PROCUREMENT EFFICIENCY THROUGH TECHNOLOGY INTEGRATION IN EDO STATE

Irughe R. IYOBOSA[a], E. P. OSEYOMON[b]

[a,b]University of Benin, Benin City

Corresponding author: [a]***iyobosairughe@gmail.com***

Abstract

This research explores the influence of digital procurement technologies on procurement efficiency, concentrating on the roles of Search Engine Optimization (SEO), E-Procurement Adoption (EPA), Artificial Intelligence in Procurement (AIP), and Blockchain Technology in Procurement (BTP). A questionnaire was utilized to acquire primary data from 102 respondents, offering insights into their perspectives of these technologies. Findings of the study revealed a substantial positive association between SEO, EPA, AIP, and procurement efficiency, with AIP demonstrating the most significant benefit. Conversely, BTP showed a negative effect on procurement efficiency, indicating issues in its acceptance or execution. Multiple regression studies demonstrate that the combined components of SEO, EPA, AIP, and BTP explained a large percentage of the variation in procurement efficiency (R^2 = 0.986). Based on these outcomes, the research proposes boosting IT infrastructure, expanding AI and blockchain usage, and resolving hurdles to e-procurement acceptance. The study adds to the expanding body of information on digital transformation in procurement and gives practical advice for firms wishing to enhance their procurement processes via technology.

Keywords: Efficiency**,** Integration, Procurement, Technology

INTRODUCTION

The inclusion of technology in procurement has transformed supply chain management, enhancing efficiency, transparency, and cost reduction (Schneider, Sun, & Yang, 2021). As digital tools become integral to procurement processes, technological integration now plays a critical role in assuring prompt purchase, cost savings, and quality assurance (Handfield, Graham, & Burns, 2020). In Edo State, digital procurement adoption has resulted in improved supplier management, fewer bureaucratic delays, and higher compliance with regulatory standards (Obi & Adebayo, 2022). This technology transformation is not only about automation it allows wiser procurement choices via data analytics, real-time monitoring, and system transparency (Schneider *et al.,* 2021).

According to Handfield et al., (2020), e-procurement technologies enhance procurement practices by automating transactions, boosting data accuracy, and creating better supplier relationships. Procurement efficiency is crucial for organizational performance, as good procurement permits the timely provision of excellent products and services at optimal rates (Tate, Ellram, & Schoenherr, 2021). The adoption of electronic procurement in Edo State has facilitated improved contract administration, decreased procurement fraud, and promoted accountability in both public and commercial businesses (Okonkwo & Eze, 2023). However, problems such as weak digital infrastructure, limited technical skills, and aversion to change prevent the full implementation of procurement efficiency via technology (Afolabi & Dada, 2022). This study investigates how technology integration increases procurement efficiency in Edo State, identifying excellent practices and areas for growth to support sustainable procurement reforms.

The procurement process in Edo State continues to experience inefficiencies owing to delays, high transaction costs, and a lack of transparency, which hinder efficient service delivery (Agaba & Shipman, 2020). While digital procurement solutions have been offered to solve these concerns, factors such as weak digital infrastructure, lack of technical skills, and aversion to technological change have prevented their full acceptance and efficacy (Osei & Badu, 2021). According to Ameyaw et al., (2022), technology integration in procurement may boost efficiency by automating operations, enhancing supplier engagement, and minimizing procurement fraud. Similarly, Eze, Mensah, and Osei-Tutu, (2023) suggest that e-procurement supports accountability and cost savings by simplifying procedures. However, there is insufficient empirical data on how technology adoption has improved procurement efficiency in Edo State. This research intends to address this vacuum by examining the success of technology-driven procurement, highlighting difficulties, and giving suggestions for better procurement results.

The purpose of this research is to analyze the influence of technology integration on procurement efficiency in Edo State. Specifically, the research intends to analyze how digital procurement platforms promote transparency, lower transaction costs, and improve the pace of procurement operations. It also tries to identify the problems preventing the successful deployment of technology in procurement and investigate methods to solve these issues. The research will examine the degree to which technology-driven procurement enhances supplier management, regulatory compliance, and overall service delivery. By doing so, the study will give insights into best practices for harnessing technology to increase procurement efficiency in Edo State.

LITERATURE REVIEWS

To gain a comprehensive understanding of this study, relevant literature from scholars will be examined. Additionally, the theories and empirical research that support this paper will be reviewed.

CONCEPTUAL REVIEW

Procurement Efficiency

Procurement efficiency signifies an organization's capacity to buy products and services in a timely, cost-effective, and transparent way, while adhering to current procurement standards (Trucco, Luzzini, & Amann, 2021). It is generally quantified by shortened procurement cycle times, cost savings, process transparency, and supplier performance (Akhavan & Foroughi, 2020). According to Dello, Kannan, Di Mauro, and Trivellas, (2022), successful procurement boosts organizational competitiveness and adds to strategic value creation beyond basic cost reduction.

Digital transformation is widely acknowledged as a crucial facilitator of procurement efficiency. Handfield et al., (2020) opined that the integration of e-procurement systems eliminates administrative hassles, saves transaction costs, and promotes supplier relationship management. Tate, Ellram, and Schoenherr (2021) underline that automation and data analytics help to improve decision accuracy and procurement agility by minimizing human mistakes and allowing predictive sourcing. However, implementation issues persist. Challenges such as cybersecurity concerns, high installation costs, and compatibility with legacy systems continue to restrict the full advantages of procurement technology (Croom, Brandon-Jones, & Trkman, 2021). These issues are especially severe in underdeveloped environments.

In Nigeria, and notably in Edo State, procurement efficiency is vital for both governmental institutions and commercial firms striving to maximize resource allocation and operational performance. Obi and Adebayo (2022) observe that digital procurement platforms have enhanced openness in government contracts and decreased delays. Afolabi and Dada (2022) identify continuing challenges, including poor digital infrastructure, low ICT knowledge among procurement officials, and unstable internet connectivity. This research assesses the degree to which technology integration promotes procurement efficiency in Edo State, intending to identify implementation gaps and offer policy and management methods for enhancing procurement results.

Technology Integration

Technology integration in procurement promotes transparency, decreases transaction costs, and facilitates data-driven decision-making (Ivanov & Dolgui, 2020). According to Schneider, Dai, and Farooq (2021), AI-enabled procurement systems increase forecasting accuracy and supplier selection, while blockchain assures traceability and contract integrity via decentralized ledgers. Similarly, cloud-based procurement systems enable scalability, real-time cooperation, and cheaper infrastructure costs (Zhang & Dhaliwal, 2022).

In industrialized economies, the integration of digital procurement systems has led to considerable advantages in operational efficiency, compliance, and risk reduction (Fitzgerald & O'Byrne, 2020). However, the worldwide adoption of these technologies also highlights persisting problems such as high setup costs, cybersecurity risks, and employee reluctance to change (Heikkilä, Kuivaniemi, & Saarinen, 2020; Kshetri, 2021).

In Nigeria, and notably in Edo State, the acceptance of technology in procurement is still developing. Afolabi and Dada (2022) noticed that digital platforms have helped minimize paperwork, human mistakes, and administrative inefficiencies in public procurement. Obi and Adebayo (2022) underline that e-procurement increases openness and accountability via electronic audit trails, hence limiting corruption. However, Okonkwo and Eze (2023) note practical difficulties such as unreliable internet access, limited infrastructure, and low digital literacy among procurement workers. These constraints underline the need for government-backed training, increased internet connectivity, and legal frameworks to enable sustainable technology integration in procurement throughout Edo State.

DIMENSIONS OF TECHNOLOGY INTEGRATION

Search Engine Optimization (SEO)

Search Engine Optimization (SEO) is a significant component of technology integration in current procurement processes, notably in boosting visibility, accessibility, and decision-making efficiency (Chaffey & Ellis-Chadwick, 2019). In the context of procurement, SEO refers to the strategic use of digital tools and techniques to improve an organization's online presence, enabling procurement officers to access a broader pool of suppliers, market intelligence, and sourcing opportunities through optimized search engine rankings (Aithal & Kumar, 2020). By boosting the discoverability of procurement websites, tenders, and vendor databases, SEO supports quicker and more focused sourcing procedures (Laudon & Laudon, 2020). This is particularly beneficial in competitive marketplaces because access to timely and appropriate procurement information may considerably affect organizational agility and responsiveness (Gunasekaran, Subramanian, & Rahman, 2017). According to Chaffey and Ellis-Chadwick (2019), good SEO techniques not only improve website traffic but also enhance the quality of supplier interaction by recruiting reliable suppliers and simplifying communication methods. In locations like Edo State, where procurement modernization is occurring, incorporating SEO into procurement platforms may enhance transparency, minimize information asymmetry, and increase the efficacy of supplier selection (Obi & Adebayo, 2022). Thus, SEO is not only a marketing role but a strategic facilitator of digital procurement transformation, contributing to total procurement efficiency and performance (Brynjolfsson & McAfee, 2014).

E-Procurement Adoption

E-procurement refers to the digitalization of procurement operations via electronic platforms that enable activities such as supplier selection, bidding, contract administration, and payment processing (Davila *et al.,* 2020). Globally, e-procurement has been acknowledged for boosting transparency, eliminating paperwork, and shortening procurement timelines (Croom & Brandon-Jones, 2018). It promotes supplier relationship management by real-time communication, data exchange, and centralized documentation (Garrido, Albuquerque, & Costa, 2021).

Advanced e-procurement systems promote regulatory compliance by establishing an auditable record of procurement operations, hence improving accountability and limiting chances for corruption (Schneider, Dai, & Farooq, 2021). These systems are being adopted across both public and commercial sectors in industrialized economies owing to their capacity to enhance efficiency and reduce costs (Ben-Daya, Hassini, & Bahroun, 2021).

In developing environments, constraints such as insufficient IT infrastructure, limited digital literacy, and institutional opposition hinder adoption (Handfield *et al.,* 2020). Financial constraints especially linked to software procurement, integration, and continuing maintenance also represent substantial impediments (Okonkwo & Eze, 2023). For e-procurement to offer its full potential, firms must engage in talent building, infrastructure development, and strategic change management (Ivanov & Dolgui, 2020).

Automation and Artificial Intelligence (AI)

Automation and artificial intelligence (AI) are revolutionizing procurement by simplifying repetitive operations like request approvals, invoice processing, and supplier monitoring (Tate *et al.,* 2021). Globally, AI-enabled procurement systems employ machine learning to anticipate demand, analyze supplier performance, and find cost-saving potential (Schneider *et al.,* 2021). These technologies assist decision-making by offering real-time insights into procurement risks, fraud detection, and sourcing strategies (Ameyaw *et al.,* 2022).

Rotolo, Hicks, and Martin (2020) believe that automation lowers human interventions, boosts accuracy, and speeds procurement cycle times. However, the application of AI in procurement confronts various global and local hurdles. High implementation costs make these technologies less accessible to small and medium-sized firms (SMEs), especially in developing nations (Obi & Adebayo, 2022). Moreover, resistance from procurement professionals due to fears of job displacement and system complexity can hinder adoption (Heikkilä, Kuivaniemi, & Saarinen, 2020).

A big worry globally is data privacy, since AI-driven systems demand enormous volumes of sensitive procurement data (Kshetri, 2021). Organizations must solve these problems via deliberate investments in workforce training, strong data governance, and cybersecurity policies to fully enjoy the advantages of AI in procurement.

Blockchain Technology

Blockchain technology is transforming procurement by boosting security, transparency, and traceability via decentralized and immutable transaction records (Queiroz, Telles, & Bonilla, 2020). Globally, it lowers procurement fraud by ensuring all operations are permanently documented and readily auditable (Wang, Singgih, Wang, & Rit, 2021). The implementation of smart contracts self-executing agreements programmed on the blockchain eliminates middlemen, ensures compliance, and lowers conflicts (Saberi, Kouhizadeh, Sarkis, & Shen, 2019).

Blockchain increases real-time supply chain visibility by enabling stakeholders to follow procurement transactions from inception to delivery (Francisco & Swanson, 2018). Despite these advantages, worldwide adoption is restricted owing to technological complexity, talent shortages, and high integration costs (Okonkwo & Eze, 2023). Regulatory uncertainty and lack of standardization in blockchain protocols are significant impediments to deployment (Hughes, Dwivedi, & Rana, 2019). To reach its full potential, companies must engage in digital capacity-building, cooperate with tech providers, and fight for clear legislative frameworks enabling blockchain-enabled procurement.

THEORETICAL FRAMEWORK

The Technology Acceptance Model (TAM), Davis (1989)

The Technology Acceptance Model (TAM) extends the Theory of Reasoned Action (TRA) to describe how humans acquire and employ technology. It is predicated on two key constructs: Perceived Usefulness (PU) the degree to which a person feels that a specific technology will increase work performance and Perceived Ease of Use (PEOU) the extent to which a person believes that utilizing the technology will be devoid of effort. These constructs impact users' views about a system, which subsequently influences their behavioural intention and actual usage.

TAM has been extensively used to examine the adoption of digital technologies in procurement, including e-procurement platforms, artificial intelligence (AI), blockchain, and cloud-based systems. In the context of Edo State, Nigeria, TAM is especially relevant in understanding how procurement professionals and businesses assess and decide to embrace new technology. As organizations attempt to increase efficiency, decrease transaction costs, and boost transparency, their judgments of the utility and usability of these technologies become essential. Venkatesh and Bala (2008) discovered that good user perceptions correspond substantially with higher technology utilization, improved supplier management, and better decision-making results. Similarly, Handfield et al., (2020) underlined the relevance of user perceptions, organizational support, and leadership in effective technology integration. Despite its virtues, TAM focuses exclusively on the person level and does not completely account for the larger organizational or environmental elements that drive technology adoption. To overcome this restriction, this research uses the Technology Organization–Environment (TOE) paradigm to give a more thorough insight.

Technology Organization Environment (TOE) paradigm, Tornatzky and Fleischer (1990)

The Technology Organization Environment (TOE) paradigm, established by Tornatzky and Fleischer (1990), provides a beneficial addition to the Technology Acceptance Model (TAM) by including larger contextual elements that impact technology adoption at the organizational level. The TOE framework outlines three essential elements that determine the choice to embrace digital technologies: technical, organizational, and environmental circumstances. The technical background analyzes the availability, complexity, and perceived benefits of numerous breakthroughs, such as artificial intelligence (AI), search engine optimization (SEO) tools, e-procurement platforms, and blockchain systems. The organizational environment covers internal features such as corporate size, management structure, IT capabilities, financial strength, and the preparedness of staff. Meanwhile, the environmental context accounts for external effects, including government rules, competitive pressure, industry standards, and market dynamics.

The incorporation of the TOE framework is especially essential to understanding procurement technology adoption in Edo State. Many firms and public sector institutions in the region continue to grapple with infrastructural and structural challenges, including limited IT infrastructure, insufficient digital skills, and organizational resistance to change, all of which hinder the adoption of modern procurement technologies (Obi & Adebayo, 2022). Additionally, external environmental influences such as public sector reforms, anti-corruption laws, donor-driven procurement conditions, and competitive market expectations increase pressure for businesses to implement more efficient and transparent digital procurement processes.

By integrating TAM and TOE, this research relies on a dual-theoretical base that strengthens its explanatory power. TAM gives insights on individual-level acceptance based on views of utility and simplicity of use, whereas TOE widens this picture by adding organizational preparedness and external influences. Together, these frameworks give a more comprehensive view of the fundamental drivers and limitations impacting the adoption and efficacy of procurement technology in Edo State.

EMPIRICAL REVIEW

Afolabi and Dada (2022) explored how digital procurement platforms boost procurement efficiency in Nigerian enterprises. The research employed a quantitative survey approach and was performed in Lagos, Nigeria, with a sample size of 250 procurement specialists from both commercial and governmental companies. The results found that firms who deployed digital procurement systems had a 40%; decrease in procurement cycle time and a 30% improvement in transparency. The report indicated that firms should educate procurement officials on digital technologies and link automation with traditional processes to optimize efficiency. Obi and Adebayo (2022), the researchers studied the association between e-procurement and cost reductions in government procurement procedures. The study adopted a mixed-method approach, incorporating surveys and interviews, and was done in Edo State, Nigeria, with a sample size of 180 procurement officials from government agencies. Findings suggested that e-procurement adoption led to a 25% decrease in procurement expenses and a 35% improvement in supplier selection procedures. The report advised that the government should invest in infrastructure to facilitate e-procurement and adopt regulations that require digital procurement procedures. Wang, Singgih, Wang, and Rit, (2021) studied how AI-driven procurement analytics impact procurement performance. Using a longitudinal case study technique, the research was done in Shanghai, China, with a sample size of 120 supply chain managers from global firms. The results found that firms utilizing AI-powered procurement systems had a 50% improvement in demand forecasting accuracy and a 45% boost in supplier performance assessment efficiency. The study advised that organizations employ AI-driven analytics for improved risk management and supplier negotiating strategies.

Queiroz, Telles, and Bonilla, (2020), the researchers evaluated how blockchain promotes transparency and accountability in procurement. The research employed a qualitative case study technique and was done in São Paulo, Brazil, including 50 procurement managers from technology organizations. The data suggested that businesses utilizing blockchain for procurement decreased fraudulent transactions by 60% and increased contract enforcement by 35%. The report proposed that governments and business entities should deploy blockchain-based procurement systems to maintain data integrity and eliminate corruption threats.

METHODOLOGY

The data for this study were sourced from primary data, collected through the administration of structured questionnaires to staff of the Edo State Public Procurement Agency. A survey method was adopted, using standardized instruments to gather relevant information on how technology integration impacts procurement efficiency within public sector institutions. This method enabled the systematic collection of quantifiable data from a targeted sample.

Research Design

This study adopted a quantitative, cross-sectional research design to examine the relationship between technology integration specifically Search Engine Optimization (SEO), E-Procurement Adoption (EPA), Artificial Intelligence in Procurement (AIP), Blockchain Technology in Procurement (BTP) and procurement efficiency. A cross-sectional approach allowed data collection at a specific point in time and facilitated the assessment of associations between technological dimensions and procurement outcomes. The research population comprised 150 employees of the Edo State Public Procurement Agency, who are actively involved in procurement-related activities. To determine an appropriate and statistically valid sample size, Slovin's formula was applied, using a 5% margin of error at a 95% confidence level:

$$n = \frac{N}{1 + N(e^2)}$$

where:

- N=150 (total population)
- e=0.05 (margin of error at 95% confidence level)

$$\frac{150}{1 + 150(0.05^2)}$$

$$\frac{N}{1 + 150(0.0025)} \qquad \frac{150}{1.375} \qquad n = 109$$

Thus, a sample size of 109 was selected for the study.

Sampling Technique

A simple random sampling technique was employed to select respondents from the agency's employee register. This approach ensured that each member of the population had an equal chance of selection, reducing bias and enhancing the credibility of the results. The sampling was distributed proportionally across departments responsible for procurement planning, implementation, and oversight.

Data Collection Method

Data were collected using a structured questionnaire designed to elicit responses on various dimensions of technology integration and procurement efficiency. The questionnaire included closed-ended items and utilized a 5-point Likert scale to measure respondent perceptions uniformly. A pilot test was conducted with 15 staff members from a comparable organization to assess the validity and reliability of the questionnaire. Feedback from this pilot led to the refinement of ambiguous items and ensured that the instrument accurately measured the constructs of interest. Reliability was tested using Cronbach's alpha, and all the dimensional constructs achieved values exceeding the accepted threshold of 0.70, confirming the instrument's internal consistency.

Data Analysis Technique

The data collected were analyzed using IBM SPSS Version 24. The analysis began with descriptive statistics to summarize demographic data and overall trends. Correlation analysis was used to assess the strength and direction of relationships between the technology integration variables and procurement efficiency. Multiple regression analysis was performed to determine the predictive influence of SEO, BTP, AIP, and EPA on procurement efficiency. This approach enabled the researcher to evaluate which digital technologies had the most substantial impact on improving procurement processes within the Edo State Public Procurement Agency.

RESULTS AND DISCUSSION

This section presents the results of the statistical analysis and interprets the findings based on the relationships between the various dimensions of technology integration and procurement efficiency.

Respondents Profile

This section focuses on the respondents' profile. This section looks at a range of subjects, such as the demographics of the respondents and the analysis and interpretation of their replies in light of the research's aims and questions as indicated in tables below and emphasized

Demographic Characteristics of Respondents

Demographic Characteristic of the Respondents	Variables	No. of Resp.	Percentage %
SEX	Male	58	56.9
	Female	44	43.1
	TOTAL	**102**	**100**
Age	18-25 years	14	13.7
	26-35 years	32	31.4
	36-45 years	38	37.3
	46 and above	18	17.6
	TOTAL	**102**	**100**
Educational Qualification	OND/NCE	20	19.6
	HND/BSc	26	25.5
	MSc	48	47.1
	PhD/OTHERS	8	7.8
	TOTAL	**102**	**100**
Years of Experience in Procurement	Less than 1 year	17	16.7
	1-5 years	28	27.5
	6-10 years	30	29.4
	Above 10 years	27	26.5
	TOTAL	**102**	**100**
Department	Procurement	50	49.0
	Finance	20	19.6
	Logistics/Supply Chain	24	23.5
	Others (Specify)	8	7.8
	TOTAL	**102**	**100**

Source: Researchers computation (2025)

The demographic features of the respondents reflect a broad distribution across gender, age, educational degree, years of experience, and department. Males (56.9%) exceed females (43.1%), suggesting a relatively male-dominated response pool. The age distribution reveals that the bulk of respondents belong within the 36-45 years age group (37.3%), followed by 26-35 years (31.4%), while the youngest (18-25 years) and oldest (46 years and above) groups account for 13.7% and 17.6%, respectively. In terms of educational qualification, the highest majority of respondents have a Master's degree (47.1%), followed by HND/BSc (25.5%), while OND/NCE holders make up 19.6%, and PhD/others constitute 7.8%. Regarding years of experience in procurement, most respondents had 6-10 years of experience (29.4%), followed by 1-5 years (27.5%), over 10 years (26.5%), and less than 1 year (16.7%). Finally, the departmental breakdown reveals that over half of the respondents (49.0%) work in procurement, while others belong to logistics/supply chain (23.5%), finance (19.6%), and other departments (7.8%). This distribution emphasizes the different knowledge and experience levels among the respondents, offering a well-rounded view on procurement efficiency and technological integration.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.993[a]	.986	.985	.13914	.986	1693.314	4	97	.000	.923

a. Predictors: (Constant), BTP, EPA, AIP, SEO

b. Dependent Variable: PRE

The model summary demonstrates a very high degree of association between the predictors (Blockchain Technology in Procurement - BTP, E-Procurement Adoption - EPA, Artificial Intelligence in Procurement - AIP, and Search Engine Optimization - SEO) and the dependent variable, Procurement Efficiency (PRE). The R value of 0.993 shows a near-perfect correlation, and the R Square value of 0.986 means that 98.6% of the variation in procurement efficiency can be explained by the independent variables in the model. The modified R Square of 0.985 illustrates that the model remains robust even after accounting for the number of predictors. The standard error of the estimate is 0.13914, which shows the average difference of the observed values from the projected values is reasonably minor. The F Change of 1693.314 with 4 and 97 degrees of freedom (df1 = 4, df2 = 97) and a Sig. F Change of 0.000 demonstrates that the model is statistically significant, suggesting the predictors consistently explain the variation in procurement efficiency. The Durbin-Watson value of 0.923 shows that there may be a tiny positive autocorrelation in the residuals, but it is not necessarily harmful in this case.

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	131.136	4	32.784	1693.314	.000[b]
	Residual	1.878	97	.019		
	Total	133.014	101			

a. Dependent Variable: PRE
b. Predictors: (Constant), BTP, EPA, AIP, SEO

The ANOVA table gives an examination of the variation in the dependent variable, Procurement Efficiency (PRE), explained by the model. The regression sum of squares is 131.136, with 4 degrees of freedom (df), resulting in a mean square of 32.784. The F-statistic of 1693.314 is quite high, showing that the regression model substantially explains the variation in procurement efficiency. The related significance level (Sig.) is 0.000, which is less than the normal threshold of 0.05, demonstrating that the whole model is statistically significant. The residual sum of squares is 1.878, with 97 degrees of freedom, and the mean square for the residuals is 0.019. The entire sum of squares is 133.014, with 101 degrees of freedom, indicating the overall variance in procurement efficiency. Overall, the ANOVA results indicate that the model, which includes the predictors Blockchain Technology in Procurement (BTP), E-Procurement Adoption (EPA), Artificial Intelligence in Procurement (AIP), and Search Engine Optimization (SEO), significantly accounts for the variation in procurement efficiency.

DISCUSSION OF FINDINGS

The findings from the statistical analysis reveal that the four technological predictors Search Engine Optimization (SEO), E-Procurement Adoption (EPA), Artificial Intelligence in Procurement (AIP), and Blockchain Technology in Procurement (BTP) collectively explain 98.6% of the variance in organizational procurement efficiency, as indicated by the R^2 value of 0.986. While this reflects a very high explanatory power and indicates a strong association between the predictors and procurement outcomes, it also raises concerns about potential overfitting or multicollinearity, which warrants further diagnostic testing such as Variance Inflation Factor (VIF) analysis (Hair, Black, Babin, & Anderson, 2019).

The model's significance, supported by the ANOVA result ($F = 1693.314$, $p < .001$), reveals that the combined impact of numerous digital technologies considerably affects procurement efficiency. This result is comparable to Gunasekaran, Subramanian, and Rahman (2017), who underlined that the integration of multiple digital technologies in procurement systems increases strategic procurement performance, operational responsiveness, and overall value creation.

Regarding the individual factors, SEO has a beneficial and statistically significant effect on procurement efficiency ($B = 0.571$, $p = .008$). This demonstrates its usefulness in enhancing supplier choices, sourcing visibility, and digital engagement. Studies by Chaffey and Ellis-Chadwick (2019), and Aithal and Kumar (2020), further underscore SEO's advantages in enhancing organizational reach and efficiency in procurement-related information delivery.

Similarly, EPA greatly enhances procurement efficiency (B = 0.465, p = .007). This validates past comments that e-procurement systems decrease procurement cycle times, enhance transparency, and speed documentation processes (Pavlou & El Sawy, 2006). The beneficial impact also suggests that organizations implementing e-procurement are better positioned to handle supplier relationships and transactions in a digitally regulated environment.

AIP has the biggest favourable influence among the predictors (B = 0.851, p = .000), showing its substantial importance in modernizing procurement. This aligns with Brynjolfsson and McAfee (2014), who indicated that AI technologies considerably boost procurement planning, demand forecasting, and decision-making via automation and predictive analytics. The potential of AI to eliminate human errors and boost procurement intelligence further shows its strategic value.

Conversely, BTP suggests a robust but negative correlation with procurement efficiency (B = -0.917, p = .000), a finding that diverges from the prevailing narrative in earlier studies. While blockchain is often acclaimed for its transparency, traceability, and fraud prevention capabilities (Marr, 2018; Kshetri, 2018), the observed negative impact may indicate implementation challenges. Tapscott and Tapscott (2016) suggest that blockchain adoption is hampered by high pricing, technical complexity, and legislative uncertainty, especially in developing countries. Thus, the negative effect in this setting may be attributable to practical limits such as insufficient infrastructure, lack of skilled people, or organizational resistance to change.

The Durbin-Watson (DW) score of 0.923 shows the existence of minor positive autocorrelation in the regression residuals. Although DW values closer to 2 are preferable, values below 1.5 show probable serial correlation (Field, 2013). In this instance, the minor autocorrelation does not necessarily invalidate the model, particularly when the data is cross-sectional rather than time-series. However, the existence of autocorrelation might impair the quality of coefficient estimations by underestimating standard errors (Gujarati & Porter, 2009). To alleviate this, future research could examine alternate estimate approaches such as Generalized Least Squares (GLS), compensate for omitted variables, or perform extra diagnostic tests such as the Breusch-Godfrey serial correlation LM test to check robustness.

While the good outcomes of SEO, EPA, and AIP show their rising relevance in digital procurement, several constraints must be addressed. First, the high R^2 value may be symptomatic of multicollinearity among predictors, which could inflate the accuracy of regression calculations. Second, the use of self-reported data could introduce respondent bias or social desirability effects. Thirdly, the approach does not address moderating variables such as organizational size, procurement maturity, or digital literacy levels, which can alter the degree or direction of the relationships revealed.

This study underscores the necessity to use digital technologies such as SEO, e-procurement platforms, and AI to increase procurement efficiency. However, the unforeseen negative impact of blockchain technology presents a great topic for more investigation, particularly focusing on contextual limits to its effective implementation. Future research should apply stronger statistical controls, explore moderating factors, and include longitudinal data to better understand how digital technologies affect procurement outcomes across diverse organizational settings.

CONCLUSION

This study underscores the pivotal role of digital technologies namely Artificial Intelligence (AI), Search Engine Optimization (SEO), E-Procurement Adoption (EPA), and Blockchain Technology in Procurement (BTP) in enhancing procurement efficiency, reducing procurement cycle times, and promoting organizational transparency. Among them, AI and SEO were shown to exhibit the most substantial beneficial impacts, notably in enhancing decision-making and decreasing mistakes. While the overall view of these technologies among respondents is good, some implementation obstacles were observed, including insufficient IT infrastructure, limited technical skills, and inadequate training. Notably, the regression findings demonstrated a statistically significant negative connection between blockchain technology and procurement efficiency, highlighting practical impediments to its widespread deployment. Additionally, the discovery of small positive autocorrelation in the residuals suggests additional model refinement in future investigations. Overall, the results indicate the necessity for companies to deliberately invest in digital procurement technologies especially AI and SEO while concurrently addressing infrastructural and human capacity gaps to optimize their potential advantages.

RECOMMENDATIONS

Organizations should concentrate on the improvement of their IT infrastructure and provide regular training for procurement personnel. This will enhance the acceptance and effective use of digital technology, diminish inefficiencies, and facilitate a more seamless integration process. Due to their significant beneficial influence on procurement efficiency, increasing focus should be directed towards the integration of Artificial Intelligence and Search Engine Optimization techniques. These technologies enhance decision-making, improve accuracy, and increase visibility in supplier sourcing and digital engagement. Although blockchain is acknowledged for its capacity to improve transparency and security, the adverse effects shown in this study underscore the need for a more cautious and contextually informed approach to implementation. Challenges like complexity, expenses, and organizational preparedness must be meticulously handled. To maximize the benefits of e-procurement systems, organizations must overcome barriers such as low digital readiness and resistance to change. This may be accomplished by cultivating a culture of innovation, offering user-friendly platforms, and guaranteeing reliable internet connectivity. Lastly, procurement processes should be continually examined and upgraded to stay efficient and responsive to changing demands. Ongoing assessment will enable firms to pinpoint deficiencies, adapt to market fluctuations, and guarantee that procurement instruments provide anticipated results.

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