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, Drivers, Construction industry, Organization, Management, Project management

Paper type Literature 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; Jacobsson *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).

The authors thank the Department of Building and Real Estate of The Hong Kong Polytechnic University for funding this research. This study forms part of a PhD research project on the adoption of e-procurement for construction project procurement, which might share similar background and methodology with other papers but with different objectives and scopes.

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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. A 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 cover 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) is 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 focussed on two aspects: 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, while 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 which is used to predict behaviour based on intentions and attitudes of people (Liu *et al.*, 2018). This suggests 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. Figure 1 summarizes the systematic process for the literature review.

The initial search results led to papers from *CME*, *JCEM*, *ECAM*, *JME*, *PICE-CE*, *IJPM*, *AIC* and *BRI* while 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 I shows the number of relevant papers identified from each journal.

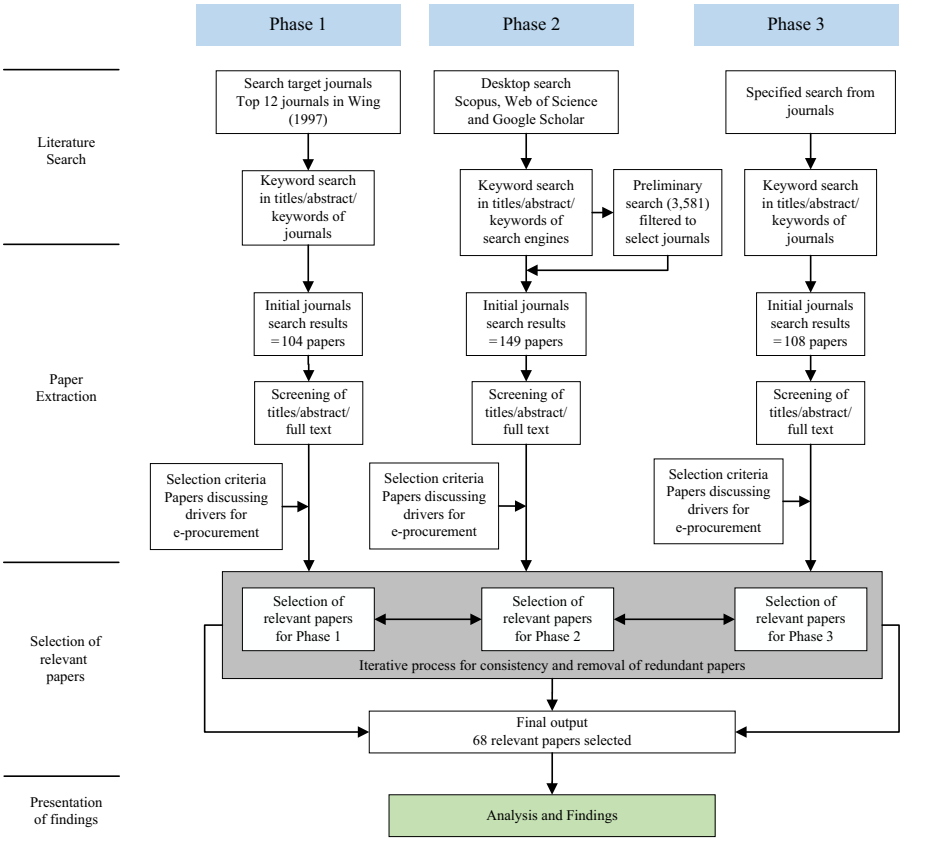

Figure 1.
Systematic process for literature review

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 I.
Summary of initial search from journals and relevant papers selected

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 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); journals that had two or more papers that dealt with the subject matter were considered; and 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 2. 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 compare favourably with other similar review studies such as Hasan *et al.*'s (2017) review on factors affecting construction productivity with 47 papers and Aarseth *et al.*'s (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

Figure 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, 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 were emerging (Gunasekaran and Ngai, 2008). Subsequent years had declined publications until 2005 and 2006 that recorder six papers successively. From Figure 2, 2010 also recorded the highest number of publications with seven papers. The lowest number of publications was recorded in 2009 with no papers recorded since publications were identified in 2002. The publication

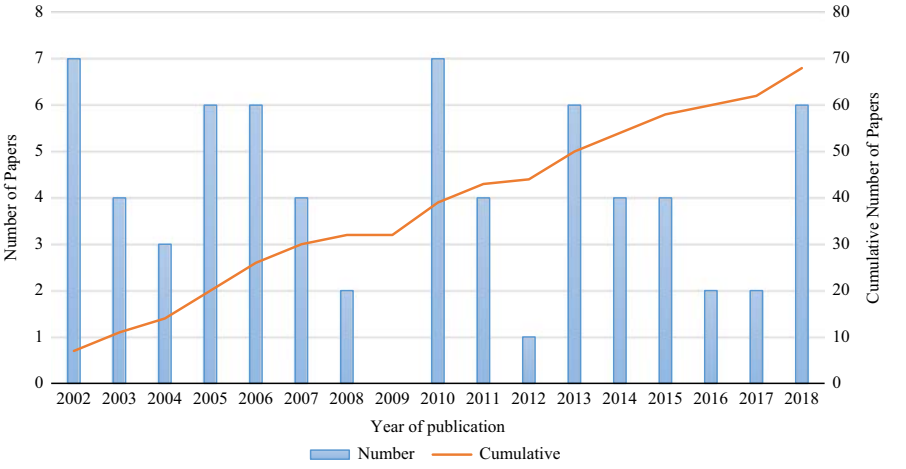

Figure 2.
Number of papers published from 2002 to 2018

trend has been generally constant, with an average of four papers per year cumulatively. This suggests 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.

4.2 Publication by countries

Figure 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,

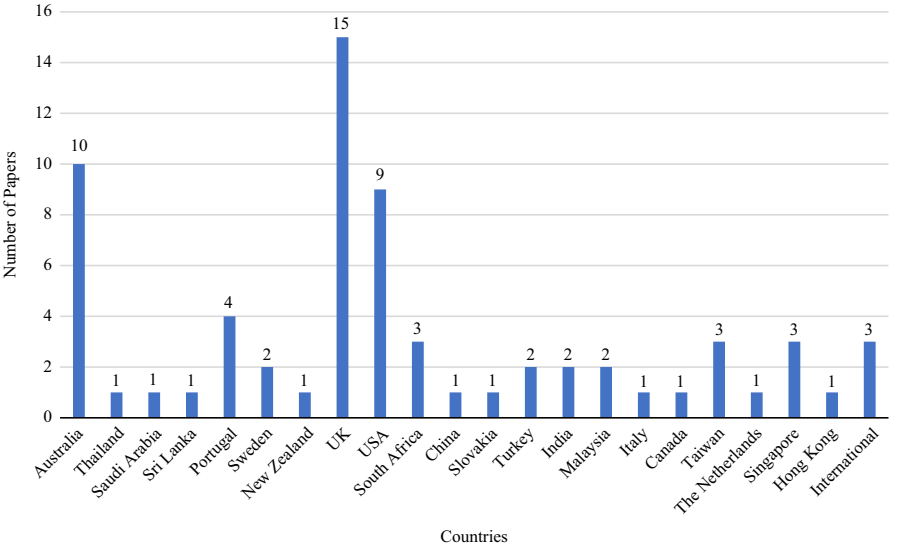

Figure 3.
Number of papers by countries

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).

4.3 Identification of drivers for e-procurement for project procurement

The 68 selected relevant papers were analyzed to identify the drivers of e-procurement in the project procurement. In total, 61 drivers were consequently identified. Details of these drivers are presented in Table II, indicating their codes and references retrieved from literature. The full details on the references can be accessed in Table AI. 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.

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

As illustrated in Table II, 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.* (2015). Some groupings of drivers/benefits have been conducted by previous studies (see Karthik and Kumar, 2013; Eadie *et al.*, 2010a). Karthik and Kumar (2013) summarized 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 focussed only on 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: 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 groupings from Karthik and Kumar (2013) and Eadie *et al.* (2010a) present 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 II 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 II 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. Figure 4 shows the framework for the classifications these drivers.

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]

Table II.
Drivers of e-procurement for project procurement identified in literature

(*continued*)

Code	E-procurement drivers	References
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]
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 Table AI

Table II.

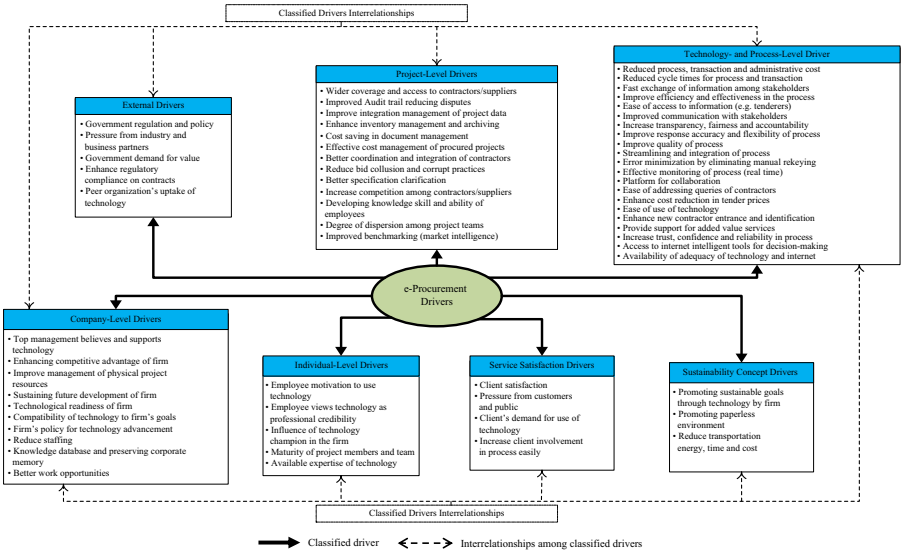

Figure 4.
Framework for e-procurement drivers for construction project procurement

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 Sakagami, 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 USA, 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 Sakagami (2008) realized that the pressure to adopt electronic platforms for coordinating projects was higher in Japan as compared to the USA. In Japan, the government has formulated policies to regulate these electronic platforms as a strategy to recover from long recession (Dossick and Sakagami, 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). These policies and regulations by governments stimulate its organizations to take up e-procurement when procuring projects. Another factor, 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 Figure 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, b). 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 *et al.*, 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 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, 2018), 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 II). 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 describe 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 II). 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 per cent of cost savings were 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 realized 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. The access of contractors/suppliers 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 is 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) realized 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.*, 2010a, 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 II). 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 Figure 4, it is shown that ten drivers were identified as factors motivating the adoption at the company level. One benefit realized 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 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. While technology champion advocates for the use of e-procurement, the technology expertise available looks at how technological capability can be accessible. The maturity of project members and team motivates them to employ a more efficient method in conducting projects (Hosseini *et al.*, 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 influences 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's 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) show 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 provide 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) inspires 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 III provides a summary of contributions from papers to e-procurement drivers' literature.

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 Figure 4. This framework shows the seven classifications of these drivers: external drivers; project-level drivers; technology- and process-level drivers; company-level drivers; individual-level drivers; service satisfaction drivers; and sustainability concept drivers. From Figure 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, for instance, error minimization by eliminating manual rekeying may be interrelated to reduced cycle times for process and transaction. As shown in Table II, the most significant drivers identified from literature were reduce process, transaction and administrative cost and reduce cycle times for process and transaction. In Figure 4, while 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.

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.*, 2016; 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 (Hasan *et al.*, 2017; 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 Skibniewski, 2006)
	Promoting sustainable development by organizations (Li *et al.*, 2015)

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

To further discuss these classifications, the total frequency and ranking of these classifications was conducted as shown in Table IV. 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 were calculated with the mean score formula below:

$$\sum (\mathrm{Dr20}+\mathrm{Dr36}+\mathrm{Dr47}+\mathrm{Dr33}+\mathrm{Dr45})/n = \sum (6+3+2+3+2)/5 = 3.20, \qquad (1)$$

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		

Table IV.
Ranking of driver classifications

(*continued*)

Classification	Code	Frequency	Mean	Rank
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		

Table IV.

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

The mean score of each classification is shown in Table III with the respective ranking. Figure 4 illustrates the graphical presentation of the mean scores for the classifications of the drivers (Figure 5).

7. Discussions

The findings from Table II and the classification framework in Figure 4 indicate 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, 2014), the seven classifications in Figure 4 present 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

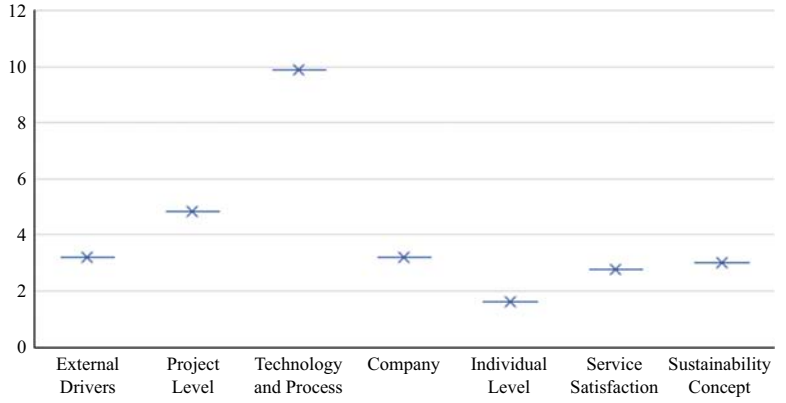

Figure 5. Graphical representation of classifications mean score

(Figure 4) shows the influence government and business partners have on promoting e-procurement uptake in organizations. This supports the argument of Loosemore (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) show that the objectives set on a project contribute 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 Figure 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.*'s (2018) argument that active steps are initiated when there is the quest to improve current conditions. This indicates that focussing 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; Jacobsson *et al.*, 2017), organizations desiring to improve the procurement process are intrinsically motivated to adopt e-procurement when information on the benefits is made available. Specifically, the drivers mostly identified in literature (Table II) are related to the benefits 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 include 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 optimization of technologies in the construction industry in the future.

The company-level drivers' classification in Figure 4 depicts that the internal environment of an organization contributes to the decisions for adopting e-procurement. The drivers in this classification indicate 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) indicates 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. This 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 Figure 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 suggests 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 Figure 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 *et al.*, 2018). 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 regard 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 promote 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 Figure 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 IV and Figure 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: 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. While 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: 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 focussed 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 present 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 II) for researchers to conduct effective future research with regard to the technological developments in the construction industry.

8.2 Practical implications

The findings in this study carry 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 be employed to motivate e-procurement uptake for other project delivery approaches such as public–private partnership, 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 indicate the existence of interrelationships among the drivers which have 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 do 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.

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Further reading

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Appendix

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

(*continued*)

Table AI.
The details of the references as indicated in Table II

Reference	Author(s)	Year	Journal
51	Pearson, J.M. and Grandon, E.E.	2005	*JIC*
52	Peansupap, V. and Walker, D.H	2005	*ITcon*
53	Peansupap, V. and Walker, D.H.	2005	*CI*
54	Croom, S.R. and Brandon-Jones, A.	2005	*JOPP*
55	Wang, W.C.	2004	*JCEM*
56	Sarshar, M. and Isikdag, U.	2004	*JME*
57	Nitithamyong, P. and Skibniewski, M.J.	2004	*AIC*
58	Voordijk, H., Van Leuven, A. and Laan, A.	2003	*CME*
59	Zhang, N. and Tiong, R.	2003	*JCEM*
60	Li, H., Cao, J., Castro-Lacouture, D. and Skibniewski, M.	2003	*AIC*
61	Alshawi, M. and Ingirige, B.	2003	*AIC*
62	Lockley, S.R., Watson, R. and Shaaban, S.	2002	*ECAM*
63	Yeo, K.T. and Ning, J.H.	2002	*IJPM*
64	Anumba, C.J. and Ruikar, K.	2002	*AIC*
65	Stewart, R.A., Mohamed, S. and Daet, R.	2002	*AIC*
66	Liao, T.S., Wang, M.T. and Tserng, H.P.	2002	*AIC*
67	Tserng, H.P. and Lin, P.H.	2002	*AIC*
68	Dulaimi, M.F., Y. Ling, F.Y., Ofori, G. and Silva, N.D.	2002	*BRI*

Notes: *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*

Table AI.

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