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The ecosystem of drivers for electronic procurement adoption for construction project procurement: A systematic review and future research directions

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Abstract

Purpose - The purpose of this paper is to present a review of research developments on the ecosystem of driving forces for electronic procurement (e-procurement) on project procurement and to propose directions for future research for an effective adoption and sustained usage.

Design/methodology/approach – A systematic literature review was conducted in three-phases to identify and examine literature. A total of 68 papers were retrieved and were thoroughly reviewed to identify the drivers for e-procurement.

Findings – A total of 61 drivers were identified and subsequently developed into a categorization framework for synthesized understanding which reveals existing interrelationships. Although literature has consensus on some selected drivers, few studies have identified drivers relating to sustainability. Gaps were identified from the existing literature and directions for future research were proposed.

Research limitations/implications - Since this is a literature review, future research could conduct further investigations focusing on the research gaps identified. The framework developed presents a basis for further research to explore the drivers in various socio-economic environments.

Practical implications – This study provides valuable insights for improving the understanding of practitioners on the complex network of drivers for e-procurement. These findings stimulate discussions on benefits required for assessment in e-procurement adoption by practitioners.

Originality/value – This study provides the first comprehensive review of the drivers for e-procurement adoption in the construction industry, which was lacking in the existing body of knowledge.

Keywords: Electronic procurement; E-procurement; Drivers; Benefits; Construction project; Construction industry; Ecosystem; Systematic review.

1. Introduction

Since construction projects provide the facilities for many other industries to thrive in an economy (Heigermoser et al., 2019), the procurement processes for these projects play a key role in the effective execution of the projects (De Araújo et al., 2017; Sawan et al., 2018). The introduction of e-procurement for conducting procurements for projects, to improve the traditional paper-based procurement, has had a slow uptake towards the process of project procurement (Isikdag, 2019; Jacobson et al., 2017). E-procurement is described as performing project procurement related activities such as tender submission and evaluation for a project through the internet or electronic portals (Mehrbod and Grilo, 2018). Project procurement has many different stakeholders such as architects, cost engineers, project managers, clients, etc. contributing information to the procurement process and, managing these information flows raises complexities (Bienhaus and Haddud, 2018; Xue et al., 2010). Also, the prevalence of physical interactions continuously for exchanging documents and information during the project procurement process was considered inefficient and expensive (Oraee et al., 2017). These circumstances required an innovative approach to address the issues, hence e-procurement was introduced. However, e-procurement uptake for construction projects has been low (Isikdag, 2019, Grilo and Jardim- Goncalves, 2011). Previous studies have explored the drivers, benefits and motivations encouraging the adoption of e-procurement from different construction professionals and organizations (Wimalasena and Gunatilake, 2018; Eadie et al., 2010a; Ibem and Laryea, 2015). But, to date, a comprehensive review of the drivers in the existing body of knowledge to guide of the next stream of effective future research is still lacking. A thorough understanding of certain research issues has not been well represented in literature, especially those related to the list of drivers identified in literature, the classification of these drivers and the interrelationships existing among the drivers. The comprehensive review of the drivers presents a broader and better understanding of the drivers across various studies to accelerate the uptake of e-procurement in the construction industry.

Therefore, to address this gap, the aim of this study is to conduct a critical review of the ecosystem of drivers for the adoption of e-procurement for projects. The primary objectives of this study are to identify the drivers, classify the drivers and reveal the interrelationships. Subsequently, a framework is developed for these classifications indicating the complex interrelationships of forces driving the adoption of e-procurement. The outcomes of this study provide in-depth understanding to the diverse driving forces encouraging the adoption of e-procurement. It also presents vital information for researchers to delve more into the synthesis and complexities of factors encouraging the uptake of e-procurement for projects. For organizations, this study supports the development of strategies to enhance e-procurement adoption and sustain its performance. In this study, drivers are defined as forces propelling, motivating and encouraging the adoption of e-procurement for project procurement. These driving forces could be the benefits, incentives, policies or motivations encouraging the adoption of e-procurement by stakeholders.

2. Background

The purpose of e-procurement is to facilitate the use of internet technology and tools on the various processes of procurement for projects (Al-Yahya et al., 2018). Technologies such as e-Tendering, e-Auction, e-Marketplace, e-Catalogue and e-Invoicing have been used to provide effective solutions that covers all procurement stages or dedicated areas of the procurement stages (Mehrbod and Grilo, 2018). For instance, e-Tendering uses internet systems to disseminate information on invitation to tender, receiving tender submissions and the evaluation of tenders for decision making during the tendering stage of procurement. The adoption process for technology as defined by Rogers (2003) are the series of actions during the decision-making process to implement or neglect new technology. During this process, various drivers influence the decisions to adopt technology by organizations (Elmustapha et al., 2018). Sepasgozar et al. (2016) indicated that the construction literature on technology adoption is focused on two aspects thus context-independent which deals with using models from other fields to explore technology adoption and context-specific which deals with exploring the adoption process through empirically analysis for projects. Further, Sepasgozar et al. (2016) observed in literature that the technology adoption was discussed from the managerial level of organizations whiles the technology acceptance was viewed from the individual level by previous studies. The technology acceptance model (TAM) describes the behavioural intention and attitudes of people towards using technology (Gong et al., 2019; Davis, 1989). The TAM draws on the theory of reasoned action (TRA) which is used to predict behaviour based on intentions and attitudes of people (Liu et al., 2018). This suggest that despite the desire to adopt technology by organizations, the willingness of individuals to use the technology is crucial for technology uptake. An understanding of the attributes and factors motivating the adoption and influencing peoples' behaviour for e-procurement technology would be essential for the wider promotion of the technology in the construction industry.

3. Research methodology

This study employed the systematic review methodology as used by previous studies (Hong et al., 2012; Le et al., 2014; Chan and Owusu, 2017) to guide the selection of relevant papers from the journals. The systematic review was chosen because it compares and integrates the findings from the papers identified (Grant and Booth, 2009). Due to the large range of research falling within e-procurement applications from other industries, a comprehensive and in-depth three-phase process was conducted to extract relevant papers (Lu et al., 2015). Unlike the review process whereby a desktop search is initially conducted and subsequently narrowed down (Osei-Kyei and Chan, 2015), this study initially targeted the list of journals in Wing

(1997) and subsequently conducted a desktop search followed by another specified search as described below.

3.1. Phase 1: Search target journals

In this phase, relevant papers were selected from the top 12 journals in Wing's (1997) ranking of construction management journals since it is widely recognized in construction management (Lu et al., 2015). The rationale behind this was to increase the scope of the search (Chan and Owusu, 2017), unlike other studies with limitation to top six journals (Le et al., 2014). The journals targeted were *Construction Management and Economics (CME), Journal of Construction Management and Engineering (JCEM), Engineering, Construction and Architectural Management (ECAM), Journal of Management in Engineering (JME), Proceedings of the Institution of Civil Engineers–Civil Engineering (PICE-CE), International Journal of Project Management (IJPM), International Journal of Construction Information Technology (CIT), Transactions of American Association of Cost Engineers (AAC), Automation in Construction (AIC), Journal of Construction Procurement (JCP), Cost Engineering (CEN) and Building Research and Information (BRI)*. The virtual libraries of these selected journals were used to access relevant papers using the following keywords: "Electronic procurement" OR "e-procurement" OR "e-Tendering" OR "e-Commerce" AND "drivers" AND "construction industry" within the search engines respectively. It is worth noting that not all potential keywords were exhausted in the search, as it is may be impractical to include all potential keywords. Hence, the keywords employed in this study are terms used to depict e-procurement concept for projects. The search criteria included publications in English and peer-review journals since the review process is extensively rigorous when compared to conference papers to ensure the quality of the process (Silva et al., 2019). There was no limitation on year range, as the study intends to gather as many papers as possible. Fig. 1 summarises the systematic process for the literature review.

<Insert Fig. 1 here>

The initial search results led to papers from CME, JCEM, ECAM, JME, PICE-CE, IJPM, AIC and BRI whiles no papers from CIT, AAC, JCP and CEN were found. Furthermore, an intensive examination of the titles or abstract or full text of the initial results from the search was conducted to select papers relevant to the study. Thus, papers that were more aligned with the subject matter, i.e., factors motivating e-procurement adoption for project procurement were considered eligible for this study. Table 1 shows the number of relevant papers identified from each journal.

<Insert Table 1 here>

3.2. Phase 2: Desktop search

As more recent construction journals were not captured in Wing's (1997) study, the approach of Xiong et al. (2015) and Chan and Owusu (2017) was adopted to identify other construction journals relevant to the study. In this regard, Scopus, the Web of Science and Google Scholar were used to conduct the search. The criteria used to select journals from these search engines included (i) journals from Google Scholar had to be indexed in either Scopus or Web of Science for further consideration since Scopus and Web of Science are globally acknowledged by construction professionals and academicians (Lu et al. 2015), (ii) journals that had two or more papers that dealt with the subject matter were considered, (iii) journals from Wing's (1997) ranking were exempted. According to the search results, *Journal of Financial Management of Property and Construction, Journal of Information Technology in Construction, International Journal of Procurement Management, Journal of Internet Commerce and Construction Innovation* had more than two papers from the initial search and at least two papers were relevant to the study for further analysis. The virtual libraries of these journals were searched with the keywords to retrieve papers.

3.3. Phase 3: Specified search from journals

Finally, to obtain journals that are in a broad domain but have close relations with construction projects and information communication technology, specific search was conducted in selected journals based on them publishing on the subject matter (Nasirian et al., 2019). *Advanced Engineering Informatics, Journal of Public Procurement, Benchmarking: An International Journal and Journal of Organizational Computing and Electronic Commerce* were selected based on the second criteria in phase two. This was done to allow journals that publish on technological issues to be considered. A total of 68 papers were considered relevant for the study after examining the papers. The 68 papers compares favourably with other similar review studies such as Hassan et al. (2018) review on factors affecting construction productivity with 47 papers and Aarseth et al. (2017) review study on project sustainability strategies. All the journals were searched in December 2018.

4. Analysis and results

The analysis and summary of findings from the selected papers are presented in two dimensions using descriptive analysis of papers and examination of drivers identified. The first dimension adopts descriptive analysis to show the characteristics of selected papers for the yearly distribution of papers by journals and the country of publication. This was done by recording the year of publication of the study and the country in a codebook by authors independently and subsequently compiled for consistency. The second dimension examines the drivers reported in literature for identification and classification, and a framework is subsequently developed. Drivers identified by each study were recorded correspondingly and later cross-referenced to avoid redundancy.

4.1. Publication trend

Fig. 2 shows the annual publication trend of the reviewed papers. Although, the time range was not specified in the search, the papers identified in the first year of the search, thus 2002, recorded one of the highest numbers with seven papers. This could be because the internet and the concept of applying e-procurement for project procurement was emerging (Gunasekaran and Ngai, 2008). Subsequent years had declined publications until 2005 and 2006 that recorder six papers successively. From Fig. 2, 2010 also recorded the highest number of publications with 7 papers. The lowest number of publications was recorded in 2009 with no papers recorded since publications were identified in 2002. The publication trend has been generally constant, with an average of four papers per year cumulatively. This suggest that the research interest in the factors encouraging e-procurement uptake has to be increased successively by research institutions, to improve the understanding of the drivers considering the dynamic nature of projects and the information technology environment for projects.

<Insert Fig. 2>

4.2. Publication by countries

Fig. 3 shows countries publishing research works on the drivers for e-procurement adoption for project procurement. The UK, Australia and the USA are the leading countries. This could be as result of their governments initiating e-procurement usage for project procurement. For instance, Egan's (1998) report in the UK, inspired improvements in the procurement processes for projects towards delivering a better service. Portugal, South Africa, Taiwan and Singapore have also made valuable contributions towards the drivers for e-procurement. The item "International" represents studies in more than one country. The number of papers by country on a topic suggests the influence of the topic on industrial developments (Hong et al., 2012).

<Insert Fig. 3 here>

4.3. Identification of drivers for e-procurement for project procurement

The 68 selected relevant papers were analysed to identify the drivers of e-procurement in the project procurement. Sixty-one drivers were consequently identified. Details of these drivers are presented in Table 2, indicating their codes and references retrieved from literature. The full details on the references can be accessed in the Appendix. The driver mostly identified in the literature is "reduced process, transaction and administrative cost". All the drivers are further discussed to provide a better understanding of the forces motivating e-procurement adoption for project procurement. Also, they were subsequently classified and discussed because some of the drivers have similar characteristics relating to broader issues.

<Insert Table 2 here>

5. Classification of drivers of e-procurement for project procurement

As illustrated in Table 2, the numerous drivers of e-procurement uptake for procuring projects were identified from the literature. To provide a better understanding of these drivers, it is necessary to classify the drivers into their respective groupings as adopted by Lu et al. (2015) and Xiong et al. (2010). Some groupings of drivers/benefits have been conducted by previous studies (see Karthik and Kumar, 2013; Eadie et al., 2010a). Karthik and Kumar (2013) summarised the grouping of drivers identified in their study into five groupings; financial benefit drivers, relative performance benefit drivers, perceived supplier benefit drivers, technical benefit drivers and other benefits (benefits that did not fit into the previous benefits identified). They grouped these benefits through the lens of the process view approach based on the perceived benefits. Their study focused on only the benefits from the managers viewpoint but did not consider other driving forces for the adoption. Eadie et al. (2010a) grouped the drivers from their study into three, from the perspective of achieving project goals thus; cost drivers, time drivers, quality drivers and general drivers (drivers that did not fit into any of the three mentioned above).

A critical examination of previous literature shows that the two grouping from Karthik and Kumar (2013) and Eadie et al. (2010a) presents a foundation that can be adopted for the classification of drivers for this study but with the introduction of additional classifications to better describe these dynamic drivers for e-procurement for project procurement. Thus, this study generally classified drivers of e-procurement for project procurement into seven classifications: external drivers; project level drivers; technological and process level drivers; company level drivers; individual level drivers; service satisfaction drivers and; sustainability concept drivers. These driving factors were classified based on the commonality among the drivers and the levels at which they operate frequently. The classification process involved grouping the drivers identified in Table 2 by the authors based on the areas of influence for these drivers. The results of the initial groupings were compared and discussed to achieve consistency and reliability in the classification of the drivers. Further, the classifications were checked with the drivers in Table 2 to ensure no drivers were omitted. Comparing the proposed classification to previous works, this classification incorporates drivers from the project goals and the benefits motivating the adoption at various levels of the procurement process. The details of these classifications are elaborated in the following subsections. Due to word and space limitations, these drivers are briefly discussed subsequently. Fig. 4 shows the framework for the classifications these drivers.

<Insert Fig. 4 here>

5.1. External drivers

External drivers refer to factors which are mainly from external bodies or organizations such as government bodies, regulatory agencies, other industry organizations, international organizations to the project organization. Based on the relationships between these factors; *government regulation and policy, pressure from industry and business partners, government demand for value, enhance regulatory compliance on contracts and peer organization's uptake of technology*, this classification was labelled external drivers. *Government regulation and policy* was the driver mostly identified in this classification. Over the past decades, many governments initiatives and international bodies have been involved in the promotion of e-procurement for construction projects (Jacobsson et al., 2017; Dossick and Sagami, 2008). In Europe for instance, the European Union's (EU) initiative to establish an e-procurement platform among its member countries began in the second millennium (Strejcek and Theil, 2003). This initiative served as motivation for many governments within the EU to further strengthen regulations and policies towards using e-procurement for procuring projects. For instance, the UK government in 1998 set out policies to facilitate e-procurement among government agencies, business and users (Foley, 2000).

In the US, several federal states have initiated e-commerce into their core business operations in order to deliver government information and projects (Layne and Lee, 2001). The study conducted by Dossick and Sagami (2008) realised that the pressure to adopt electronic platforms for coordinating projects was higher in Japan as compared to the US. In Japan, the government has formulated policies to regulate these electronic platforms as a strategy to recover from long recession (Dossick and Sagami, 2008). Other countries such as Australia, Portugal and Malaysia have their governments pushing for the adoption of e-procurement in construction organizations through policies and regulated frameworks (Jaafar et al., 2007; Dooley and Purchase, 2006; Costa and Grilo, 2015). These policies and regulations by governments stimulates its organizations to take up e-procurement when procuring projects. Another factor, thus *government demand for value*, encourages organizations to seek optimal ways of carrying out projects (Jacobsson et al., 2017). Governments across the globe demand for value on projects with increased efficiency and effectiveness because of the limited availability of resources (Sullivan, 2010).

An additional factor in this classification is *pressure from industry and business partners*. The study by Li et al., (2015) and Pearson and Grandon (2005) showed that, organizations that adopted e-procurement were influenced by industrial dynamics and pressure from their business partners. The interplay between an organization and its industry is a complex network (Jacobsson et al. (2017), since organizations have both direct and indirect connections with various stakeholders in the industry. Fulfilling the stakes of these industry players on a project, modifies the approaches and the structures of the organization to adopt improved ways of performing procurement. *Peer organization's uptake of technology* is another factor influencing organizations to adopt e-procurement. In China, the study by Li et al. (2015) provided empirical support of the influence of competitors/rivals/peer organizations on the adoption on e-procurement for projects. There is an imitation behaviour among organizations that adopt technology, hence if one organization adopts the e-procurement technology, it positively influences other organizations to adopt it (Sun, 2013). Such imitation behaviour reduces regrets associated with post-adoption because the peer organization's adoption provides suitable justification for the other organization to adopt it (Li et al., 2015). Svidronova and Mikus (2015) showed evidence that organizations and project managers that adopted e-procurement, inspired other project managers to adopt e-procurement for procuring projects.

5.2. Project level drivers

From the findings of the study, project level drivers can be described with 13 drivers which include *wider coverage and access to contractors/suppliers, improved audit trail reducing disputes, enhance inventory management for project data, reduce bid collusion and corrupt practices, increase competitions among contractors/suppliers* etc. (see Fig. 4). These drivers look at the motivations and benefits that can be gained when e-procurement is applied for procuring a project. *Wider coverage and access to contractors/suppliers* is one benefit that stakeholders anticipate in using e-procurement, in order to achieve better contract value for projects. This also allows larger access to quality contractors and suppliers for partnerships, which in turn would enhance the quality of project delivery (Anumba and Ruikar, 2002). The project image and capability are further increased for cooperation with other parties (Nitithamyong and Skibniewski, 2006). This provides the opportunity for the project to increase its spectrum of contractors and suppliers enhancing the decision for a suitable selection of contractor or supplier for the project. Another driver at the project level is *improved audit trail and reducing disputes*. Studies by Nitithamyong and Skibniewski (2006) and Ruikar et al. (2005) have shown that effective audit trail created by the e-procurement platform, has resulted in the reduction of disputes among project teams. Considering the fragmented nature of the project teams, which is easily prone to disputes, efforts or measures that prevent or mitigate the occurrence of disputes have received attention by project managers (Ho, 2015; Hansen, 2018). Hence, project managers are inspired to adopt e-procurement in order to ensure effective audit information and avoid disputes which in turn promotes the collaborative environment for project delivery.

Improving the management of project data and portfolio from the beginning of the procurement process is important for project success. *Improve integration management of project data* as a driver, provides the opportunity for data to be integrated across project teams from both design and construction teams (Zou and Seo, 2006). Various team members participate in the procurement process of projects, which makes it necessary for the integration of procurement information for the project delivery. *Enhance inventory management and archiving* is another benefit project managers desire for the entire procurement process (Eadie et al., 2010a; Eadie et al., 2010b). Studies from Eadie et al. (2010b) indicated that enhancing inventory management was a significant motivator for construction professional to adopt e-procurement for projects in the UK. The professionals also indicated that the inconvenience of archiving the process and completed work through the traditional way motivates them to adopt e-procurement (Eadie et al., 2010b). The volume of documents exchanged during the procurement process for a project makes it imperative for project managers to adopt technological methods for archiving such data. The cost associated with managing documents on projects motivates project managers to adopt e-procurement. *Cost savings in document management* is one of the factors driving project managers and organizations to adopt e-procurement (Abu-Elsamen, 2010; Ruikar et al., 2005), since it provides a more efficient approach to managing documents compared to the traditional paper-based document management. Abu-Elsamen et al. (2010) in their study, identified that *effective cost management of procured projects* was one factor that motivated organizations to adopt e-procurement. This factor allows the organization to have a better view of their financial portfolio with respect to a larger number of projects. Another benefit of e-procurement thus, *better coordination and integration of contractors* has also attracted project managers to adopt e-procurement for projects (Nitithamyong and Skibniewski, 2006). Integrating the portfolio of numerous contractors or suppliers becomes inefficient when it is paper-based for procurement processes. This has given cause for project managers to adopt e-procurement for efficient coordination and integration of contractors and suppliers.

The risk of having procurement malpractices on projects during the procurement process encourages the uptake of e-procurement. Studies by Santoso and Bourpanus (2018) and Liao et al. (2002), showed that, one motivation for organizations to adopt e-procurement was to *reduce bid collusion and corrupt practices*. The procurement process in the construction and engineering sector is highly vulnerable to corrupt practices (Transparency International, 2005; Owusu and Chan, 2019), hence organizations employ e-procurement to curb these corrupt practices. *Increase competition among contractors/suppliers* is an additional driver that motivates organizations to adopt e-procurement for projects. Project managers perceive that increasing the number of competitors for the project, leads to achieving better value for that project (Awwad and Ammoury, 2018). Moreover, e-procurement presents the opportunity of accessing bigger coverage of contractors hence, increasing the competitiveness of that project (Doloi, 2014; Gardenal, 2013). This driver received the most attention in this classification with nine studies addressing it (see Table 2). Studies such as Eadie et al. (2011) identified *developing knowledge skill and ability of employees* as a driver for e-procurement. Projects that employ e-procurement equip the team members with technological skills and abilities in conducting procurement processes. This stimulates stakeholders to implement e-procurement for their projects.

The two other drivers *improved benchmarking* and *degree of dispersion of project teams* describes the level at which the organization is informed about the supply market, based on the ease of compilation of data and the characteristics of project teams (Kang et al., 2011; Eadie et al., 2011; Hosseini et al., 2018). These drivers influence the decisions of management to adopt e-procurement due to the technological benefits it provides enhancing market search and teamwork across regions.

5.3. Technology and process level drivers

The technology and process level drivers describe the motivations or benefits e-procurement brings to the process of procuring projects. A total number of 21 drivers were identified from literature for this classification, making it the largest classification with the highest number of drivers compared to the other classifications. From the findings, *reduce process, transaction and administrative cost* was the most identified driver for using e-procurement in procuring projects (see Table 2). Sepasgozar and Davis (2018) indicated that organizations are willing to adopt technology due to the possible solutions it offers for their needs, hence cost reduction is a major factor promoting e-procurement adoption. Studies such as Kang et al. (2011), Svidronova and Mikus (2015), Eadie et al. (2010a) and Doloi (2014) have shown that organizations and project professionals are highly driven to adopt e-procurement due to the need to save cost on project procurement. Similarly, the adoption of other technologies such as construction equipment technologies depends on the project's need for it (Sepasgozar et al. (2018). For instance, in Svidronova and Mikus (2015) study, about 12% of cost savings was achieved on the tendering process for construction projects by public agencies when e-procurement was used. Another major driver for the adoption of e-procurement from literature is *reduce cycle times for process and transaction*. Project delay is one phenomenon influencing the performance of projects especially project timelines (Mahamid et al., 2011). Any opportunity to quicken the process of the project draws the attention of project managers, hence the attraction to adopt e-procurement by reducing the time spent for the procurement process. Previous studies by Ibem and Laryea (2015) and Doloi (2014) showed how this ability of e-procurement to reduce time had greatly influenced project managers decisions in employing it for projects.

Further motivation for the adoption of e-procurement is the *fast exchange of information among stakeholders,* which also describes the swiftness with which information is shared among project teams (Dossick et al., 2019). Ruikar et al. (2005) indicated that project organizations that employed e-procurement for procuring projects realised an increase in the exchange of information which enhanced the delivery of the project. E-procurement presents a platform whereby information is shared rapidly to update project teams on the project, which subsequently enhances informed decisions by project managers (Kim et al., 2015) Since the procurement process contributes to initiating a project, efficiency and effectiveness in the process of procurement is vital. *Improved efficiency and effectiveness in the process* as a benefit has encouraged the e-procurement uptake. The traditional paper-based process of procurement suffered some inefficiencies and exposed lots of ineffectiveness in the process, which has made e-procurement attractive for procuring projects (Li et al., 2015; Tas et al., 2013).

Additional drivers for e-procurement adoption are *ease of access to information* and *improved communication with stakeholders*. Contractors/suppliers access to information is crucial in the process and the study by Pearson and Grandon (2005) substantiated the interest of organizations to adopt e-procurement to ensure easy access to information by contractors/suppliers. Contractors/suppliers are a major part of the project procurement process hence their access to information relating to the project determines the success of the project (Sariola, 2018; Khan et al. 2016). The use of e-procurement ensures that the communication among project teams are stable and effective (Grilo and Jardim-Goncalves, 2013). Due to the complexity of networks within the project procurement process (Khan et al. 2016), improving communication has become important to avoid unnecessary bottlenecks of communication breakdown. Considering the extent to which project cost is determined at the initial stages for a project, *transparency, fairness and accountability* becomes key motivations for using e-procurement to ensure a sound process. The construction professionals who participated in study by Eadie et al. (2010a) and Ruikar et al. (2006), indicated that the benefits of increasing transparency, fairness and accountability encouraged them to use e-procurement when procuring projects. Studies by both Kang et al. (2011) and Eadie et al. (2010b) realised that drivers such as *improve response, accuracy and flexibility of the process,* and *improve quality of process* were significant benefits that attracted organizations to adopt e-procurement. Although the procurement process is usually stepwise, it can also be iterative. This requires the procurement process to be flexible and responsive with accurate information to project teams on the project. The quest for organizations to improve the quality of the traditional paper-based procurement processes has encouraged the adoption of e-procurement, since early adopters of the technology observed improvement in the quality of the process (Isikdag, 2019; Zhang and Tiong, 2003).

The implementation of e-procurement helps simplify the process for easy integration, hence *streamlining and integration of process* as a driver, has gained attention in literature (Mehrbod and Grilo, 2018; Eadie et al., Kang et al. 2013). Due to the number of processes required in project procurement, having a platform that integrates it, enhances effective decision making. One shortfall of the traditional paper-based procurement was the recurrence of errors due to manual keying of information. One advantage of e-procurement which has encouraged its uptake is *error minimization by eliminating manual rekeying* (Alshawi and Ingirige, 2003; Ruikar et al., 2005). The driver, *effective monitoring of process (real time),* provides the opportunity for tracking the status of the procurement process in real time, e.g. from invitation to bidding to award of contract (Jaafar et al., 2007). This enhances the progress reporting of the process to project teams. Drivers such as *platform for collaboration*, *ease of addressing queries of contractors*, *enhance cost reduction in tender prices* and *ease of use of technology* have contributed considerably to motivating construction project managers to adopt e-procurement (Khan et al. 2016; Hong et al., 2016; Eadie et al., 2011; Ibem and Laryea, 2015). Drivers that had less attention from literature at the technology and process level were *enhance new contractor entrance and identification*, *provide support for added value services*, *increase trust, confidence and reliability in process*, *access to internet intelligent tools for decision-making* and *availability of adequacy of technology* (see Table 2). Notwithstanding the fact that few studies identified these drivers, they also provide motivations for organizations to adopt the technology.

5.4. Company level drivers

The company level classification relates to drivers that motivate the management or corporate echelons to adopt e-procurement. From Fig. 4 it is shown that 10 drivers were identified as factors motivating the adoption at the company level. One benefit realised with the use of the technology is the reduction in the number of human personnel (Eadie et al., 2007). *Reduce staffing* was identified by Eadie et al. (2007) as a driver among construction organizations in the UK for the implementation of e-procurement. Considering the number of people typically involved in the traditional paper-based procurement, e-procurement takes away major portions of the process executed by human personnel. For example, less labour is required for tender document preparation (Liao et al., 2002).

The competitive nature of organizations towards projects has encouraged organizations to seek ways of boosting its prospects in winning projects (Nitithamyong and Skibniewski, 2006). The driver, *enhancing the competitive advantage of firm*, has given organizations the desire to implement e-procurement in order to improve the organization's image. Presently, construction organizations function as knowledge-based entities, therefore, to support organizational learning, corporate memory is created to manage the knowledge (Huang et al., 2013). The advantage of having a *knowledge database and preserving corporate memory* when e-procurement is adopted has encouraged organizations to implement it, this is evident in the study by Ruikar et al. (2005). The support of top management towards the adoption of a technology is vital to both the initiative and the usage of that technology. *Top management believes and supports technology* as a driver, is a stimulator for the organization to seek technological approaches of solving issues (Pearson and Grandon, 2005).

Prior studies by Hassan et al. (2017) showed that organizations are more motivated to adopt e-procurement based on how well it is tailored to their organizational needs and goals.

Compatibility of technology to firm's goals as identified from literature exhibits the organizations attraction to take up e-procurement when procuring projects. Further, *technological readiness of firm,* indicates the preparedness of the organization for technology uptake. For instance, in Svidronova and Mikus (2015) study, the organizations were encouraged to adopt e-procurement for construction projects because of the information technology sophistication and readiness of the organization. The driver *firm's policy for technology advancement,* inspires management to easily adopt technological innovations such as e-procurement (Peansupap and Walker, 2006). *Sustaining future development of firm* is one incentive for organizations to encouraging e-procurement uptake (Sarshar and Isikdag, 2004). Since organizations dwell in dynamic technological environments, sustaining the processes of the organization, demands aligning to technological improvements. E-procurement presents ameliorating opportunities to manage physical resources, hence the driver *improve management of physical project resources* was recognized in literature (Kang et al., 2011). The anticipation of e-procurement offering *better work opportunities* has similarly inspired some construction organizations to adopt e-procurement (Zou and Seo, 2006).

5.5. Individual level drivers

The individual level of drivers describes the motivations and efforts by individuals to promote the adoption of e-procurement. Five drivers were identified at this level of classification. In human behaviour, there is the urge for people to master their operational environment, thus, to control their lives and attain some level of competence (Murtagh et al., 2016). The driver *employee personal motivation to use technology*, describes the desire from individuals or project team members to take up e-procurement for procuring projects. This desire could stem from personal characteristics of the individual such as embracing technology, receptive learning skills and good rewards with using technology in the past (Peansupap and Walker, 2005). Further, the driver *employee views technology as professional credibility*, shows that construction professionals perceive that some level of professional credibility is attained when technological innovations are employed in their work process (Peansupap and Walker, 2005).

Another driver at this level is the *influence of technology champion in the firm*. A technology champion is an individual with high enthusiasm for technology and influences other people to accept such technology (Peansupap and Walker, 2006). The technology champion which could be the project manager, dedicates much effort encouraging project teams and other individuals to adopt e-procurement. *Available expertise of technology* among project members and employees has driven e-procurement to be embraced in organizations (Li et al., 2015). Individual determination to have expert competence of a technology, inspires the project organization to adopt that technology, since these individuals will ensure that the technology is applied productively and efficiently. Whiles technology champion advocates for the use of e-procurement, the technology expertise available looks at how technology capability can be accessible. The *maturity of project members and team* motivates them to employ a more efficient method in conducting projects (Hosseini, 2018). The level of partnership and collaboration existing between the project members increases the interest for these members to adopt e-procurement for projects.

5.6. Service satisfaction drivers

The service satisfaction drivers classification refers to demands from clients or customers which motivates the adoption of technology on a project. Ruikar et al. (2005) indicated in their study that technology adoption can be client driven. A total number of four drivers were identified for this classification. The *client satisfaction* driver was the most identified driver in this classification. The desire to perform the procurement process to the satisfaction of the client is a good indicator for the success of the project. For instance, in the study by Ruikar et al. (2005), project managers employed e-procurement for projects in order to respond to client enquiries faster hence improving their service to the client. Further, Zou and Seo (2006) identified that organizations were willing to adopt e-procurement to provide better construction services to the satisfaction of the client. The second driver, *pressure from customers and public*, indicates how customers or public advocacy on a matter can motivate technology adoption. The pressure from the public through public media towards uptake of e-procurement due to its benefits, can influence the organizations to consider adopting it (Dooley and Purchase, 2006). This is because, currently public advocacy is been used as a tool to promote changes in various spheres of both government and private activities (Men and Tsai, 2014). The *client's demand for use of technology* driver, describes the request made by clients on a project concerning the use of a specific technology (Jacobsson et al. 2017). For example, in the study by Ruikar et al. (2005) a company adopted e-procurement because their client insisted its usage on the project. Involving the client in the procurement process also influence the adoption of e-procurement on construction projects. The motivation to *increase client involvement in the process easily*, enables the client to be abreast with the current status of the procurement process (Ruikar et al., 2005). This enhances the client to make input at any stage of the procurement process.

5.7. Sustainability concept drivers

This classification describes the factors or efforts that stimulate the project or organization's contribution to sustainability on the procurement process of projects. Three drivers were identified under this classification. Within this classification, *promoting paperless environment* was the driver mostly identified in literature. Studies by Gardenal (2013), Ruikar et al. (2005) and Nitithamyong and Skibniewski (2006) shows that organizations that adopted e-procurement experienced the benefit of reducing the total volume of papers used for the procurement process. Reducing the volume of papers used for procurement has an environmental value considering the number of trees that could be saved (Gardenal, 2013). Although this contribution to sustainability might be little globally, some organizations view it important and have made commitments towards promoting paperless environment (Ruikar et al., 2005). *Promoting sustainable goals through technology by firm* is another driver encouraging the adoption of e-procurement (Li et al., 2015). Policies by firms to use technology to promote sustainability provides exploration opportunities for the organization to contribute towards sustainability. *Reduce transportation energy, time and cost* as a driver for e-procurement for procuring projects (Alshawi and Ingirige, 2003), inspire project managers and organizations to contribute to environmental sustainability. Although, reducing the transportation energy, time and cost associated with the procurement process can be allocated to the cost and time benefits of adopting e-procurement, conserving the amount of energy expended on transportation has some valuable contribution towards environmental sustainability. Table 3 provides a summary of contributions from papers to e-procurement drivers literature.

<Insert Table 3 here>

6. Complex relationships among classified drivers

The various factors driving the motivations to adopt e-procurement for project procurement have been identified and discussed above. From the findings of the study, a framework was developed as shown in Fig. 4. This framework shows the seven classifications of these drivers thus: external drivers; project level drivers; technology and process level drivers; company level drivers; individual level drivers; service satisfaction drivers and; sustainability concept drivers. From Fig. 4, some drivers in one classification may influence other drivers in another classification. For example, increase in transparency, fairness and accountability may influence the reduction in bid collusion and corrupt practices driver and vice versa. Also, the drivers within one classification are interrelated thus, for instance, error minimization by eliminating manual rekeying may be interrelated to reduced cycle times for process and transaction. As shown in Table 2, the most significant drivers identified from literature were reduce process, transaction and administrative cost and reduce cycle times for process and transaction. In Fig. 4, whiles the bold arrow lines lead to the main classifications of e-procurement drivers, the short-dashed arrow lines infer the influence of a driver from one classification to another driver in other classifications and vice versa. This framework provides guides that help identify drivers that motivate the adoption of e-procurement for project procurement for wide implementation.

To further discuss these classifications, the total frequency and ranking of these classifications was conducted as shown in Table 4. The arithmetic employed was based on individual frequencies of papers identified for each classification and their respective mean scores (Chan and Owusu, 2017). The total frequency of papers for each factor in a classification was summed up and divided by the respective number of factors within that classification. The first rank was allotted to the classification with the highest mean score. For example, external drivers was calculated with the mean score formula below:

$$\sum(Dr20 + Dr36 + Dr47 + Dr33 + Dr45)/n \qquad (1)$$

$$= \sum(6 + 3 + 2 + 3 + 2)/5 = 3.20$$

Where *Dr* denote the corresponding drivers within that classification and *n* denotes the number of drivers within that classification.

<Insert Table 4 here>

The mean score of each classification is shown in Table 3 with the respective ranking. Fig. 4 illustrates the graphical presentation of the mean scores for the classifications of the drivers.

<Insert Fig. 5 here>

7. Discussions

The findings from Table 2 and the classification framework in Fig. 4 indicates that there are more drivers motivating the adoption of e-procurement which could be better classified to improve the understanding of e-procurement drivers when compared to previous classifications (Karthik and Kumar, 2013; Eadie et al., 2010a). Whereas previous classifications in literature were derived through the lens of process view approach and perspectives of project goals, the classification in this study provides a broader and comprehensive view of the drivers for e-procurement and the interrelationships among them for understanding the current and emerging motivations for e-procurement uptake. Due to the construction industry experiencing intense pressure to adopt new technologies and concepts in recent years (Loosemore et al., 2014), the seven classifications in Fig. 4 presents a broader spectrum for capturing the drivers for e-procurement. Therefore, new drivers emerging in the construction industry in the future can be grouped under these classifications with respect to their commonalities with the proposed classification. The external drivers classification (Fig. 4) shows the influence government and business partners have on promoting e-procurement uptake in organizations. This supports the argument of Loosemore et al. (2014) and Jacobsson et al. (2017) concerning the pressure in the industry to modernize in recent years. In effect, this pressure from external sources might not decrease since the quest for improved productivity is high and more governments are interested in implementing e-procurement. Therefore, construction organizations need strategic alignment of business processes and objectives in order to adapt to such coercive pressures.

Further the findings reveal that the goals and objectives determined for projects have motivated the adoption of e-procurement as depicted in the project level drivers classification. For instance, project objectives such as improve project audit trail (Dr21) and increase competition among tenderers (Dr9) (Hansen, 2018) shows that the objectives set on a project contributes towards e-procurement uptake. This provides effective strategies for implementers and promoters of e-procurement to ensure that project objectives stimulate project stakeholders to adopt e-procurement. The drivers identified in the project level drivers classification could serve as a guide for formulating projects objectives that enhance e-procurement adoption. From Fig. 4, the technology and process level drivers show that organizations are attracted by the benefits e-procurement brings in improving the procurement process. This supports Sepasgozar et al. (2018) argument that active steps are initiated when there is the quest to improve current conditions. This indicates that focusing attention on the attributes of e-procurement should be a key activity for convincing organizations to adopt e-procurement. This study reveals that aside coercive external pressures (Li et al., 2015; Jacobssen et al., 2017), organizations desiring to improve the procurement process are intrinsically motivated to adopt e-procurement when information on the benefits are made available. Specifically, the drivers mostly identified in literature (Table 2) are the related to the benefits thus reducing process cost and time (Dr1 and Dr2). This finding presents policy makers and project developers with the key benefits encouraging e-procurement, hence, continuous improvements in these areas would enable a sustained usage. Other benefits that could be engaged actively to motivate the adoption includes increasing transparency and accountability (Dr8) (Santoso and Bourpanus, 2018) and support for value added services (Dr34) (Costa and Tavares, 2014). These benefits present integration opportunities between e-procurement and other emerging technologies to advance the optimisation of technologies in the construction industry in the future.

The company level drivers classification in Fig. 4 depicts that the internal environment of an organization contributes to the decisions for adopting e-procurement. The drivers in this classification indicates that the relationship between the organizational goals and its capacity presents fertile grounds for e-procurement adoption. For example, the goal of an organization to enhance their competitive advantage (Dr15) coupled with the technological capacity of the organization (Dr32) indicate the organization's willingness to adopt e-procurement in order to sustain the future development of the organization (Dr52). This suggests that the drivers within this category have interdependencies. These supports current literature which acknowledges that the competitive agenda of organizations for increased market share and their technological preparedness makes it suitable for adopting new technology (Santoso and Bourpanus, 2018; Wimalesena and Gunatilake, 2018). This finding helps in the identification of potential organizations for e-procurement adoption in the construction industry, hence, the implementation strategy becomes targeted for optimum results. In Fig. 4, this study reveals there are motivations at the individual level facilitating e-procurement adoption which were not categorized in previous studies (Karthik and Kumar, 2013; Eadie et al., 2010a). This individual classification of drivers supports the findings of previous studies in other fields that individual actors provide key motivations for building information modelling (BIM) and energy technologies (Su et al., 2019; Singh and Holmström, 2015). This suggest that key individuals such as technology champion (Dr53) which could be a manager could be actively used to strategically promote e-procurement on projects and influence top management decisions for e-procurement usage.

The service satisfaction drivers classification in Fig. 4 emphasizes the influence of modern construction concepts in the procurement process. This finding supports the assertions from recent studies that organizations are continuously driven to satisfy their clients (Aspeteg and Mignon, 2019; Aliakbarlou and Costello, 2019). Client satisfaction has been highlighted as major indication of the success of a project in current literature (Haq et al., 2018), hence there is a desire from organizations to achieve this project goal. However, Jacobsson et al. (2017) identified another type of driver which is based on client's demand (Dr46). This suggests that aside using satisfaction as a project objective, the demand for certain use of technology by the client can be used to drive the adoption of e-procurement. In the sustainability concept drivers classification, this study identified that the proliferation of sustainable practices and initiatives is influencing e-procurement uptake. With regards to the impact construction activities have on the environment, the call for sustainability has increased in recent years (Roman, 2017; Montalbán-Domingo et al., 2018). In promoting a paperless environment (Dr18), Santoso and Bourpanus (2018) acknowledged that the use of e-procurement supports the efforts for environmental preservation. This call for sustainability has encouraged organizations to formulate sustainability initiatives which subsequently promotes their corporate image in the construction industry (Murtagh et al., 2016). Hence, it is predicted that as sustainability initiatives increase in the construction industry, organizations will be increasingly encouraged to adopt e-procurement technology.

In Fig. 4, this framework improves on existing literature by showing the interrelationships among the drivers (see Section 6). These interrelationships show that the drivers in one classification could stimulate other classification of drivers, hence, there may be some interdependencies among the classified drivers which may create a certain cluster of drivers motivating e-procurement in different contexts. Further, the findings from Table 4 and Fig. 4 indicate that the technological and process level drivers were the drivers mostly identified in literature. Also, this classification contains the most frequent drivers identified for e-procurement thus reduce process, transaction and administrative cost (Dr1) and reduce cycle times for process and transaction (Dr2). Although the sustainability concept drivers were less frequent in the literature, it is anticipated that the current promotion of sustainability in the construction industry would influence the uptake of e-procurement. Whiles this study explores the driving factors for e-procurement, other review studies such as Sepasgozar et al. (2016) indicate that the adoption process for construction technology innovations moves through a three phase process of investigation, adoption decisions and implementation. Also, Ahmed and

Kassem (2018) investigated the influence of BIM drivers on the first three stages of the BIM adoption process. Hence an investigation into the drivers influencing the various stages of e-procurement adoption process would be needful in promoting e-procurement.

8. Conclusions, implications and future research

Drivers for the adoption of e-procurement for project procurement have received considerable attention from literature within the past decades. However, a comprehensive review of the drivers to enhance future research is still lacking in existing literature. To address this gap, the aim of this study was to review existing literature by primarily identifying the drivers and classifying the drivers to facilitate future studies via the systematic review process. The study reviewed 68 related journal papers between 2002 and 2018, which revealed 61 drivers for the adoption of e-procurement. From the findings, drivers such as reduced process, transaction and administrative cost and; reduced cycle times for process and transaction were the most identified drivers from literature. Other drivers not frequently identified but might gain attention in the future are promoting paperless environment and promoting sustainable goals by firms.

The classification framework depicted seven categories thus; external drivers, project level drivers, technological and process level drivers, company level drivers, individual level drivers, service satisfaction drivers and sustainability concept drivers. The interrelationships among the categories are further revealed. Despite the dominance of technological drivers in the literature, the sustainability concept drivers and the service satisfaction driver reveal the penetration of emerging construction concepts to project procurement. Considering the lack of review studies for e-procurement drivers, this classification presents the foundation for promoting e-procurement for project procurement. From this present review, there exist more drivers when compared to some decades ago, which indicates the need for further empirical investigation.

Although much effort was exerted in reviewing the drivers in literature, it is acknowledged that this study is not exhaustive and is only focused on selected papers. Also, the sample size is relatively small even though an extensive search approach was used. However, it was considered adequate for the study with reference to similar review studies.

8.1. Theoretical implications

This study primarily contributes to the body of knowledge by developing a classification framework for e-procurement drivers to guide future research in exploring the interrelationships among the drivers. With the seven classified drivers identified in literature, this study identified that modern construction concepts such as sustainability and client satisfaction are influencing the adoption of e-procurement. This provides a hint for researchers to understand the possible influence of modern concepts on encouraging e-procurement adoption. In addition, the interrelationships revealed among these drivers in the framework presents a more nuanced understanding of the drivers for e-procurement by expanding the current knowledge beyond the narrow borders of isolated classification of drivers. Hence, as suggested by Papadonikolaki (2018) that drivers for BIM adoption have complex interactions, this study indicates that theoretical contributions towards e-procurement drivers literature should explore the interrelationships among these drivers. Also, this study offers a broader set of drivers when compared to previous individual empirical studies (see Table 2) for researchers to conduct effective future research with regards to the technological developments in the construction industry.

8.2. Practical implications

The findings in this study carries implications for practitioners in the construction industry by showing the interrelationships and influence modern construction concepts have on e-procurement adoption. These interrelationships inform policy makers that, to promote e-procurement, a structured method should be used to determine the group of drivers that motivate e-procurement among different kinds of stakeholders in the industry since the influence of the drivers may vary contextually. Majority of the drivers could be used to facilitate e-procurement uptake for the traditional contracting approach since it enhances transparency and accountability, reduces manual errors and increases competition among tenderers. Also, some benefits at the project level and technology and process level could employed to motivate e-procurement uptake for other project delivery approaches such as public-private partnership (PPP), design and build. Drivers such as platform for collaboration, enhancing inventory management and archiving and providing support for added value services could be used to improve productivity on these project delivery approaches.

8.3. Directions for future research

The findings from this study indicates the existence of interrelationships among the drivers which has been lacking in existing literature. In addressing this gap, future research could investigate how these drivers combine to influence e-procurement uptake regarding different stakeholders such as client organizations, large contractors, small and medium enterprises and consultants. For instance, how does external drivers, sustainability drivers and project level drivers combine to create a cluster of drivers to influence e-procurement uptake for consultants. This provides insight into which drivers to employ to motivate e-procurement uptake considering the different stakeholders in the construction industry. Also, future research could further refine the framework by exploring the influence of other advanced concepts in the construction industry on e-procurement uptake.

Appendix

Table 4. The details of the references as indicated in Table 2.

Reference	Author(s)	Year	Journal
1	Hosseini, M. R., Martek, I., Chileshe, N., Zavadskas, E. K., & Arashpour, M	2018	JCEM
2	Al-Yahya, M., Skitmore, M., Bridge, A., Nepal, M. P., & Cattell, D	2018	IJoPM
3	Santoso, D. S., & Bourpanus, N	2018	JFMPC
4	Al Yahya, M., Skitmore, M., Bridge, A., Nepal, M., & Cattell, D	2018	CI
5	Wimalasena, N. N., & Gunatilake, S	2018	CI
6	Mehrbod, A., & Grilo, A	2018	AEI
7	Jacobsson, M., Linderoth, H. C., & Rowlinson, S	2017	CME
8	Hassan, H., Tretiakov, A., & Whiddett, D	2017	JOCEC
9	Khan, K. I. A., Flanagan, R., & Lu, S. L	2016	CME
10	Pala, M., Edum-Fotwe, F., Ruikar, K., Doughty, N., & Peters, C	2016	CME
11	Kim, A. A., Sadatsafavi, H., & Kim Soucek, M	2015	JME
12	Ibem, E. O., & Laryea, S	2015	ITcon
13	Li, X., Pillutla, S., Zhou, H., & Yao, D. Q	2015	JOCEC
14	Svidronova, M. M., & Mikus, T	2015	JoPP
15	Doloi, H	2014	JCEM
16	Costa, A. A., & Tavares, L. V	2014	AIC
17	Ibem, E. O., & Laryea, S	2014	AIC
18	Laryea, S., & Ibem, E. O	2014	ITcon
19	Tas, E., Cakmak, P. I., & Levent, H	2013	JCEM
20	Kang, Y., O'Brien, W. J., & O'Connor, J. T	2013	JME
21	Karthik, V., & Kumar, S	2013	IJoPM
22	Bahri, S., Mahzan, N., & Kong, L. C	2013	IJoPM
23	Grilo, A., & Jardim-Goncalves, R	2013	AEI
24	Gardenal, F	2013	JoPP
25	Eadie, R., Millar, P., Perera, S., Heaney, G., & Barton, G	2012	IJoPM
26	Kang, Y., O'Brien, W. J., & O'Connor, J. T	2011	JME
27	Grilo, A., & Jardim-Goncalves, R	2011	AIC
28	Gupta, S. L., Jha, B. K., & Gupta, H	2011	IJoPM
29	Eadie, R., Perera, S., & Heaney, G	2011	JFMPC
30	Ajam, M., Alshawi, M., & Mezher, T	2010	AIC
31	Cheng, J. C., Law, K. H., Bjornsson, H., Jones, A., & Sriram, R	2010	AIC
32	Abu-ELSamen, A., Chakraborty, G., & Warren, D	2010	JIC
33	Eadie, R., Perera, S., & Heaney, G	2010a	ITcon
34	Eadie, R., Perera, S., & Heaney, G	2010b	ITcon
35	Quesada, G., González, M. E., Mueller, J., & Mueller, R	2010	BAIJ
36	Azadegan, A., & Teich, J	2010	BAIJ
37	Dossick, C. S., & Sakagami, M	2008	JCEM
38	Rahim, M. M., & Singh, M	2008	JIC
39	Jaafar, M., Aziz, A. R. A., Ramayah, T., & Saad, B	2007	IJPM
40	Castro-Lacouture, D., Medaglia, A. L., & Skibniewski, M	2007	AIC
41	Fox, P., & Skitmore, M	2007	BRI
42	Eadie, R., Perera, S., Heaney, G., & Carlisle, J	2007	ITcon
43	El-Diraby, T. E	2006	JCEM
44	Peansupap, V., & Walker, D. H	2006	ECAM
45	Ruikar, K., Anumba, C. J., & Carrillo, P. M	2006	AIC
46	Zou, P. X., & Seo, Y	2006	ITcon
47	Dooley, K., & Purchase, S	2006	JoPP
48	Nitithamyong, P., & Skibniewski, M. J	2006	JCEM
49	Ruikar, K., Anumba, C. J., & Carrillo, P. M	2005	ECAM
50	Obonyo, E., Anumba, C., & Thorpe, T	2005	ECAM
51	Pearson, J. M., & Grandon, E. E	2005	JIC
52	Peansupap, V., & Walker, D. H	2005	ITcon
53	Peansupap, V., & Walker, D. H	2005	CI
54	Croom, S. R., & Brandon-Jones, A	2005	JoPP
55	Wang, W. C	2004	JCEM

Table 4. (Continued).

Reference	Author(s)	Year	Journal
56	Sarshar, M., & Isikdag, U	2004	JME
57	Nitithamyong, P., & Skibniewski, M. J	2004	AIC
58	Voordijk, H., Van Leuven, A., & Laan, A	2003	CME
59	Zhang, N., & Tiong, R	2003	JCEM
60	Li, H., Cao, J., Castro-Lacouture, D., & Skibniewski, M	2003	AIC
61	Alshawi, M., & Ingirige, B	2003	AIC
62	Lockley, S. R., Watson, R., & Shaaban, S	2002	ECAM
63	Yeo, K. T., & Ning, J. H	2002	IJPM
64	Anumba, C. J., & Ruikar, K	2002	AIC
65	Stewart, R. A., Mohamed, S., & Daet, R	2002	AIC
66	Liao, T. S., Wang, M. T., & Tserng, H. P	2002	AIC
67	Tserng, H. P., & Lin, P. H	2002	AIC
68	Dulaimi, M. F., Y. Ling, F. Y., Ofori, G., & Silva, N. D	2002	BRI

Note: **JCEM** = Journal of Construction Engineering and Management; **CME** = Construction Management and Economics; **JFMPC** = Journal of Financial Management of Property and Construction; **IJoPM** = International Journal of Procurement Management; **CI** = Construction Innovation; **AEI** = Advanced Engineering Informatics; **JME** = Journal of Management in Engineering, **JOCEC** = Journal of Organizational Computing and Electronic Commerce; **ITcon** = Journal of Information Technology in Construction; **JoPP** = Journal of Public Procurement; **AIC** = Automation in Construction; **JIC** = Journal of Internet Commerce; **BAIJ** = Benchmarking: An International Journal; **IJPM** = International Journal of Project Management; **BRI** = Building Research & Information; **ECAM** = Engineering, Construction and Architectural Management.

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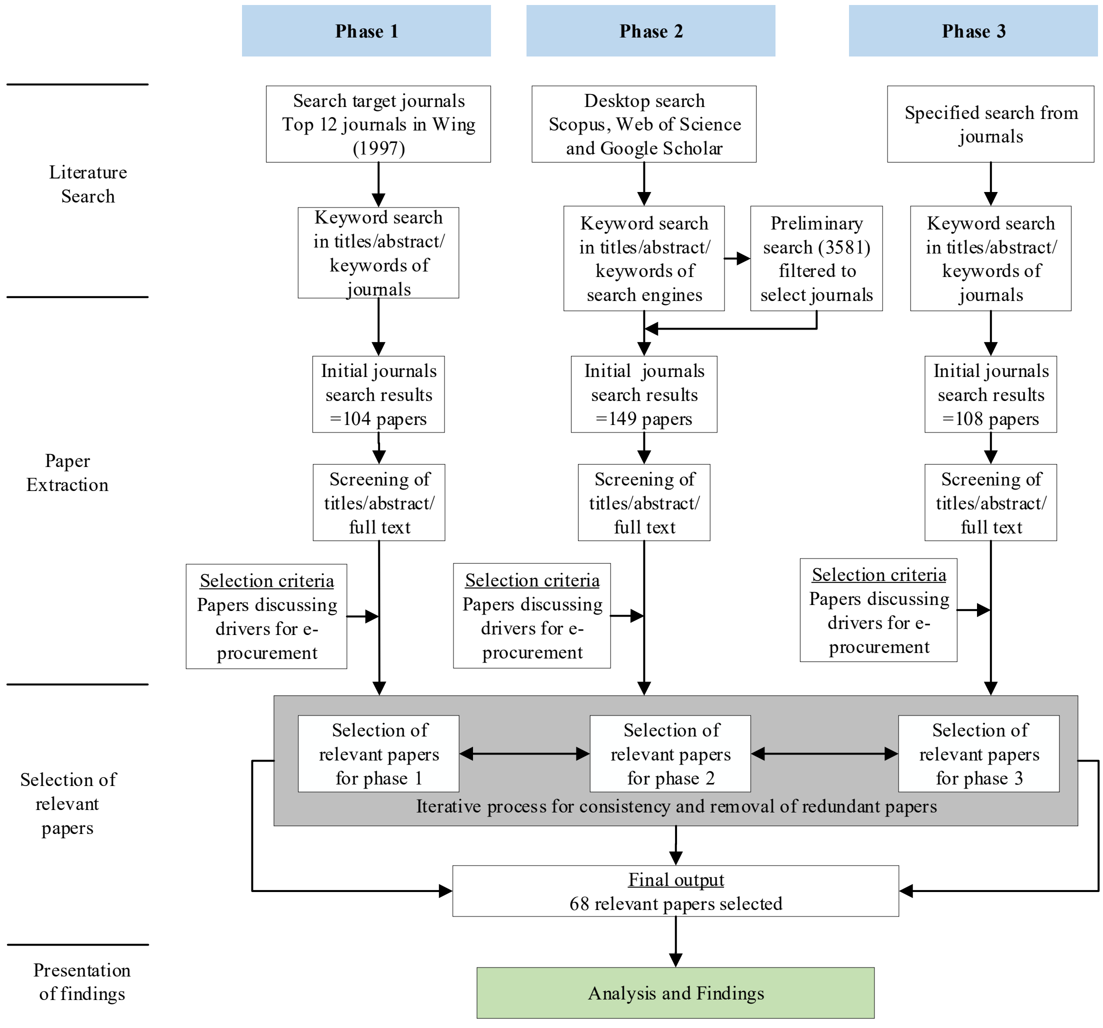

Fig. 1. Systematic process for literature review.

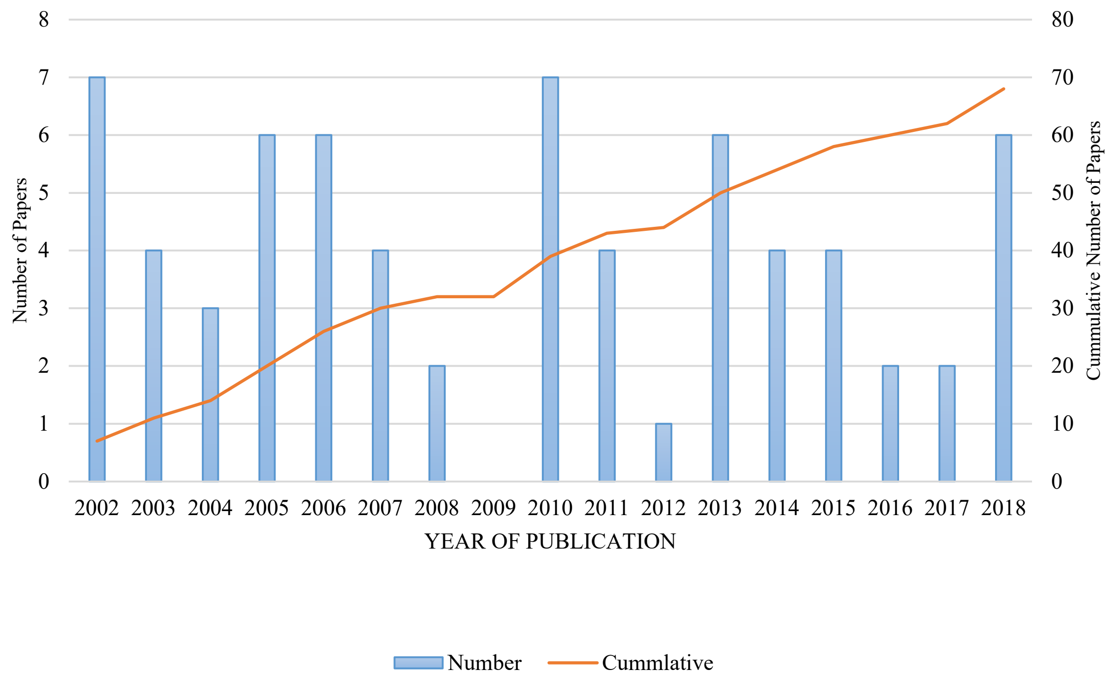

Fig. 2. Number of papers published from 2002 to 2018

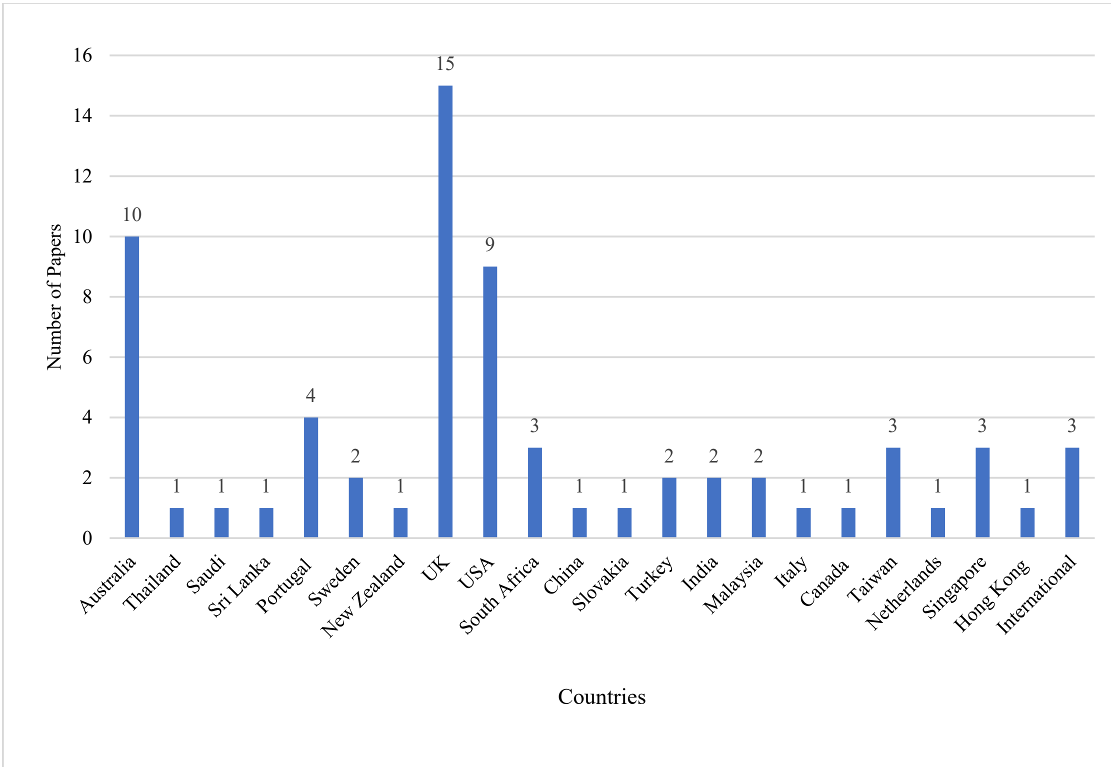

Fig. 3. Number of papers by countries

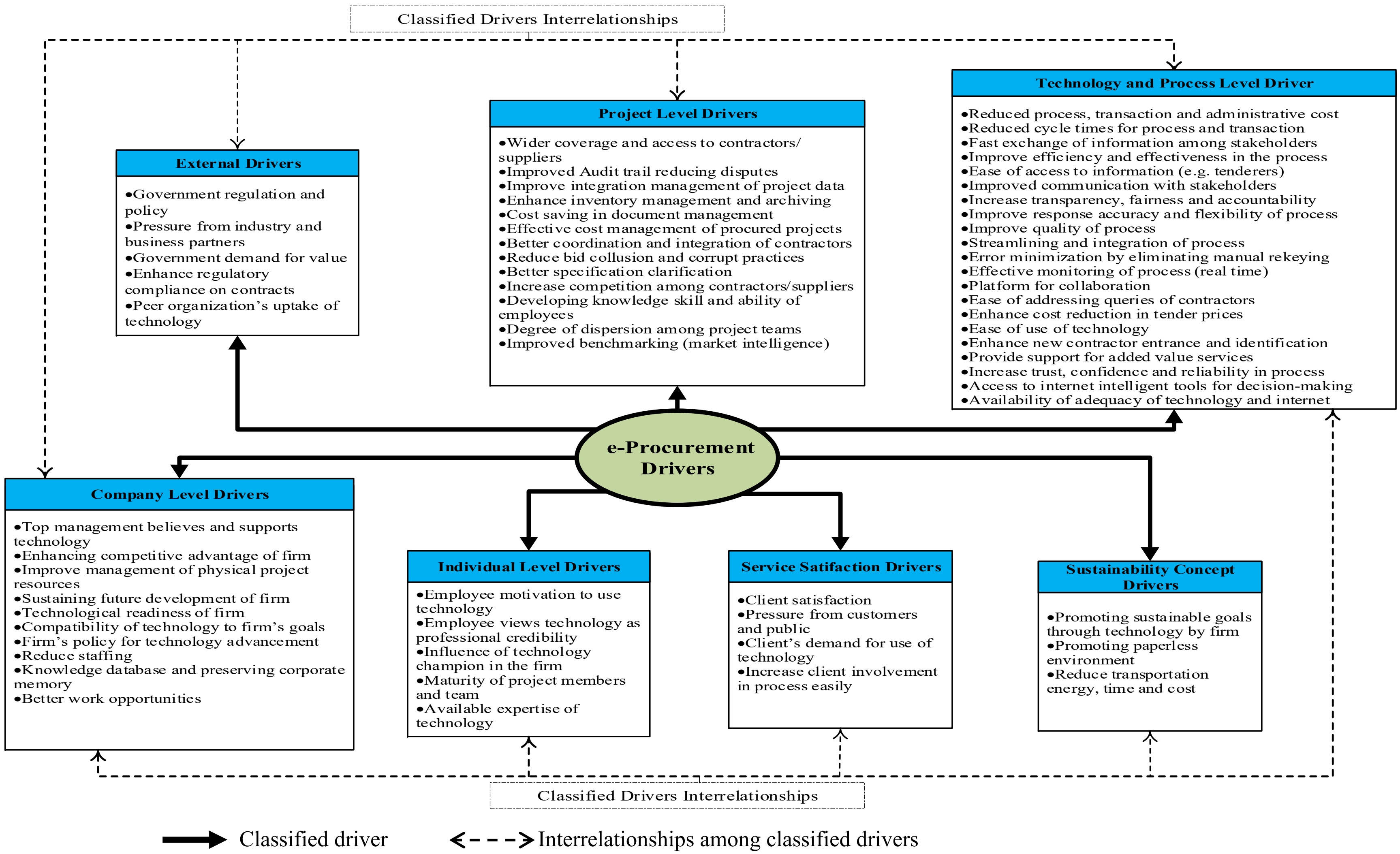

Fig. 4. Framework for e-Procurement Drivers for Construction Project Procurement

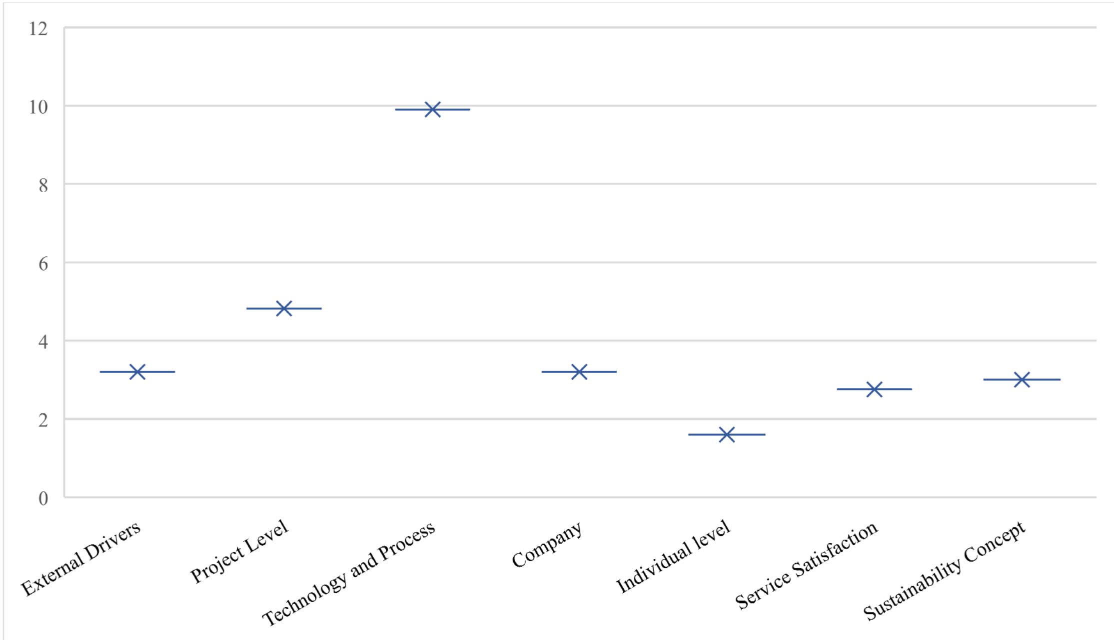

Fig. 5. Graphical representation of classifications mean score

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Table 1

Summary of initial search from journals and relevant papers selected.

Phase	Journal	Initial Search	Selected papers
1	Construction Management and Economics	14	4
	Engineering, Construction and Architectural Management	9	5
	Journal of Management in Engineering	9	3
	International Journal of Project Management	7	2
	Journal of Construction Engineering Management	15	8
	Automation in Construction	39	14
	Proceedings of the Institution of Civil Engineers–Civil Engineering	4	0
	Building Research and Information	7	2
2	International Journal of Procurement Management	72	5
	Journal Financial Management Property and Construction	5	2
	Journal of Internet Commerce	17	3
	Journal Information Technology in Construction	45	7
	Construction Innovation	10	3
3	Benchmarking: An International Journal	20	2
	Advance Engineering Informatics	8	2
	Journal of Organization Computing and Electronic Commerce	20	2
	Journal of Public Procurement	60	4
	Total	361	68

Table 2
Drivers of e-procurement for project procurement identified in literature

Code	E-procurement Drivers	References
Dr1	Reduce process, transaction and administrative cost	[2, 3, 5, 8, 12, 14, 15, 16, 17, 21, 22, 25, 26, 27, 28, 29, 32, 33, 34, 35, 36, 40, 42, 45, 46, 47, 48, 54, 60, 64, 66]
Dr2	Reduce cycle times for process and transaction	[2, 3, 4, 5, 8, 12, 15, 16, 21, 25, 28, 29, 32, 33, 34, 35, 36, 39, 42, 43, 45, 46, 49, 51, 53, 57, 61, 64, 67]
Dr3	Improve efficiency and effectiveness in the process	[5, 13, 17, 18, 21, 24, 26, 29, 30, 33, 34, 35, 37, 38, 46, 47, 51, 55, 61, 66]
Dr4	Fast exchange of information among stakeholders	[5, 9, 11, 16, 18, 20, 26, 40, 43, 49, 50, 51, 61, 63, 65, 67, 68]
Dr5	Ease of access to information (e.g. tenderers)	[3, 7, 9, 26, 28, 38, 40, 46, 48, 51, 54, 57, 59, 60, 64]
Dr6	Improve response, accuracy and flexibility of process	[12, 13, 19, 23, 26, 27, 31, 32, 34, 45, 46]
Dr7	Improved communication with stakeholders	[23, 29, 31, 33, 34, 42, 48, 49, 57, 61, 64]
Dr8	Increase transparency, fairness and accountability	[3, 5, 14, 21, 24, 29, 33, 39, 45, 49, 66]
Dr9	Increase competition among contractors/suppliers	[14, 15, 16, 24, 27, 29, 32, 33, 66]
Dr10	Improve quality of process	[2, 17, 26, 29, 33, 34, 45, 57, 59]
Dr11	Streamlining and integration of process	[6, 8, 9, 15, 20, 21, 38, 45, 48]
Dr12	Error minimization by eliminating manual rekeying	[15, 29, 33, 34, 48, 49, 57, 64]
Dr13	Wider coverage and access to contractors/suppliers	[8, 17, 21, 32, 48, 49, 62, 64]
Dr14	Reduce staffing	[5, 21, 26, 38, 42, 58, 59, 66]
Dr15	Enhancing competitive advantage of firm	[2, 28, 29, 36, 42, 44, 45, 48]
Dr16	Effective monitoring of process (real time)	[15, 18, 26, 28, 39, 48, 63]
Dr17	Platform for collaboration	[8, 9, 10, 23, 26, 38, 59]
Dr18	Promoting paperless environment	[24, 28, 48, 49, 64, 66]
Dr19	Improved benchmarking (market intelligence)	[26, 29, 32, 33, 34, 42]
Dr20	Government regulation and policy	[7, 37, 39, 47, 51, 55]
Dr21	Improved Audit trail and reducing disputes	[46, 48, 49, 57, 61]
Dr22	Improve integration management of project data	[32, 46, 48, 54, 58]
Dr23	Client satisfaction	[15, 17, 26, 46, 49]
Dr24	Enhance inventory management and archiving	[21, 29, 32, 33, 34]
Dr25	Developing knowledge skill and ability of employees	[1, 29, 33, 34, 38]
Dr26	Ease of addressing queries of contractors	[28, 48, 49, 61]
Dr27	Cost savings in document management	[32, 42, 49, 61]
Dr28	Enhance cost reduction in tender prices	[29, 32, 34, 42]
Dr29	Ease of use of technology	[8, 12, 13, 51]
Dr30	Knowledge database and preserving corporate memory	[28, 49, 61]
Dr31	Enhance new contractor entrance and identification	[26, 32, 35]
Dr32	Technological readiness of firm	[13, 14, 15]
Dr33	Enhance regulatory compliance on contracts	[26, 48, 54]
Dr34	Provide support for added value services	[16, 30, 66]
Dr35	Top management believes and supports technology	[13, 45, 51]
Dr36	Pressure from industry and business partners	[13, 47, 51]
Dr37	Pressure from customers and public	[13, 47, 51]
Dr38	Employee motivation to use technology	[13, 52, 53]
Dr39	Increase trust, confidence and reliability in process	[12, 26, 49]

Table 2.

Drivers of e-procurement for project procurement identified in literature (Continued)

Code	E-Procurement Drivers	References
Dr40	Compatibility of technology to firm's goals	[8, 12, 47]
Dr41	Effective cost management of procured projects	[32, 55]
Dr42	Employee views technology as professional credibility	[52, 53]
Dr43	Better coordination and integration of contractors	[35, 48]
Dr44	Reduce transportation energy, time and cost	[48, 61]
Dr45	Peer organization's uptake of technology	[13, 14]
Dr46	Client's demand for use of technology	[7, 47]
Dr47	Government demand for value	[7, 47]
Dr48	Reduce bid collusion and corrupt practices	[3, 66]
Dr49	Better specification clarification	[55]
Dr50	Access to internet intelligent tools for decision-making	[59]
Dr51	Firm's policy for technology advancement	[44]
Dr52	Sustaining future development of firm	[56]
Dr53	Influence of technology champion in the firm	[44]
Dr54	Increase client involvement in process easily	[49]
Dr55	Improve management of physical project resources	[26]
Dr56	Better work opportunities	[46]
Dr57	Available expertise of technology	[13]
Dr58	Availability of adequacy of technology and internet	[12]
Dr59	Promoting sustainable goals through technology by firm	[13]
Dr60	Maturity of project members and team	[1]
Dr61	Degree of dispersion among project teams	[1]

Note: The details of these references are provided in the Appendix.

Table 3.
Summary of contributions of papers to e-procurement drivers literature.

Classification	Description
External drivers	Government directives for technology usage (Jacobsson et al., 2017; Dossick and Sakagami, 2008; Jaafar et al., 2007) Direct and indirect influence of business partners (Li et al., 2015; Dooley and Purchase, 2006) Isomorphic influence from other organizations (Svidronova and Mikus, 2015; Li et al., 2015) Achieving value on government procurement (Jacobsson et al., 2017; Dooley and Purchase, 2006)
Project Level Drivers	Reducing malpractices on project procurement (Santoso and Bourpanus, 2018) Broader access to market and higher competition (Hassan et al., 2017; Svidronova and Mikus, 2015; Ibem and Laryea, 2014) Improving inventory, archiving and procurement audit trail (Karthik and Kumar, 2013; Kang et al., 2011; Eadie et al., 2011) Improving specification clarifications and information coordination (Quesada et al., 2010; Nitithamyong and Skibniewski, 2006)
Technology and Process Level Drivers	Reducing procurement process cost and time cycle (Wimalasena and Gunatilake, 2018; Hassan et al., 2017; Ibem and Laryea, 2015; Costa and Tavares, 2014; Eadie et al., 2012) Improving communication and exchange of information for project stakeholders (Santoso and Bourpanus, 2018; Wimalasena and Gunatilake, 2018; Khan et al., 2016; Kim et al., 2015) Improving transparency, trust and reliability of procurement process (Mehrbod and Grilo, 2018; Khan et al., 2017; Gardenal, 2013) Facilitating better supplier management (Gupta et al., 2011; Kang et al., 2011) Platform for improving collaboration and coordination in the process (Hassan et al., 2017; Pala et al., 2016; Doloi, 2014) Using internet intelligent tools for procurement (Hassan et al., 2017; Ibem and Laryea, 2015; Ajam et al., 2010)
Company Level Drivers	Improving competitive advantage of firms (Al-Yahya et al., 2018; Gupta et al., 2011) Optimizing human resource in organizations (Wimalasena and Gunatilake, 2018; Karthik and Kumar, 2013) Organizational leadership support and readiness for technology (Li et al., 2015; Svidronova and Mikus, 2015) Organizational policies and strategies towards technology (Hassan et al., 2018; Dooley and Purchase, 2006)
Individual Level Drivers	Individual motivation to adopt technology in organizations (Li et al., 2015; Peansupap and Walker, 2006) Maturity of project teams (Hosseini et al., 2018) Available expertise and attaining professional credibility in practice (Li et al., 2015; Peansupap and Walker, 2005)
Service Satisfaction Drivers	Satisfying the demands of the project client (Jacobsson et al., 2017; Doloi, 2014; Zou and Seo, 2006) Pressure from public and customers (Dooley and Purchase, 2006; Pearson and Grandon, 2005)
Sustainability Concept Drivers	Enhancing environmental sustainability (Gardenal, 2013; Nitithamyong and Skibnieswki, 2006) Promoting sustainable development by organizations (Li et al., 2015)

Table 4.
Ranking of driver classifications

Classification	Code	Frequency	Mean	Rank
External Drivers			3.20	3
Government regulation and policy	Dr20	6		
Pressure from industry and business partners	Dr36	3		
Government demand for value	Dr47	2		
Enhance regulatory compliance on contracts	Dr33	3		
Peer organization's uptake of technology	Dr45	2		
Project Level Drivers			4.50	2
Wider coverage and access to contractors/suppliers	Dr13	8		
Improved audit trail and reducing disputes	Dr21	5		
Improve integration management of project data	Dr22	5		
Enhance inventory management and archiving	Dr24	5		
Cost savings in document management	Dr27	4		
Effective cost management procured projects	Dr41	2		
Better coordination and integration of contractors	Dr43	2		
Reduce bid collusion and corrupt practices	Dr48	2		
Increase competition among contractors/suppliers	Dr9	9		
Developing knowledge skill and ability of employees	Dr25	5		
Improved benchmarking	Dr26	6		
Degree of dispersion of project teams	Dr61	1		
Technology and Process Level Drivers			9.90	1
Reduce process, transaction and administrative cost	Dr1	31		
Reduce cycle times for process and transaction	Dr2	29		
Fast exchange of information among stakeholders	Dr4	17		
Improved efficiency and effectiveness in the process	Dr3	20		
Ease of access to information and	Dr5	15		
Improved communication with stakeholders	Dr7	11		
Transparency, fairness and accountability	Dr8	11		
Improve response, accuracy and flexibility of the process and	Dr6	11		
Improve quality of process	Dr10	9		
Streamlining and integration of process	Dr11	9		
Error minimization by eliminating manual rekeying	Dr12	8		
Effective monitoring of process (real time)	Dr16	7		
Platform for collaboration	Dr17	7		
Ease of addressing queries of contractors	Dr26	4		
Enhance cost reduction in tender prices	Dr28	4		
Ease of use of technology	Dr29	4		
Enhance new contractor entrance and identification	Dr31	3		
Provide support for added value services	Dr34	3		
Increase trust, confidence and reliability in process	Dr39	3		
Access to internet intelligent tools for decision-making	Dr50	1		
Availability of adequacy of technology and internet	Dr58	1		
Company Level Drivers			3.20	3
Reduce staffing	Dr14	8		
Enhancing the competitive advantage of firm	Dr15	8		
Knowledge database and preserving corporate memory	Dr30	3		
Top management believes and supports technology	Dr35	3		
Compatibility of technology to firm's goals	Dr40	3		
Technological readiness of firm	Dr32	3		
Firm's policy for technology advancement	Dr51	1		
Sustaining future development of firm	Dr52	1		
Improve management of physical project resources	Dr55	1		
Better work opportunities	Dr56	1		
Individual Level Drivers			1.60	7
Employee personal motivation to use technology	Dr38	3		
Employee views technology as professional credibility	Dr42	2		
Influence of technology champion in the firm	Dr53	1		
Available expertise of technology	Dr57	1		
Maturity of project members and teams	Dr60	1		
Service Satisfaction Drivers			2.75	6
Client satisfaction	Dr23	5		
Pressure from customers and public	Dr37	3		
Client's demand for use of technology	Dr46	2		
Increase client involvement in the process easily	Dr54	1		
Sustainability Concept Drivers			3.00	5
Promoting paperless environment	Dr18	6		
Promoting sustainable goals through technology by firm	Dr59	1		
Reduce transportation energy, time and cost	Dr44	2		