construction project in Rivers State.

4. RESULTS AND ANALYSIS

Results

This section presents the field data obtained from the 180 study participants comprising the demographic information of the participant. Collecting this demographic information provides valuable context for analyzing the responses and understanding the influence of different background factors on the adoption and effectiveness of electronic procurement systems in building construction projects in Rivers State, Nigeria. The participants were asked to provide information based on their gender; this is presented below;

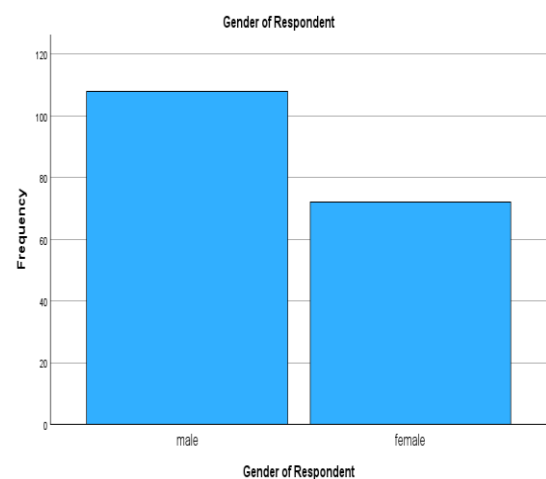### General Demographic Data of Respondents

Figure 1: Gender of Respondent

The figure 1 shows that 60% of the respondents are male representing a higher percentage of the respondents while 40% are female. This is also shown in the table 1below.

Table 1:   Gender of Respondent

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Male	108		60	60
female	72		40	10
Total	180		10	

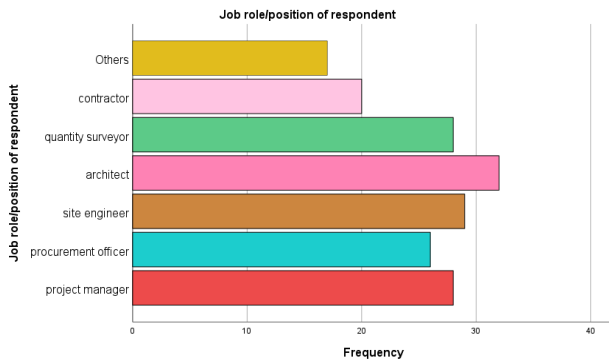|	Frequency	Percent	Valid Percent	Cumulative Percent
site engineer	29		16.1	46.1
Architect	32		17.8	63.9
quantity surveyor	28		15.6	79.4
Contractor	20		11.1	90.6
Others	17		9.4	100.0
Total	180		100.0	

Figure 2: Job role/position

Figure 2 above represents the job role/position of each respondent, 15.6% represents project manager, 14.4% represents procurement officers, 16.1% represents site engineer, 17.7% were architect, 15.5% were quantity surveyor, contractors represent 11.0% of the population, while 9.4% of the respondent are captured as security personnel among others, as shown also in table 4.2 below.

Table 2:   Job role/position of respondent

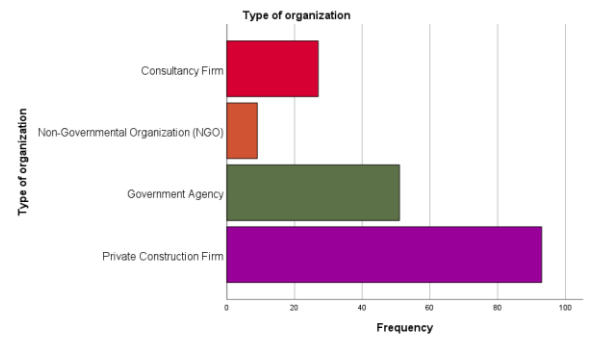|	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Project Manager	28	15.5	15.6	15.6
Procurement Officer	26	14.4	14.4	30.0

Figure 3: Type of organization

Figure 3 above shows the type of organization captured in our analysis, private construction firm was 51.4% follow by government agency with 28.3%, non-governmental organization with 5.0% and finally consultancy firms with 14.9%. This is also reflected in table 4.3 below.

Table 3: Type of organization

	Frequency	Percent	Valid Percent	Cumulative Percent

Val id					
Valid	Private Construction Firm	9 3	5 1. 4	5 1 . 7	5 1. 7
	Government Agency	5 1	2 8. 2	2 8 . 3	8 0. 0
	Non-Governmental Organization (NGO)	9	5. 0	5 . 0	8 5. 0
	Consultancy Firm	2 7	1 4. 9	1 5 . 0	1 0 0. 0
	Total	1 8 0	9 9. 4	1 0 0 . 0	

Table 4: Familiarity with Electronic Procurement Systems

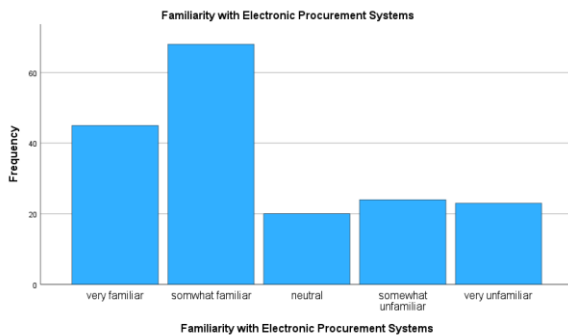|		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very familiar	45	24. 9	25. 0	25. 0
	some what familiar	68	37. 6	37. 8	62. 8
	Neutral	20	11. 0	11. 1	73. 9
	some what unfa miliar	24	13. 3	13. 3	87. 2
	very unfa miliar	23	12. 7	12. 8	10 0.
	Total	18 0	99. 4	100 .	

Figure 4: Level of familiarity with electronic procurement systems

We examined each participant in terms of their level of familiarity with electronic procurement systems, from figure 4.4 above, 24.9% and 37.6% are familiar with electronic procurement systems, and 11.0% were neutral while 13.3% and 12.7% were unfamiliar with electronic procurement system supported in table 4.4 below.

Results for the First Objective

Assess the level of adoption of electronic procurement on building construction projects in Rivers State.

Table 5: The level of adoption of electronic procurement on building construction projects in Rivers State

S/ N	Level of Adoption of Electronic Procurement	SD	D	N	A	S A	RI I
1	I am well aware of the concept and benefits of electronic procurement in building construction projects	10	20	3 5	9	46	0. 73 4
2	Electronic procurement is frequently used in our building construction projects.	20	30	2 1	68	41	0. 68 9

3	Employees in our organization have received adequate training on electronic procurement systems	21	27	18	75	39	0.693
4	Electronic procurement systems are well integrated with our existing project management and procurement systems.	9	21	18	67	65	0.779
5	The rate of adoption of electronic procurement in our building construction projects is high	12	31	37	77	23	0.676

Table 5 displays the level of adoption of electronic procurement on building construction projects in Rivers State. From the result, it was noted that awareness of e-Procurement has a high RII score of 0.734 indicates strong awareness of electronic procurement among respondents, showing that they are familiar with the concept and its benefits in building construction projects. The RII of 0.689 suggests a moderate-to-high frequency of using electronic procurement in projects. However, this lower score compared to awareness implies that while respondents are aware of e-procurement, its usage may not be as frequent. With an RII of 0.693, it indicates that a considerable number of respondents agree that adequate training has been provided to employees on the use of e-procurement systems. Integration with other systems shows the highest RII of 0.776, it reflects strong agreement that electronic procurement systems are well integrated with existing project management and procurement systems. This is a positive indicator of technological readiness for e-procurement adoption. High adoption rate of 0.676 suggests that while there is awareness and some level of use, the overall adoption rate is slightly lower, which might point to potential barriers in scaling up e-procurement usage.

The Technology Acceptance Model (TAM) can help explain these results. According to TAM, two major factors influence the adoption of technology: perceived usefulness and perceived ease of use. High awareness (73.4%) and integration (77.6%) suggest that respondents perceive e-procurement as beneficial and compatible with their existing systems. However, the lower scores in training (69.3%) and frequent use (68.9%) might indicate perceived challenges in ease of use, thus slowing widespread adoption. Empirical studies, such as those by Afolabi et al. (2019), have found that inadequate training and low compatibility with existing systems are significant barriers to the adoption of e-procurement in Nigerian construction projects, which aligns with the moderate RII values for these factors in the study. This suggests that while strides have been made in awareness and integration, more focus is needed on employee training and easing the use of e-procurement to fully achieve high adoption levels.

Results for the Second Objective

Identify the barriers of electronic procurement systems on building construction projects in Rivers State.
To assess the barriers to the adoption of electronic procurement systems in construction projects in Rivers State, the Severity Index (SI) method and Factor Analysis for dimensional reduction are used to analyze the responses from 180 participants.

Severity Index Analysis:

The Severity Index (SI) is used to determine the level of severity of each barrier by ranking the severity of each based on the responses collected (Table 6).

$$SI = \frac{\sum (f \, X \, w)}{N \, X \, 5} X \, 100 \qquad \text{Equation 1}$$

Where:

- f = Frequency of each response

- w= Weight assigned to each response (1 to 5, where 5 = "Strongly Agree" and 1 = "Strongly Disagree")

- N = Total number of respondents

- 5 = Maximum weight (Strongly Agree)

Table 6: Severity Index Results

Barrier	Severity Index (SI)
The cost of implementing electronic procurement systems is a major barrier for our organization.	74.2%
Security concerns regarding electronic procurement systems prevent us from fully adopting them.	73.6%
Our organization lacks the necessary expertise to fully implement and utilize electronic procurement systems.	67.2%
We face significant technical challenges in implementing electronic	66.6%

procurement systems.		
There is resistance to adopting electronic procurement systems among our staff.	61.0%	

The most significant barrier, with a severity index of 74.2%, is the cost of implementing electronic procurement systems, followed closely by security concerns at 73.6%. The lack of expertise and technical challenges are also major barriers, with severity indexes of 67.2% and 66.6% respectively. Resistance from staff has the lowest severity index of 61.0%, though it remains a considerable barrier.

Factor Analysis (Dimensional Reduction)

Factor analysis was conducted to identify underlying factors or dimensions that contribute to the barriers, grouping similar barriers into broader categories.

Results from Factor Analysis

Using SPSS, factor analysis (Principal Component Analysis) reduced the barriers into the following dimensions:

Table 7: Factor Analysis

Factor	Barriers Loaded	Factor Loadings
Organizational and Cost Barriers	- Cost of implementation - Lack of expertise - Resistance among staff	0.78 - 0.82
Technical and Security Barriers	- Technical challenges - Security concerns	0.74 - 0.85

In table 7 above, organizational and cost barriers capture the internal challenges organizations face, including financial constraints, lack of skilled personnel, and resistance to change. Technical and Security Barriers represents external challenges, including technical difficulties and concerns related to the security of electronic procurement systems. The factor loadings for Organizational and Cost Barriers range from 0.78 to 0.82, indicating a strong relationship between these barriers and electronic procurement. Higher factor loadings suggest that these barriers significantly contribute to the identified component, which is likely focused on organizational and cost-related issues. The factor loadings for Technical and Security Barriers range from 0.74 to 0.85. These values suggest a strong association between technical and security issues and electronic procurement. The higher loadings indicate that these barriers

are crucial in understanding the technical and security challenges related to electronic procurement on building construction in river state. The findings align with the Diffusion of Innovation (DOI) Theory by [41], which highlights key barriers to the adoption of new technologies, such as complexity, lack of compatibility with existing systems, and perceived risks like security concerns. According to [31], technical challenges, security concerns, and inadequate skills are significant barriers to the adoption of e-procurement in the Nigerian construction industry, consistent with the results of this study.

Results for the Third Objective

Develop strategies of overcoming the barriers of electronic procurement systems on building construction projects in Rivers State.

The attempt to curb the difficulty of too many variables in quest to accurately trace the most relevant factor(s) that have strong influence or significant improvement to e-procurement systems in construction projects, Principal Component Analysis (PCA) was deployed to achieve this.

Table 8: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.676
Bartlett's Test of Sphericity	Approx. Chi-Square	248.582
	Df	10
	Sig.	<.001

Table 8 is the Bartlett's Test of sphericity applied to ascertain the adequacy of the correlation matrix. In the present analysis, the test yielded a value of 248.582 with a KMO of 0.676 and an associated degree of significance smaller than 0.001. Thus, the hypothesis that the matrix is an identity matrix is rejected, implying that the matrix has significant correlations among at least some of the variables. Figure 5 shows Screen plot of factors for improving e-procurement systems in building construction project.
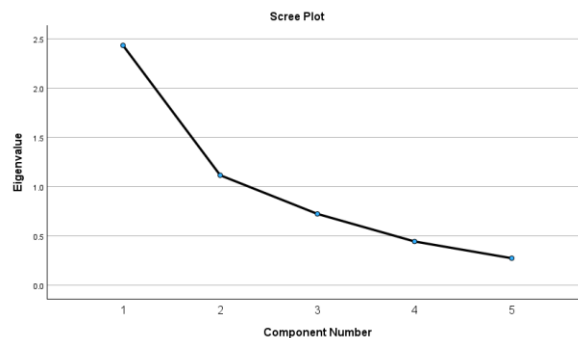

Figure 5: Screen plot of factors for improving e-procurement systems in building construction project

Table 9: Rotated Component Matrix[a]

	Component	
	1	2
Training Programs		.175
Cost Management	.788	
Technical Support		.810
Change Management	.838	
Enhancing Security Measures		.608

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaise Normalization.

a. Rotation converged in 3 iterations.

Table 9 shows that a scan through the various factors loading indicates the most significant loading in factor one has the score 0.838, which relates to change management follow behind is cost management with 0.788. Under the second factor, the most significant loading has the value 0.810 and this relates to technical support follow by enhancing security measures (0.608[].

5. HYPOTHESES TESTING

H₀₁: There is no significant level of adoption of electronic procurement on building construction projects in Rivers State.

Table 10: Model Summary I

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.867a	.855	.819	.59308

state of adoption of electronic procurement in the study area.

Table 11: ANOVA[a] II

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	12.777	5	2.555	7.265	<.001b
	Residual	61.204	174	.352		
	Total	73.981	179			

a. Dependent Variable: Level of Adoption of Electronic Procurement
b. Predictors: (Constant), Adoption Rate, Awareness of Electronic Procurement, Integration with Existing Systems, Employee Training:, Usage Frequency:

Given $F = 7.265$ and $p = 0.00$ at $\alpha = 0.05$, the null hypothesis is rejected, hence the conclusion that the current state of adoption and implementation of electronic procurement systems has a significant effect on building construction project in Rivers State.

H₀₂: There are no significant barriers to the adoption of electronic procurement systems on building construction projects in Rivers State.

Table 12: Model Summary II

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.987a	.966	.947	. 59753

a. Predictors: (Constant), Security Concerns, Resistance to Change, Lack of Expertise, Cost of Implementation, Technical Challenges

Table 12 indicates that 94.7% of the total variability in construction building project with barriers to adoption of electronic procurement is accounted for by current state of adoption of electronic procurement in the study area.

Table 13: ANOVA[a] II

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	226.451	3	78.832	520.710	.000b
	Residual	62.129	143	.357		
	Total	287.540	145			

a. Dependent Variable: Barriers to Electronic Procurement Systems
b. Predictors: (Constant), Security Concerns, Resistance to Change, Lack of Expertise, Cost of Implementation, Technical Challenges

Given $F = 520.710$ and $p = 0.01$ at $\alpha = 0.05$, the null hypothesis is rejected, hence the conclusion that there are significant barriers to the adoption of electronic procurement systems on building construction projects in Rivers State.

H₀₃: There are no effective strategies for overcoming the barriers to the adoption of electronic procurement systems on building construction projects in Rivers State.

Table 13: Model Summary III

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.963a	.879	.865	.47040

a. Predictors: (Constant), Enhancing Security Measures, Technical Support, Cost Management, Change Management, Training Programs

Table 13 indicates that 86.5% of the total variability in construction building project with strategies for overcoming the adoption of electronic procurement is accounted for by current state of adoption of electronic procurement in the study area.

Table 14: ANOVA[a]III

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	265.544	3	64.434	239.758	.000[b]
	Residual	37.065	143	.221		
	Total	277.530	146			

a. Dependent Variable: Strategies to Overcome Barriers

b. Predictors: (Constant), Enhancing Security Measures, Technical Support, Cost Management, Change Management, Training Programs

Given $F = 239.758$ and $p = 0.01$ at $\alpha = 0.05$, the null hypothesis is rejected, hence the conclusion that there are effective strategies for overcoming the barriers to the adoption of electronic procurement systems on building construction projects in Rivers State.

6. DISCUSSIONS

Discussion on the Results of the First Objective

The aim of this study was to examine the effects of electronic procurement (e-procurement) on building construction projects in Rivers State, Nigeria. From our analysis, the results indicate a moderate level of adoption of electronic procurement systems in building construction projects in Rivers State, Nigeria. The high Relative Importance Index (RII) for awareness (0.734) and system integration (0.776) suggests that while there is a strong understanding of e-procurement's benefits and its integration with existing systems, its actual usage is somewhat less frequent (RII = 0.689[]). The moderate score for training (0.693) highlights that although training is provided, it may not be sufficient or effective enough to facilitate widespread use. High awareness and integration but moderate usage imply that while organizations recognize the value of e-procurement, practical adoption and utilization lag behind. This could be attributed to issues such as insufficient training or perceived difficulties in using the system. The result of this objectives is in consonance with the opinion of [24] in their investigation of the factors that influenced the adoption of e-Procurement in building projects delivery using online questionnaire survey involving 603 stakeholders in the South African construction industry. The three most widely used e-Procurement technologies were e-mail, websites and portals, which were used for communication, exchange of bill of quantities, CAD drawings and project specifications. Findings revealed that the characteristics of e-Procurement technology, size of firms, and the influence of firms outside the building industry were among the key factors that influenced the use of e-Procurement in the delivery of building projects. However, the study [24] did not identify the leading adopters of e Procurement and the organizational factors that have significant influence on its adoption. Nonetheless, [3] noted that inadequate training and

low system compatibility are barriers to e-procurement adoption, aligning with the study's findings.

Discussion on the Results of the Second Objective

To examine barriers to Adoption, Severity Index analysis was used, the result revealed that the cost security concerns (73.6%), lack of expertise (67.2%), and technical challenges (66.6%[]). Resistance to change, while notable, has a lower severity index (61.0%[]). The high cost and security concerns are major hurdles for adoption. This is supported by the factor analysis, which grouped barriers into organizational and cost barriers, and technical and security barriers, showing that both internal and external challenges impact the adoption of e-procurement systems. [41] Diffusion of Innovation Theory emphasizes the importance of perceived risks and compatibility, which aligns with the identified barriers in the study. PCA identified two primary factors influencing the adoption of e-procurement: Organizational and Cost Management, and Technical Support and Security Measures. The first factor includes cost management and change management, while the second focuses on technical support and security. The extraction of these factors indicates that overcoming barriers involves addressing both financial constraints and technical challenges. Organizations need to manage costs effectively and enhance technical support and security measures to improve e-procurement adoption. The PCA findings are consistent with empirical studies such as those by [31], which highlight the significance of addressing both organizational and technical barriers in e-procurement. The results of the objective equally align with the study of [44] in their examination of a questionnaire survey of 93 respondents in the South African construction industry. Findings revealed that the factors that constituted barriers to the adoption of e-Procurement in sourcing construction materials were the lack of awareness, resistance to change, (c) high cost of installation and operation and Internet fraud. However, [44] focused only on the use of e-Procurement in the procurement of construction materials; and thus, neglecting other uses of e-Procurement in construction. In addition, the study did not identify the specific type of e-Procurement technologies and application used.

Discussion on the Results of the Third Objective

PCA was also used to identify the most significant strategy to electronic procurement adoption. The analysis revealed two key factors: Factor 1; Change management and cost management were the most significant, explaining 48.71% of the variance, Factor 2: Technical support and enhancing security measures, explaining 22.35% of the variance.

The study's hypotheses were tested and confirmed, leading to the following conclusions:

i. The adoption and implementation of electronic procurement systems have a significant effect on building construction projects in Rivers State.

ii. There is a significant difference between electronic procurement systems and traditional procurement systems.

iii. There are significant barriers to the adoption of electronic procurement systems.

iv. There are effective strategies for overcoming these barriers.

However, the adoption of these systems is hindered by several barriers, primarily the cost of implementation and security concerns. Addressing these barriers through targeted strategies such as comprehensive training, cost management, and robust technical support can facilitate the broader adoption and successful implementation of electronic procurement systems in the construction. The result of this objectives also draws insights from the opinion of [2] in their evaluation of the critical success factors (CSFs) for e-Procurement adoption in the Nigerian construction industry. The study was carried out in the six geo-political zones in Nigeria using a survey research design. Construction stakeholders were selected using purposive and random sampling techniques. The study also revealed that construction stakeholders perceived the availability of reliable, affordable, and fast Internet services as the most critical success factor for the adoption of e-Procurement technologies. The critical success factors (CSFs) were further classified into management support for physical infrastructure, and human factors and characteristics of the technology. The study showed that these critical success factors (CSFs) are crucial for the adoption of e-Procurement systems in the Nigerian construction industry.

7. CONCLUSION

The first objective of this study was to assess the level of adoption of electronic procurement (e-procurement) in building construction projects in Rivers State. This objective was achieved through the use of Relative Importance Index (RII) analysis, which revealed that while awareness of e-procurement is relatively high (RII = 0.734), actual usage remains moderate (RII = 0.689[]. This indicates a gap between stakeholders' understanding of e-procurement and its practical application. To bridge this gap, it is recommended that targeted awareness campaigns and incentives for adoption be introduced, ensuring that stakeholders transition from awareness to active implementation.

The second objective aimed to identify the barriers to adopting e-procurement systems. Through Severity Index analysis, the study revealed significant barriers, including high costs (73.6%), security concerns (67.2%), lack of expertise (66.6%), and technical challenges (66.6%[]. Resistance to change, although present, showed a lower severity index (61.0%[]. These findings underscore the need for strategic interventions to address these challenges. It is recommended that financial support mechanisms, such as grants or subsidies, be provided to mitigate the high costs, while robust security protocols and

capacity-building initiatives are implemented to enhance expertise and technical readiness.

The third objective was to develop strategies for overcoming the barriers to e-procurement adoption. This objective was achieved through the validation of strategies such as comprehensive training, cost management, robust technical support, and effective change management. These strategies were shown to address the key barriers and facilitate broader adoption of e-procurement systems. It is recommended that stakeholders adopt a phased implementation plan that incorporates these strategies, ensuring a smooth transition and sustained adoption.

8. RECOMMENDATION

Based on the findings from this study on the effects of electronic procurement (e-procurement) on building construction projects in Rivers State, Nigeria, the following recommendations are proposed:

1. **Capacity Building and Training**

Implement comprehensive training programs for procurement professionals, contractors, and suppliers to enhance their technical expertise and understanding of e-procurement systems.

Provide user-friendly guides and tools to simplify the adoption process and increase confidence in using e-procurement platforms.

Address Cost Barriers

2. Introduce financial support mechanisms such as subsidies, grants, or tax incentives to reduce the high initial implementation costs of e-procurement systems.

Encourage partnerships with software vendors to develop affordable solutions tailored to the construction industry in Rivers State.

3. **Strengthen Security Measures**

Develop and enforce strict cybersecurity policies to address stakeholders' concerns regarding data breaches and system vulnerabilities.

Invest in advanced security technologies and provide ongoing support to ensure system integrity and user trust.

4. **Promote Awareness and Stakeholder Engagement**

Conduct targeted awareness campaigns and workshops to educate stakeholders on the benefits of e-procurement, including improved efficiency, transparency, and cost-effectiveness.

Facilitate collaboration among government agencies, construction firms, and technology providers to promote adoption.

5. **Adopt and Support Change Management Strategies**

Develop structured change management programs to address resistance among stakeholders and encourage a culture of innovation.

Highlight the long-term benefits of e-procurement through pilot projects and success stories to build trust and enthusiasm for adoption.

By implementing these recommendations, construction companies in Rivers State can overcome the barriers to e-procurement adoption and fully leverage the benefits of these systems, ultimately improving efficiency, transparency, and cost-effectiveness in their procurement processes.

5.1 Contribution to Knowledge
1. This study contributes to knowledge by providing empirical evidence on the adoption level and barriers of e-procurement in the construction industry in Rivers State.
2. It offers a methodological approach that combines Relative Importance Index, Severity Index, and Principal Component Analysis to assess adoption and identify critical factors influencing e-procurement.
3. Additionally, the study proposes validated strategies for overcoming barriers, which can serve as a framework for policymakers and industry stakeholders to enhance e-procurement adoption and implementation.

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