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Barriers to the Adoption of Electronic Procurement in Public Sector Construction Projects in Zimbabwe

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Abstract: The construction business has evolved worldwide, with private and public entities increasingly adopting modern technology. Construction procurement constraints have partly been resolved by adopting electronic procurement systems. However, the use of electronic procurement has faced a myriad of barriers. Therefore, this study sought to determine barriers affecting the adoption of e-procurement by public construction entities in Zimbabwe. A pragmatic philosophy was adopted, with a questionnaire survey administered to registered construction consultants and contractors to collect quantitative data and interviews were conducted with procurement practitioners. The data was analysed using the normality test, chi-squared test, thematic analysis and factor analysis. The results of the univariate revealed that the top three issues affecting e-procurement adoption in public sector construction projects are the unavailability of e-procurement software, negative attitude towards the use of the technology and unavailability of information technology (IT) infrastructure. Procurement practitioners revealed similar barriers that included the lack of top management support, technical expertise, inadequate supporting infrastructure/lack of IT infrastructure for e-procurement adoption, lack of adequate procurement personnel training and inadequate legal frameworks supporting e-procurement adoption. Results from the factor analysis revealed six components that included "Training, practice and management support inadequacies", "Organisational policy aspects", "Technical and budgetary concerns", "Teamwork and change issues" and "Inadequate government technical support system". The findings revealed that public entities still need to fully embrace e-procurement in construction projects as there is much dependency on paper-based processes. Vital e-government reforms should precede the launch of e-procurement. Also, full participation and involvement of public-private partnerships and expertise are required to assist in the adoption of e-procurement by public construction entities.

Keywords: Electronic procurement, Public sector, Construction projects, Procurement in construction, Construction in Zimbabwe

INTRODUCTION

Electronic procurement (e-procurement) has taken over the traditional way of procurement and paved the way for the development, advancement and application of more intelligent tools for handling and executing procurement activities of infrastructure-related works (Chan and Owusu, 2022). It is undeniable

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that the procurement system in Zimbabwe is conducted conventionally with a high degree of human interference at each stage of the procurement process (Chigudu, 2014). Mabhodha and Choga (2021) reveal that the tendering processes used to procure goods through the Zimbabwean Urban Councils are still very much paper-based. This exacerbates unfavourable outcomes that include delays in public project completion, inflated project costs and poor-quality service or supplies, as deduced in the study by Dello and Yoshida (2017). The introduction of the e-procurement system is considered a catalyst to rectify shortfalls observed in manual procurement systems (Shatta, Shayo and Layaa, 2020). Rajah (2015) states that attempts by the government of Zimbabwe to set up e-government to plug revenue leaks caused by inefficiencies and time-consuming tendering processes have been unsuccessful. Conversely, Dlakuseni, Kanyepe, and Tukuta (2018) suggest that most state-owned enterprises in Zimbabwe have adopted the e-procurement system even though several procurement functions are still carried out in the traditional manual system.

Therefore, this paper sought to determine the barriers faced by public construction entities in Zimbabwe to adopting e-procurement. The need for efficiency in public procurement has increased, emanating from a need for improved financial management, transparency and fairness among government agencies in most of the implementing countries (Mawuko, Ron and Rod, 2013). In addition, Chan and Owusu (2022) noted that the development or adoption of e-procurement-related tools could be more encouraging due to the nature and setup of the construction project concerned. Chebii (2016) and Chan and Owusu (2022) highlight that the introduction of e-procurement transformed the operational schema of traditional procurement. The authors clarified that the manual approach in procuring goods, works and services for construction projects was transformed to promote efficiency and timeous delivery of projects.

The following section considers the theoretical foundation of procurement and e-procurement and reviews the barriers that affect the adoption of e-procurement. The methodology is then outlined and justified. The results are presented, interpreted and discussed. Finally, the conclusions and recommendations are presented.

LITERATURE REVIEW

Procurement in Construction

Procurement in construction management begins with a well-formulated project execution plan that defines all activities for the project, including staffing, procurement, contracting and location (Crumm, 2013). In addition, construction procurement is broad and complex; as such, Laryea and Ibem (2014) identified six basic construction procurement activities, which include what is to be procured, procurement strategies, soliciting for tender offers, evaluating tender offers, awarding of contracts and administrating contracts. Further, Li, Arditi and Wang (2015) view transaction cost economic theory as being foundational to procurement. The authors state that the actual cost of a construction project does not consist of only the production cost but rather transaction costs that include the costs of preparing a bidding document, estimating, drawing up a contract, administering the contract and dealing with any deviations from contract conditions. Hence, adopting cost-effective procurement processes is fundamental. In addition,

Muhwezi and Ahimbisibwe (2015) highlight that understanding performance, based on the whole organisation, involves analysis of all procurement processes, from budgeting and procurement planning to contract closure.

E-Procurement in the Construction Industry

UNEP (United Nations Environment Programme, 2017) defines e-procurement as the combined use of electronic information and communications technology to enhance the links between customer and supplier, thereby improving external and internal production and systems management. Moreover, with the rise of information, communication and technology (ICT), organisations have been compelled to move their tasks to e-procurement practices for sustainability (Ibem and Laryea, 2015). Literature has shown that various studies have been conducted focusing on e-procurement in retail, manufacturing and banking (Addo, 2019; Tiwari et al., 2019; Xu, Tang and Zhou, 2019). The public sector construction industry should thrive in adopting e-procurement. Public sector construction procurement is broad and complex and represents 40% to 45% of many economies in the developed world in terms of spending on providing services (Knight et al. 2012). According to Afolabi et al. (2019), construction organisations still need to obtain the many potential benefits of ICT investment. In support of this assertion, Hamma-Adama and Ahmad (2021) interrogated the challenges and opportunities presented by e-procurement in the Nigerian construction industry and proposed the need for high-level commitment through robust legislative provisions. Wimalasena and Gunatilake (2018), in their study, investigated the readiness of Sri Lankan construction contractors and consultants to adopt e-tendering and concluded that although both consultants and contractors used electronic media in the tendering process, they were still not ready for complete e-tendering implementation.

Nziku and Siwandeti (2019) note that adopting e-procurement in an organisation brings benefits such as reducing transaction and administrative costs in procurement. In addition, the study by Salum and Ntimbwa (2020) on the effectiveness of e-procurement in local government in Tanzania concludes that the efficiency of e-procurement depends on the reduction of costs. Afolabi et al. (2017) reveal the readiness and maturity of construction stakeholders to participate in e-procurement processes. However, awareness of innovative tools was determined to be a significant shortcoming. Pitso, Kabanda and Kapepo (2018) note that there has been an increase in internal service perception due to the adoption of e-procurement in Lesotho. This is because of the witnessed ability to automate various activities to achieve an acceptable level of efficiency in organisations. Dlakuseni, Kanyepe and Tukuta (2018) conclude that adopting e-procurement improves transparency and accountability.

Barriers Affecting the Adoption of E-Procurement in Public Sector Construction Projects

Several barriers from previous studies have been considered significant, as shown in Table 1.

Table 1. Barriers to the adoption of e-procurement from previous studies

Code	Barriers	Sources
B01	Absence of supportive policy and legislative framework	Khalil and Waly (2015); Korir, Afande and Maina (2015)
B02	Inadequate staff training/ IT-related training	Obel, Abiero and Njeru (2016); Patel, Satrndraku and Khajuria (2016); Pitso, Kabanda and Kapepo (2018)
B03	Untenable ethical practices	Aduwo et al. (2020); Ahmad, Hassan and Ismail (2023)
B04	Hitches in the use of technologies	Ahmad, Aljafari and Venkatesh (2019); Ronald and Omwenga (2015)
B05	Budgetary constraints/Unavailability of adequate funds	Korir, Afande and Maina (2015); Patel, Satrndraku and Khajuria (2016); Nani and Ali (2020)
B06	Nature of organisation	Khalil and Waly (2015); Seresht, Alizadeh and Abdollahi (2017); Afolabi et al. (2019)
B07	Lack of preparedness to adopt e-procurement from the buyers' side	Patel, Satrndraku and Khajuria (2016); Pitso, Kabanda and Kapepo (2018)
B08	Lack of willingness to adopt e-procurement from the suppliers' side/User acceptance	Khalil and Waly (2015); Patel, Satrndraku and Khajuria (2016); Pitso, Kabanda and Kapepo (2018)
B09	Inadequate top management support	Korir, Afande and Maina (2015); Koech, Ayoyi and Mugambi (2016); Afolabi et al. (2019); Kumar et al. (2019); Masudin et al. (2021)
B10	Disruptions of network infrastructure	Ronald and Omwenga (2015); Nawi et al. (2017).
B11	Reduced security level	Khalil and Waly (2015); Obel, Abiero and Njeru (2016)
B12	Inadequate servers and backups	Ronald and Omwenga (2015); Nawi et al. (2017)
B13	Prohibitive cost of procurement	Afolabi et al. (2019); Ibem and Laryea (2015)
B14	Lack of e-procurement skills	Mushi and Nsimbila (2022); Obel, Abiero and Njeru (2016),
B15	Size and structure of the organisation-related barrier	Afolabi et al. (2019); Mushi and Nsimbila (2022)

(*Continued on next page*)

Table 1. *Continued*

Code	Barriers	Sources
B16	Unstable power supply	Mambo, Ombui and Kagiri (2015); Ronald and Omwenga (2015)
B17	Negative attitude towards the use of the technology/Resistance to change	Koech, Ayoyi and Mugambi (2016); Alomar and Visscher (2017); Pitso, Kabanda and Kapepo (2018); Afolabi et al. (2019)
B18	Unavailability of e-procurement software	Ronald and Omwenga (2015); Obel, Abiero and Njeru (2016); Nawi et al. (2017)
B19	Lack of supportive organisational policies	Korir, Afande and Maina (2015); Rotich and Okello (2015); Seresht, Alizadeh and Abdollahi (2017)
B20	Unavailability of IT infrastructure for e-procurement adoption	Mambo, Ombui and Kagiri (2015); Koech, Ayoyi and Mugambi (2016); Afolabi et al. (2019)
B21	Speed of transactions mismatch with normal business transactions	Ibem and Laryea (2015); Afolabi et al. (2019)
B22	Unwillingness to change	Koech, Ayoyi and Mugambi (2016); Pitso, Kabanda and Kapepo (2018)
B23	Lack of teamwork for e-procurement implementation	Aduwo et al. (2017); Mushi and Nsimbila (2022)
B24	Lack of government support	Afolabi et al. (2019); Korir, Afande and Maina (2015)
B25	Scope of activities is too narrow vs. Investment in e-procurement	Hashim, Said and Idris (2013); Mambo, Ombui and Kagiri (2015)

The nature of barriers to e-procurement adoption varies. Khalil and Waly (2015) highlight and categorise the barriers to e-procurement in the Egyptian construction industry into four groups: security-related, user acceptance and staff resistance, accessibility issues and legal barriers. Pitso, Kabanda and Kapepo (2018) state that contextual barriers posed during the implementation of an e-procurement system in the Lesotho electricity sector include the organisational lack of adequate training, employee resistance and lack of project management skills by top management. Ronald and Omwenga (2015) assert that IT infrastructure, such as computers, databases, and communication networks, needs to be available to promote the adoption of e-procurement. The assertion had been noted by Carlström and Olsson (2014), highlighting that some companies have a problem acquiring the right platform to carry out e-procurement. The reason might be the high costs involved in installing the proper IT systems. Nani and Ali (2020) note that Indonesian local government organisations face the barrier of the technological infrastructure failing to support e-procurement. In support, Nawi et al. (2017) suggest that it is essential for the government to pay more attention to the availability of infrastructure, such as information technology, for better e-procurement adoption.

There is a need for supportive administrative constructs and technological systems. Similarly, the lack of investment by the management to purchase software and hardware may inhibit the rate of user uptake of the e-procurement system (Obel, Abiero and Njeru, 2016).

The lack of government support has emerged as a barrier to the successful adoption of e-procurement on public sector construction projects. Afolabi et al. (2019) believe that the government needs to play a crucial role in providing the necessary ICT infrastructure and leadership in using e-procurement technologies in their public procurement process. In agreement, Marei et al. (2020) identified that government support has been categorised as a factor that influences the adoption of e-procurement use in public construction projects as it plays a crucial role in developing governing rules and regulations in the development of IT and the use of innovation amongst business stakeholders. The absence of support from the organisation at the managerial level or lack of top management commitment hinders the adoption of e-procurement by public sector construction projects. Asare and Prempeh (2017) and Kumar et al. (2019) argue that the importance of higher-level management support comes from its ability to influence other human resource-related factors and develop change management strategies to make the procurement transformation process successful. Therefore, the backing of top management could reduce the barrier of lack of resource allocation by top management as the top management is the main allocator of resources.

Bulut and Yen (2013) highlight that one of the barriers reported by the European Commission on using e-procurement includes the need for more training for procurement personnel. Koech, Ayoyi and Mugambi (2016) point out that a lack of e-procurement knowledge can occur when the company has an older generation of employees who are change-resistant regarding IT-related issues. Melidi (2013) notes that the existing training infrastructures in public sectors need to be more elaborate in accommodating the growing number of people willing to learn innovative ways to manage projects. The study by Obel, Abiero and Njeru (2016) on the effects of organisational factors on e-procurement reveals that the success of implementation and adoption of e-procurement in any organisation highly depends on the knowledge and skills of the workforce in the system.

RESEARCH METHODOLOGY

The study adopted a pragmatic philosophy to reveal the main barriers that affect the adoption of e-procurement in public sector construction projects and hinder their successful delivery. The mixed research method focused on the convergent parallel mixed methods design or triangulation, which follows pragmatism as a philosophy (Creswell and Clark, 2018). In the study by Ibem and Laryea (2015), mixed methods were used to investigate e-procurement use in the South African construction industry.

A questionnaire survey and interviews were employed in the study. The study considered closed and open-ended questions in the questionnaire. Johannesson and Perjons (2014) believe that surveys guide the research work on a more detailed level and usually have broad coverage. Thus, the surveys were used to collect data from contractor and consultancy firms (registered with the Procurement Regulatory Authority of Zimbabwe [PRAZ] to offer construction services on public entities' construction projects) to investigate their perceptions of the barriers to adopting

e-procurement to deliver public sector construction projects. The consultancy firms included architectural, civil/structural engineering and quantity surveying, which represent clients in delivering public sector construction projects. The study made use of interviews to obtain information from procurement practitioners from public entities, such as procurement managers, construction directors, procurement management unit members and procurement officers. An in-depth exposition was required from those who implement procurement within the public sector entities, as supported by Ibem and Laryea (2015). Interviews were done till data saturation was reached, as posited by Creswell and Clark (2016). The research focused on public entities acting as clients, such as local authorities, government ministries and parastatals or government agents.

The first section of the questionnaire was on the respondents' profiles, which included gender, education level, position experience and age. The second section ranked the barriers affecting public entities' adoption of e-procurement in their construction projects. Initially, the respondents were asked to indicate the importance of the identified barriers using a five-point Likert scale. Thereafter, another five-point Likert scale (1= "Insignificant", 2 = "Low Significant", 3 = "Somewhat Significant", 4 = "Significant" and 5 = "Very Significant") was employed to indicate their significance towards affecting the adoption of e-procurement. The interview guide collected similar demographic information before requesting the participants to identify and elaborate on the barriers that affect their adoption of e-procurement in public sector construction projects.

Sampling

The study considered contractors from the PRAZ list that appeared in Categories A to C of the Construction Industry Federation of Zimbabwe (CIFOZ) list. The population size drawn from the PRAZ list and CIFOZ for both Bulawayo and Harare contractors was 39. The researchers selected Categories A to C because they are more actively involved in construction projects, because of their experience in the industry. The study adopted census sampling for consultancy and contractor firms using the 2023 PRAZ list of registered consultants. The researchers took the entire population of firms of architects (19), quantity surveyors (15) and engineers (50). It is important to note that the existing populations were skewed towards engineers, and hence, a bias towards that designation is expected. Census sampling was used because the population of the listed consultants was small (Creswell and Clark, 2018). A total of 123 respondents participated in the survey, with an expected sample size of at least 40%, as adapted from Schutt (2016). Purposive sampling was used to identify procurement practitioners who would participate in the study. Local authorities, government ministries, and parastatals that have solicited tenders and ongoing projects were identified through the PRAZ database.

Data Analysis

The Shapiro-Wilk test was used to test normality, with a result of $0.001 < 0.05$, indicating the data was not normally distributed and supporting the use of non-parametric tests (Chi-squared tests) for further analysis (Field, 2014). The mean item score was used to rank the responses to the insights on barriers' importance, as Omer, Rahman and Almutairi (2022) supported. The standard deviation was computed

to determine the average amount of variability in a dataset and to measure, on average, how far each value lies from the mean and where variables had the same mean, the lesser standard deviation was ranked higher (Bhandari, 2020). The means ≥ 3.00 were considered important (Chigara and Smallwood, 2016). Sekaran and Bougie (2016) state that the chi-square test compares the expected frequency (based on probability) and the observed frequency. In addition, the study utilised the chi-square test to test the statistical significance at $p < 0.05$. The chi-square as a non-parametric test was used to establish the independence or otherwise between two nominal variables (Field, 2014), which are the identified barriers and adoption of e-procurement in the public sector construction project. The variables' association level was tested using Cramer's V (v) (Field, 2014), where the highest Cramer value, between 0 and 1, was considered to have the highest association. In addition, a $v < 0.3$ indicates a low association, $0.3 < v < 0.5$ indicates a medium association and a $v > 0.5$ value indicates a high association between the barrier and its effect on e-procurement adoption.

The factor analysis method was adopted to develop factors or components that show the relationships among the identified barriers. According to Yong and Pearce (2013), factor analysis is used to identify latent constructs or factors and it is commonly used to assemble common variables into descriptive categories. The research used factor analysis to group the barriers associated with adopting e-procurement in public sector construction projects into clusters for more comprehensive data analysis. Yong and Pearce (2013) contributed to the considerations for factor loadings, reliability tests, Kaiser Meyer-Olkin (KMO) and eigenvalues. The KMO was used to measure the sampling adequacy for validity, with a measured value > 0.5 being acceptable for factor analysis (Yong and Pearce, 2013). Bartlett's test for sphericity of less than 0.05 was considered suitable for multivariate factor analysis (Field, 2014). Components for analysis were extracted using principal component analysis with varimax rotation because of its advantage in maximising variance for each factor (Yong and Pearce, 2013), with those with eigenvalues > 1 being considered. The extracted components were named after their contributing barriers.

The qualitative data derived from interview transcripts was analysed through thematic analysis. The thematic analysis provided brief descriptions and interpretations of themes and patterns from a data set. It was also used to interpret essential aspects of the research topic further and, hence, describe the research data in an organised and rich form (Maguire and Delahunt, 2019). Further, data was analysed and interpreted into themes through initial coding and categorising.

RESULTS AND DISCUSSION

This section focuses on the response rate and demographics of the respondents. It also reports the barriers highlighted in adopting e-procurement in public sector construction projects from the interview surveys.

Response Rate

The study targeted consultants and contractors, as shown in Table 2 and interviews were conducted targeting procurement practitioners from public entities, as shown in Table 3. Out of a total population of 123 firms, valid responses were received from

74 firms (60.16%) and underwent further analysis. The response rate was acceptable and supported by Schutt (2016), who suggested a response rate of at least 40% as allowable for professional populations.

Table 2. Demographics of respondents (questionnaire)

Demographic Variable	**Number of Respondents**	**%**
Educational Level		
National certificate	3	4.10
Bachelor's degree	32	43.20
Master's degree	38	51.30
Doctor of Philosophy (PhD)	1	1.40
Professional Background		
Engineering (mechanical/civil and water/electrical/structural engineers)	23	31.05
Quantity surveying	36	48.65
Architectural	15	20.30
Length of Service with Organisation		
0 to 5 years	18	24.30
6 years to 10 years	28	37.80
11 years to 15 years	17	22.90
More than 15 years	11	15.00

This section presents the work experience and education level of respondents in the study. From Table 2, most of the respondents had between 6 years to 10 years of experience within their organisations, likely indicating that they were generally knowledgeable of the existing organisational systems. Most of the questionnaire respondents had a master's degree (51.3%), indicating advanced qualifications and potentially enhancing the validity of the study. To further reinforce the validity of the study, quantity surveyors (48.65%) were the most represented profession and quantity surveyors undertake procurement as part of their roles and responsibilities.

Data saturation was achieved during the 10th interview. Table 3 shows that the experience of the interviewees ranged from 9 years to 26 years. The findings on the experiences of participants could point to their enhanced familiarity with procurement processes.

Table 3. Demographics of interviewed participants

Respondent	Designation	Professional Background	Highest Qualification	Years of Experience	Age
R1	Procurement manager	Logistics and supply chain	MSc	10	35
R2	Procurement manager	Logistics and supply chain	MSc	15	39
R3	Supply chain and administration services executive	Logistics and supply chain	MSc	26	53
R4	Procurement and administration officer	Accounting	BSc	9	31
R5	Senior buyer	Logistics and supply chain	MSc	10	33
R6	Supply chain category lead	Logistics and supply chain	MSc	15	45
R7	Deputy director of construction projects	Quantity surveying	MSc	18	44
R8	Procurement management unit leader	Logistics and supply chain	MSc	23	46
R9	Procurement management unit member	Law	BSc	12	37
R10	ICT infrastructure and support specialist (from procurement regulatory authority)	Informatics	MSc	13	40

Notes: Msc = Master of Science; BSc = Bachelor of Science.

Barriers to the Adoption of E-Procurement in Public Sector Construction Projects: Perspectives from Construction Professionals and Procurement Practitioners

In this study, the contractors and consultants who work on public construction projects ranked the barriers to adopting e-procurement. Table 4 shows the importance of the 25 barriers towards the adoption of e-procurement by public entities in the construction industry to successfully deliver projects.

Table 4. Mean score analysis of barriers

Code	Barrier	Mean	Standard Deviation	Rank
B02	Inadequate staff training/ IT-related training	4.219	0.712	1
B18	Unavailability of e-procurement software	4.219	1.003	2
B04	Hitches in the use of technologies	4.206	0.833	3
B13	Prohibitive cost of procurement	4.206	0.971	4
B17	Negative attitude towards the use of technology	4.206	0.999	5
B14	Lack of e-procurement skills	4.178	0.991	6
B05	Budgetary constraints/ Unavailability of adequate funds	4.164	0.817	7
B03	Untenable ethical practices	4.164	0.850	8
B12	Inadequate servers and backups	4.096	1.082	9
B01	Absence of supportive policy and legislative framework	4.026	0.897	10
B08	Lack of willingness to adopt e-procurement from the suppliers' side/ User acceptance	3.945	1.201	11
B06	Nature of organisation	3.904	0.960	12
B09	Inadequate top management support	3.863	1.194	13
B11	Reduced security level	3.808	1.221	14
B20	Unavailability of IT infrastructure for e-procurement adoption	3.795	1.258	15
B15	Size and structure of the organisation-related barrier	3.781	1.017	16
B10	Disruptions of network infrastructure	3.781	1.250	17
B19	Lack of supportive organisational policies	3.726	1.121	18

(*Continued on next page*)

Table 4. *Continued*

Code	Barrier	Mean	Standard Deviation	Rank
B16	Unstable power supply	3.699	0.996	19
B22	Unwillingness to change	3.658	1.272	20
B07	Lack of preparedness to adopt e-procurement from the buyers' side	3.548	1.313	21
B23	Lack of teamwork for e-procurement implementation	3.343	1.272	22
B24	Lack of government support	3.301	1.255	23
B21	Speed of transactions mismatch with normal business transactions	3.192	1.440	24
B25	Scope of activities is too narrow vs. Investment in e-procurement	3.055	1.461	25

The findings indicated that all the barriers have means > 3.0, which shows that respondents consider the barriers important. The discussion only considered the top three important barriers as much focus was directed towards their significance to the effective adoption of e-procurement. The first ranked barrier was (B02) "Inadequate staff training/IT-related training" (mean score = 4.219). The barrier was ranked higher than (B18) "Unavailability of e-procurement software", due to the lower standard deviation, although they had the same mean score. The results show the importance of having adequately trained staff to enable the operationalisation of the e-procurement systems. Pitso, Kabanda and Kapepo (2018) alluded to the need for IT-related training for those who deploy the system. Related to that, e-procurement software is essential if its adoption is to be realised, as suggested by Obel, Abiero and Njeru (2016). To support adequately trained staff and the availability of e-procurement software, organisations must ensure that the deployment of e-procurement is uninhibited by technology inefficiencies, as indicated by Ahmed et al. (2019). Thus, (B04) "Hitches in use of technologies" was the third-ranked important barrier.

The contractors and consultants who work on public construction projects ranked the significant barriers to adopting e-procurement, as shown in Table 5.

Table 5. Significance of barriers

Code	Barriers	Sig.	Cramer's V	Rank
B13	Prohibitive cost of procurement	0.001	0.559	1
B14	Lack of e-procurement skills	0.001	0.557	2
B17	Negative attitude towards the use of technology	0.001	0.545	3
B16	Unstable power supply	0.001	0.541	4
B18	Unavailability of e-procurement software	0.001	0.539	5
B06	Nature of organisation	0.001	0.522	6
B22	Unwillingness to change	0.001	0.519	7
B05	Budgetary constraints/Unavailability of adequate funds	0.001	0.506	8
B11	Reduced security level	0.001	0.502	9
B20	Unavailability of IT infrastructure for e-procurement adoption	0.001	0.495	10
B09	Inadequate top management support	0.001	0.491	11
B23	Lack of teamwork for e-procurement implementation	0.001	0.479	12
B21	Speed of transactions mismatch with normal business transactions	0.001	0.468	13
B15	Size and structure of the organisation-related barrier	0.001	0.466	14
B10	Disruptions of network infrastructure	0.001	0.457	15
B24	Lack of government support	0.001	0.452	16
B08	Lack of willingness to adopt e-procurement from the suppliers' side/User acceptance	0.001	0.448	17
B12	Inadequate servers and backups	0.001	0.428	18
B07	Lack of preparedness to adopt e-procurement from the buyers' side	0.001	0.427	19
B04	Hitches in the use of technologies	0.001	0.382	20
B25	Scope of activities is too narrow vs. Investment in e-procurement	0.002	0.379	21
B03	Untenable ethical practices	0.006	0.356	22
B19	Lack of supportive organisational policies	0.009	0.347	23
B01	Absence of supportive policy and legislative framework	0.043	0.282	24
B02	Inadequate staff training/IT-related training	0.133	0.259	–

The findings indicated the significance of the barriers, showing that respondents consider the barriers to affect the adoption of e-procurement by public entities in the construction industry. These barriers are seen as prominent in

affecting the adoption of e-procurement in public sector construction projects. The thematic analysis generated one central theme of management and technical support inadequacies affecting the adoption of e-procurement systems. Several categories were generated and this included "Lack of top management support", "Lack of technical expertise", "Inadequate supporting infrastructure/Lack of IT infrastructure for e-procurement adoption", "Lack of adequate procurement personnel training" and "Inadequate legal frameworks supporting e-procurement adoption". Both sets of results are discussed hereafter.

The first ranked barrier was (B13) "Prohibitive cost of procurement" (Sig. = 0.001 and Cramer's V = 0.559). The exorbitant costs involved in setting up the e-procurement system in an organisation can badly affect the revenue streams in the short run, mainly if the procurement is done on a smaller scale. This assertion has been supported by Ibem and Laryea (2015). In addition, adopting e-procurement might reduce procurement costs in a well-structured organisation, as supported by Afolabi et al. (2019). Ranked second was (B14) "Lack of e-procurement skills". The findings from the consultants indicated that lack of e-procurement skills contributes significantly to the barrier to adopting e-procurement, with a high association (v = 0.557) and ranked second. The practitioners also identified the lack of technical expertise. The views of the consultants and contractors were also represented by comments from Respondent 3 on the barriers affecting e-procurement. R3 noted that "There is no e-procurement within public entities in Zimbabwe. The reason could be that the government entities have not taken time to invest in the required resources – software and human skills". This barrier could be affecting the adoption of e-procurement as public entities might not have adequate or relevant skills in terms of human resources, as revealed by (Obel, Abiero and Njeru, 2016).

Moreover, (B17) "Negative attitude towards using the technology" was ranked third. The results are in sync with those of Afolabi et al. (2019), who opine that the negative attitudes and behaviour of individuals in an organisation greatly determine the extent of technology adoption. The insights from the practitioners did not identify this barrier. This could be due to the lack of opportunity for the practitioners to operationalise e-procurement processes. The survey findings indicated that the "Unavailability of IT infrastructure for e-procurement" could be a major hindrance towards the adoption of e-procurement in public sector construction projects, with v = 0.495, occupying the 10th rank according to the significance ranking of barriers. The practitioners also identified this as a critical barrier. For example, Respondent 7 indicated that "There is a lack of supporting infrastructure in public entities. Most of our infrastructure does not support this system well, as it needs to be upgraded to suit the technology system". There is a need for supportive administrative constructs and technological systems. In addition, the government must play a crucial role in providing the necessary ICT infrastructure and leadership in using e-procurement technologies in their public procurement process (Koech, Ayoyi and Mugambi, 2016).

Of the 10 interviews conducted with practitioners, seven respondents expressed the same sentiments regarding the "Lack of support from top management within organisations" as the main barrier affecting the adoption of e-procurement on public entities during construction works. For example, Respondent 2 argued that "I have found out that most of the challenges public entities face are centred on lack of cooperation from top management as they do not want to cooperate by pushing for new technological ways which improve the successfulness of the organisation". In addition, the chi-square results indicated

that the significance of inadequate top management support was at 0.001 with Cramer's V of 0.491 and ranked at position 11th. The Cramer's V indicated a medium association of the barrier and its effect on e-procurement adoption. Despite the rankings, the survey findings show that top management could be influential in adopting e-procurement because senior management's primary function in e-procurement is facilitating a more effective and efficient procurement process. They are also regarded as the main allocator of resources needed to adopt and implement e-procurement. The study's findings concur with those of Masudin et al. (2021), who postulate that senior management support significantly affects e-procurement implementation.

The results from the survey indicated that "Inadequate staff training/IT-related training" was not significant towards adopting e-procurement in the construction of public sector projects. This was evidenced by the p = 0.133, which is > 0.05. This is contrary to the insights of practitioners. Respondents 1 and 5 intimated that "Most of us lacked proper training on running and using this whole e-procurement system. Some of us are eager to be trained, but they have inadequate funds and setups to invest in training workshops" and "We as members of public procurement management units have little knowledge of using e-procurement. We lack technical experts who can guide us during implementation and usage rate. We also lack common technological standards which can smooth the flow of the work movement on easier tasks", respectively. Viewed in this way, one could add that staff training and awareness of e-procurement systems are critical at all organisational levels to create a conducive setting for adoption. The findings indicate that adequate training is needed to advance procurement personnel. This could be due to the unavailability of funds to invest in the required infrastructure needed for training; this has been supported by Obel, Abiero and Njeru (2016). Respondent 8 stated that "Delays in decision making on policy and regulations that support e-government procurement has led to slow uptake of e-procurement users by public entities. This long-awaited proposed statutory instrument is yet to be adopted". In addition, the chi-square results indicated that the barrier was significant, with p = 0.043 and a low association (v = 0.282). The findings illustrate that there could be a barrier to a lack of full promulgation of statutes that support the full implementation of e-procurement. Prior studies support the existence of this barrier. Khalil and Waly (2015) and Korir, Afande and Maina (2015) highlight this barrier as significant during the implementation of e-procurement systems.

The two respondent groups are generally in sync concerning the barriers that affect the adoption of e-procurement in public sector projects. The construction professionals have more insights concerning e-procurement since they may have dealt with private players who have already adopted e-procurement in their construction projects. The primary barrier construction professionals and procurement practitioners cited is the need for procurement top management buy-in in adopting e-procurement. Most practitioners point out the need for more enforcement of legislative frameworks to embrace the adoption of e-procurement. Although some statutes may be available to support the use of technology, they have yet to be fully enforced. This has led to a reluctance to tap into the new technologies enshrined in e-procurement statutes for public sector construction projects. Moreover, the findings also indicate that although construction professionals are willing to use e-procurement on government projects, the existing infrastructure facilities in the public sector could not be adequate to support the full adoption of the e-procurement package in the public construction sector.

Relationships among the Barriers: Perspectives from Construction Professionals

As shown in Table 6, factor analysis was done and six components, which explained 74.33% of the total variance, were obtained.

Table 6. Factor analysis of barriers affecting the adoption of e-procurement

Code	Barriers	Component					
		1	2	3	4	5	6
Training, Practice and Management Support Inadequacies							
B03	Untenable ethical practices	0.884					
B02	Inadequate staff training/IT-related training	0.874					
B09	Inadequate top management support	0.814					
B14	Lack of e-procurement skills	0.656					
Organisational Policy Aspects							
B06	Nature of organisation		0.879				
B19	Lack of supportive organisational policies		0.846				
B25	Scope of activities is too narrow vs investment in e-procurement		0.696				
B15	Size and structure of the organisation-related barrier		0.532				
Technical and Budgetary Concerns							
B16	Unstable power supply			0.752			
B05	Budgetary constraints/ Unavailability of adequate funds			0.740			
B04	Hitches in the use of technologies			0.635			
B12	Inadequate servers and backups			0.613			

(*Continued on next page*)

Table 6. *Continued*

Code	Barriers	Component					
		1	2	3	4	5	6
Teamwork and Change Issues							
B23	Lack of teamwork for e-procurement implementation				0.808		
B22	Unwillingness to change				0.759		
B08	Lack of willingness to adopt e-procurement from the suppliers' side/User acceptance				0.641		
Inadequate Government Technical Support System							
B24	Lack of government support					0.765	
B01	Absence of supportive policy and legislative framework					0.734	
B10	Disruptions of network infrastructure	0.514					
Inadequate IT and E-Procurement Systems							
B20	Unavailability of IT infrastructure for e-procurement adoption						0.845
B18	Unavailability of e-procurement software						0.829
Eigenvalue		8.292	2.004	1.784	1.351	1.167	1.012
Proportion of variance (%)		39.488	9.541	8.496	6.433	5.556	4.819
Cumulative variance (%)		39.488	49.029	52.525	63.958	69.514	74.334

Notes: Extraction method – Principal component analysis; Rotation method – Varimax with Kaiser normalisation. Rotation converged in six iterations.

Barriers with factor loadings greater than 0.50 were retained and resultantly, five barriers, which are (B07) "Lack of preparedness to adopt e-procurement from the buyers' side", (B11) "Reduced security level", (B13) "Prohibitive cost of procurement", (B17) "Negative attitude towards the use of the technology/ Resistance to change" and (B21) "Speed of transactions mismatch with normal business transactions", were dropped because their factor loadings were below 0.50. A Cronbach's alpha of 0.923 was obtained, indicating good reliability. The KMO was 0.784, which was considered acceptable since it was more than the threshold of 0.50. Bartlett's test of sphericity significance level was less than 0.001, being < 0.05, which was also acceptable for factor analysis to be used. Using the eigenvalues greater than one criterion, six principal components and 20 subfactors were revealed. The extracted components, which were named by the composition of the variables that correlate highly with that factor, are discussed hereafter.

Component 1: Training, practice and management support inadequacies

The first factor was "Training, practice and management support inadequacies", explaining 39.49% of the variance. Four variables loaded to this factor, namely, "Untenable ethical practice", "Inadequate staff training or IT-related training programmes", "Inadequate top management support" and "Lack of e-procurement skills". Unethical procurement practices could have an effect on decreased IT-related training programmes, influenced by inadequate support from top management, which in turn might lead to poor individual skills in handling e-procurement processes. These findings are contrary to those by Khalil and Waly (2015), where for instance, the staff were reported to be resisting the adoption of e-procurement as opposed to inadequate training and top management support. Mushi and Nsimbila (2022) highlighted that individual skills or workforce knowledge significantly related to electronic procurement adoption in public organisations. Buy-in of public entities' top management and staff generally creates an opportunity for e-procurement adoption in the public sector construction projects for successful delivery in Zimbabwe. The assertion has been supported by Koech, Ayoyi and Mugambi (2016) and Aduwo et al. (2020), who point out that top management's resistance slows the adoption of e-procurement and results in a failure to reach many of the perceived benefits.

Component 2: Organisational policy aspects

The second factor was named "Organisational policy aspects" and explained 9.54% of the total variance. Four variables loaded to this factor, namely, "Nature of organisation", "Lack of supportive organisational policies", "Scope of activities is too narrow vs. Investment in e-procurement" and "Size and structure of the organisation". The nature of the organisation, lack of supportive policies within the organisation, the scope of activities available and the size and structure of the organisation impede the adoption of e-procurement in construction projects by public entities. What surrounds the organisation determines the effectiveness of policies supporting the adoption of e-procurement and the organisation's aim. Nani and Ali (2020) and Rotich and Okello (2015) believe that e-government regulations and policies must ensure that new systems are aligned within the organisation for e-procurement adoption to succeed in the public sector. The results corroborate

the findings of Ibem and Laryea (2015), who note that organisations have been compelled to move their task to e-procurement practices for sustainability reasons due to the amount of work. Also, Seresht, Alizadeh, and Abdollahi (2017) support the idea that a sound organisational structure for accessible communication between top-level management and lower-level employees supports the adoption of new technology.

Component 3: Technical and budgetary concerns

The third factor was "Technical and budgetary concerns" and explained 8.50% of the total variance. Four variables loaded to this factor are: "Unstable power supply", "Budgetary constraints/unavailability of adequate funds", "Hitches in use of technologies" and "Inadequate servers and backups". An unstable power supply hinders the adoption of e-procurement in public sector construction projects. This has been exacerbated by budgetary constraints, posing barriers to opting for alternative ways, such as using solar energy to curb unstable power supply. Budgetary constraints are the key barrier leading to public entities requiring assistance in procuring technologies that are easy to use or operate and adequate servers and backups required to promote e-procurement adoption in public sector construction projects. Difficulty using technologies points to no trained or skilled personnel and a lack of advanced technology that is fast and easy to use as e-procurement platforms. The results reinforce the findings of Mushi and Nsimbila (2022), who conclude that employees will accept the technology if they find it easy to use and if the management within the organisation insists on the benefit from the system. In addition, data security needs to be vital to ensure no confidentiality breaches or hacking on the system. The existing policy must accommodate the provision that the procuring entity is allowed to use electronic mail in its bidding process, provided the confidentiality and security of bids are assured.

Component 4: Teamwork and change issues

The fourth factor, "Teamwork and change issues" explained 6.43% of the total variance. Three variables contributed to this factor, namely, "Lack of teamwork for e-procurement implementation", "Unwillingness to change" and "Lack of willingness to adopt e-procurement from the suppliers' side/User acceptance". This factor highlights how the absence of team spirit attracts or transforms staff unwilling to accept any change within an organisation. This will then affect the external stakeholders as the unwillingness of internal stakeholders to adopt e-procurement could be transmittable to suppliers as external stakeholders. The results reinforce the findings of Mushi and Nsimbila (2022) and Afolabi et al. (2019), which revealed that teamwork is one of the determinants of adopting e-procurement systems. The willingness to change must be one of the organisational factors influencing the adoption of e-procurement, as reported by Pitso, Kabanda and Kapepo (2016).

Component 5: Inadequate government technical support system

The fifth factor was named "Inadequate government technical support system" and explained 5.56% of the total variance. Three variables contributed to this factor, namely, "Lack of government support", "Absence of supportive policy

and legislative framework" and "Disruptions of network infrastructure". The findings indicate that inadequate government support discourages public entities as buyers from preparing for the adoption of e-procurement. Khalil and Waly (2015) support this assertion. In addition, inadequate government support can lead to a lack of supportive policy and legislative framework, which could be one barrier to adopting e-procurement in public sector construction projects. Therefore, this might point out that the legal and institutional frameworks already exist and require enforcement. Most government entities in Zimbabwe are faced with the barrier of poor internet networks; this could be due to too much dependency on ethernet or internet fibre, which are quickly affected in case of power cuts. Similar to Ronald and Omwenga's (2015) findings, communication networks and undisputed network infrastructure with a stable power supply must be available to promote e-procurement adoption.

Component 6: Inadequate information technology and e-procurement systems

The sixth factor was "Inadequate IT and e-procurement systems", which explained 4.82% of the total variance. Two variables loaded to this factor, namely, "Unavailability of IT infrastructure for e-procurement adoption" and "Unavailability of e-procurement software". This factor reveals that the unavailability of IT Infrastructure and e-procurement software hampers public entities from adopting the e-procurement system. This observation corroborates Obel, Abiero and Njeru (2016) and Afolabi et al. (2019). IT infrastructure such as computers, e-procurement software, databases and communication networks must be available to promote e-procurement adoption. The study's findings reveal that most construction public entities need compatible computers and related software for project management. This suggests that construction stakeholders perceive the availability of reliable, affordable, and fast internet services as a critical success factor in adopting e-procurement.

CONCLUSIONS

Procurement systems contribute to construction project delivery in public entities. The advent of e-procurement has the potential to enhance the successful delivery of public sector construction projects. However, barriers constrain its implementation. Therefore, this study sought to determine these barriers affecting the adoption of e-procurement by public construction entities in Zimbabwe. The five top-ranked barriers were "Unavailability of e-procurement software", "Negative attitude towards the use of the technology", "Unavailability of IT infrastructure for e-procurement adoption", "Cost of procurement" and "Lack of top management support". These barriers reveal a need to understand and pay attention to aspects affecting the adoption of e-procurement emanating within organisations and the reality of technological advancements, as highlighted by most construction professionals and procurement specialists. From the findings, both the procurement practitioners and construction professionals share almost the same insights and agree that the existence of barriers discussed in the study dramatically impacts adopting e-procurement systems within the construction industry. Therefore, the lack of top management buy-in and inadequate enforcement of legislative frameworks to embrace the adoption of e-procurement continue to be an

impeding catastrophe based on procurement practitioners' and construction professionals' views. Factor analysis revealed interrelated significant sets of barriers affecting the adoption of e-procurement in public sector construction projects for successful delivery. The analysis generated six-factor groupings, namely: "Training, practice and management support inadequacies", "Organisational policy aspects", "Technical and budgetary concerns", "Teamwork and change issues" and "Inadequate government technical support system". The results of factor analysis restate the need to understand and pay attention to aspects hindering the adoption of e-procurement in public sector construction projects for successful delivery that are emanating within the organisations, the reality of technological advancements and the input of external parties through decision making.

The study has several practical implications. There is a need for the public sector to ensure that all technical support systems are functional and their staff is well trained to execute e-procurement roles. In addition, adequate managerial support must be ensured in public entities. Cost-sharing mechanisms must be implemented to reduce the cost burden of operationalising the e-procurement system. Regulating all procurements to be undertaken through the e-procurement systems will encourage uptake and reduce the resistance from stakeholders. The revealed inter-relationships indicate the need for a holistic approach that entails a multi-pronged approach to resolving the barriers. That said, a holistic procurement regulatory framework that supports funding, training and infrastructure is envisaged and recommended. Although the study was confined to barriers impeding e-procurement in the construction industry, an in-depth study is needed to develop a comprehensive framework for e-procurement adoption in Zimbabwean public sector construction projects. It should be noted that this study used a relatively small sample size; thus, caution is needed when generalising the findings to other regions.

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