Critical analysis of procurement techniques in construction management sectors

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Abstract. Over the last three decades, numerous procurement techniques have been one of the highlights of the Construction Management (CM) for ventures, administration contracting, venture management as well as design and construct. Due to the development and utilization of those techniques, various researchers have explored the criteria for their choice and their execution in terms of time, cost and quality. Nevertheless, there is a lack of giving an account on the relationship between the procurement techniques and the progressed related issues, for example, supply chain, sustainability, innovation and technology development, lean construction, constructability, value management, Building Information Modelling (BIM) as well as e-procurement. Through chosen papers from the reputable CM-related academic journals, the specified scopes of these issues are methodically assessed with the objective to explore the status and trend in procurement related research. The result of this paper contributes theoretically as well as practically to the researchers and industrialist in order to be aware and appreciate the development of procurement techniques.

1. Introduction
It is aphoristic that an undertaking of CM project might be viewed as effective if the completion of building is done in the expected timeline, not beyond the allocated budget and the quality which is being standardized in order to attain the maximum level of customer fulfillment. Progressively, the satisfaction of these criteria has been related with the issue of procurement technique for construction. In other words, the determination of the suitable procurement technique can shape the achievement of the project. Comprehensively, the issues that are confronting the building procedure are: (1) Separation of outline plan from construction; (2) absence of team integration; (3) absence of effective communication; (4) vulnerability; (5) evolving environment, (6) changing customers’ needs and desires, and (7) increment of project complications [1]. These, together with monetary changes such as recession and inflation, have driven construction experts and the business to offer elective techniques for building procurement, for example, design and build, administration contracting and construction of project management. There are various methods in procuring a venture which are Private Finance Initiative (PFI), Public-Private Partnership (PPP), and so forth which may likewise be contemplated under the procurement technique. Despite that, they are categorised more precisely as a pathway towards procurement and depicted it as a theory and an agreement of trust [2]. For instance, majority partnering arrangements are a general understanding, which incorporates one or a few contracts below one of the three key techniques. The explored research has offered ascended to an extensive number of definitions of procurement technique. The best two procurement techniques definitions are:
i) “a procurement system is an organizational system that assigns specific responsibilities and authorities to people and organizations, and defines the relationships of the various elements in the construction of a project” [3].

ii) “a mechanism for linking and coordinating members of the building team throughout the building process in a unique systematic structure, both functionally and contractually. Functionally via roles, authority and power, contractually via responsibilities and risks. The main aim is to deliver a project that meets its objectives and fulfill the client criteria and expectations”[4].

With the expansion in usage of alternate procurement techniques, various researchers have design charts of decision-making process to examine the criteria for their choice and their rate of achievement regarding time, cost and quality. Throughout the years the selection procedure of procurement has progressed toward becoming progressively complex, primarily because of the prolonged expansion of various procurement techniques for procuring building tasks, the tasks’ consistently expanding its complexity and the customer's requirement for a more incentive for money projects. Thus, it is necessary to classify that the factor of time, cost and quality only are currently insufficient in regards to the present complex condition of construction's project. The objective of this paper is to reveal an inclusive review of literature which arbitrates to address the current factors that are related with the determination of current procurement technique. In order to accomplish this objective, a systematic literature review has been conducted for the year of 1980 to 2016, highlighting on the current issues with the purpose of building up an up-to-date decision making chart to choose the suitable procurement technique for the construction's project.

2. Research methodology

In order to accomplish the aim of this paper, a two stage of methodology procedure has been carried out. They are:

2.1 Stage 1: Determining the relevant materials

The identification process of materials for literature review began by investigating primary and secondary sources. The primary sources included refereed conferences, refereed journals, theses, intermittent papers and government reports. The secondary sources included trade journals, textbooks, magazines, and newspapers. The sources that will be selected should be related to CM. The top five best journals which were reviewed during the exploration are: i) International Journal of Procurement; ii) International Journal of Project Management; iii) Engineering, Construction and Architectural Administration; iv) American Society of Civil Engineers (ASCE); v) Construction Management and Economics. The justifications of choosing these respective five journals are due to the fact that it has been highly ranked in the field of CM by [5]. Subsequently, these five journals are also being identified to have a high frequency of procurement techniques published paper.

Other than that, the selection of another five peer reviewed journals which indicates a high frequency of CM published papers is being done for the literature review. These five peer reviewed journals are from i) Industrial Marketing Management; ii) Construction Innovation; iii) An International Journal; iv) International Journal of Quality and Reliability Management; v) International Journal of Managing Projects in Business. Overall, these top 10 journals are being chosen for the journals source. Besides, four of the top international conferences proceedings related to CM are being reviewed as well. They are i) Organisation and Management of Construction Symposium (known as CIB W65); ii) Procurement Systems Symposium (CIB W92); iii) Building Economics and Construction Management (CIB W90) as well as iv) Association of Research in Construction Management (ARCOM). In addition, reports and occasional paper were also selected as one of the material due to its complete and current information related to CM and procurement. These papers are i) Chartered Institute of Building (CIOB); ii) Royal Institute of Chartered Surveyors (RICS); iii) Royal Institute of British Architects (RIBA); iv) Building Research Establishment (BRE); v) Construction Industry Research and Information Association (CIRIA). The search has been carried out using ten journals and nine conference proceedings and report. Thus, the search indicates 120 CM-procurement related articles and for the aim of this paper, the reference stated below were suitable and being chosen to be discussed extensively.

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2.2 Standardized note-taking and assessment

Subsequently, at this particular stage the summary of the literature review were filtered and a literature document was created. The primary scopes that were looked in this research are supply chain, sustainability, innovation and technology development, lean construction, constructability, value management, Building Information Modelling (BIM) and e-procurement. These scopes were selected based on the previous literature in the procurement related fields as well as their connection with CM. In particular, the specific writings of previous authors [6,7,8,9,10,11,12,13]. After assembling the materials for literature review, the selected articles are reviewed critically and systematically in order to identify the resemblance in the literatures of previous researchers, the prevalent issues highlighted, and disparity or disagreement of the facts as well as elucidations made by previous researchers.

3. Critical review of current issues related to procurement methods

3.1 Supply Chain Management (SCM)
Supply chain management (SCM) is defined as the network management of interconnecting businesses ramified in the overall arrangement of goods and service packages demanded by end customers [14]. Therefore it is obvious that SCM encloses all the significant movement and depository of raw materials, work-in-process inventory, as well as finished goods from the origin point to the consumption point. According to [15] “(SCM) is directed toward the minimisation of transaction cost and the “enhancement and transfer of expertise between all parties”. Modern procurement method does not make a hierarchical structure to manage the social issue and discontinuity of the building procedure. Researchers recommended that clustering by a technology group approach as a method for handling reconciliation issue. It was contended that SCM is a management theory and that its philosophy is applicable to any procurement techniques; in spite of the fact that management types of procurement contributes a better framework [16].

3.2 Sustainability
Sustainable Procurement (SP) is a procedure whereby associations address their issues and demand for goods, services, administrations, works and utilities in a way that accomplishes the value of money on an entire life premise in order to create genuine long haul benefits, to the association, as well as to society and the economy, while reducing the damage to the environment [17]. Currently, there is an obligatory introduced in Europe which is all new built and refurbished building structures are ought to show consistence with 'Target Carbon Emissions Rates' and in addition with the Building Energy Model (Part L) of the Building Regulations 2006. Researchers agree that the generation of such models demands a few cycles at the design and plan stage and invites close integration between the various experts [6,18,19]. Breakthrough in term of innovation has been thwarted by numerous hindrances, for example, the industry's divided nature, absence of long haul perspective, customers' unwillingness to share load, lack of clear definition and advantages of sustainable construction, constraint related to regulations and conflict in government policies and insufficient fiscal incentives [20]. The research done [21] indicates that there is a huge conflict between SP and cost reduction mainly in central government. Thus, in this manner, this would provoke the inquiry regarding the balance of the design and build contractor will consider among sustainability for presenting a more focused and competitive offer for the works. In addition, it is supported that sustainable construction demands change to the method of construction, the utilization of resources yet more and most importantly in the building procedure [22]. Therefore, to accomplish this, critical change to the organisation, structure and communication channels of the business should be made. It was also highlighted that the usage of traditional procurement techniques creates a professional obstruction to innovative change that is required by sustainability. Besides, [6] explained that the usage of traditional procurement involving design and build is proven to be an extremely difficult task to outline environmentally sensitive buildings as the emphases required are inconsistent with the contractor motivating force to stay away from postponements and additional cost. By following the guideline of sustainable construction, from the government's point of view, it will encourage a genuine social change in the CM towards the selection of collaborating as a procurement process [23].
3.3 Lean Construction

The previous researchers looked for radical changes to enhance production in the construction industry and they identified that the usage of lean techniques are the best practice. This idea has been explained in the articles specifically, [24] that in spite of the fact that the impact of integration on the design and delivery of construction projects have been discussed at length, the effect of this on the teams’ organisation deserves detailed investigation. They set forward the case that researchers in lean construction contended that traditional design practices are outdated and have performed ineffectively in dealing with the stream or meeting customers' prerequisites. Therefore, it can be contended that, for the standards of lean construction to be adequately connected, there should be a collaboration associated with all parties which is eventually cultivated through integration. The previous researcher recorded six main components of lean construction which are: i) waste minimisation; ii) procedure which highlights production, planning and control; iii) end of customer’s focus; iv) continuous developments; v) strong collaborative relationships; and vi) systems point of view [10]. Lean construction in terms of procurement can be contended that a high emphasise can be done upon the significance of cultivating a powerful collaborative relationships from the initial stage such as partnering and also recognizing continuous improvement. Methodical experimentation, continuous improvement, and as well as constant learning over all technical and organisational levels are significant factor of the lean theory, especially as a method of endeavor to improve the value of customer while minimising waste [25,26]. Nevertheless, there was some evidence available which demonstrates that executing lean practices in the collaborating consortium is not really straight forward as been frequently suggested [27]. A basic change ought to be in the practices and behaviors of the included participants or parties. They noted three sorts of boundaries towards cooperation in particular, industrial, organizational and cultural barriers.

3.4 Innovation and Technology Development

The term innovation directly shows that it is about practicing latest sciences and solutions for construction and it has turned out to be fundamental for development of construction organisations due to the high pressure from customers to enhance quality, minimise cost and accelerate construction processes. These scopes were discussed in the early year of 1960s’ [28] who arranged the four different sort of innovation with the logic that they are executed and created. They are i) time or cost: An advancement or innovation which is cost-efficient and time-saving in comparison of the current strategies or techniques; ii) performance development: an innovation which has the best performance in execution; iii) aesthetic: a development of innovation that has different and latest appearance; iv) ersatz: an elective method for doing things that is constrained by particular circumstances (i.e. lack of particular materials or manpower). Subsequently, innovation is considered as one of the element of competitive advantage and can be seen as pre-imperative for an organisation achievement and survival. Egbu [29] contended that the capacity to improve or innovate highly depends on how an organisation manage and exploit their own available resources. In spite of a few hindrances towards innovation in construction, there has been a change currently to settle the divided structure of the CM in industries with critical endeavors to collaborate the design and construction. This is especially obvious in the increments in design and builds ventures, administration contracting and project management [6,13,27,30,31,32].

3.5 Constructability

First and foremost, a design plan which can be built would prompt to time and cost-saving. Nonetheless, regardless of its significance, little advancement has been made to resolve the constructability issue and this is because of the confrontational behavior between customer, contractors and consultants under the conventional procurement settings. The term “constructability” was introduced in the 1960s and 1970s but confronted negative feedbacks for its restriction in scope as it limits to the design procedure [33]. After that, various researches have been carried out with a specific end goal to a better task execution and improvement of constructability. For instance, research in procurement methods embraced the idea that “the continual use of traditional lump sum may stifle technological innovation, particularly the design and constructability of public sector buildings” [8]. Since the year of 2000, the connection among constructability and procurement technique has been broadly discussed, with most researchers in
assertation that fully coordinated procurement techniques, for example, Design and Build and venture administration are most suitable for customers setting a high need on the constructability of their project.

3.6 Value management
Value management is a standardized way to deal in delivering a project with the needed functions at optimum whole life cost without affecting negatively to quality, execution and reliability. Thus, it will be the group of team which is systematically used to distinguish and wipe out superfluous expenses of the goods. Superfluous cost is the one which contributes neither the qualities, utilization, life cycle, appearance nor client required demands. The requirement of the clients are normally: Aesthetics (magnificence, colour, design), ergonomics (shape, measurements, ease), Economics (cost of operation, maintenance cost), and Technical (performance). Through the help of workshops of the ventures, value management can guarantee a dynamic support from all stakeholders of project and hence energize integration, innovation enhanced constructability, improved communications through the network of supply chain and the incorporation of sustainability practices [34]. This focuses towards a more incorporated management related approach as the design can be adjusted ahead under the advice of the main contractor by utilising their knowledge and input with a perspective of minimising waste, enhancing buildability and contributing clearer understanding of the brief through the working group, for example, management contracting and partnership [12,24,35,36,37]. By breaking the divided approach of the conventional course and empowering collaboration through an incorporated strategy for procurement, communication and concepts can be shared that can enhance the value for the particular project. The earlier this approach is being carried out, the more the advantages will be available for the customer.

3.7 Building Information Modeling (BIM)
Building Information Modeling (BIM) is a revolutionary innovation and process that has immediately transformed the perspectives and way of buildings are considered, designed, constructed and operated [38]. BIM in its optimal state influences the whole project life-cycle from procurement, feasibility studies through to design, engineering, construction, operation, and demolition. The significance that procurement has as influence of this cycle has for some time been underrated. Much further, it is not just the impacts of procurement on BIM one ought to consider, but overall also depends on the opportunities BIM offers in revolutionising the way projects are procured in the first place. Without a doubt, while looking at world construction industries, one of the most serious issues is the trouble in implementing widespread team working and cooperation, mainly because of social barriers – something that BIM brags as one of its primary qualities. As indicated by previous researchers, this is because of the working BIM demonstrates to be generally available by all team member of projects, whereby configuration changes can be consequently updated [11,39,40]. It is known that clause 2.1 of JCT’s Construction Excellence advances coordinated effort as an abrogating guideline. BIM contributes from all individuals from the building group with a specific end goal to plan, model and monitor any genuine circumstances or site conflicts before executing as well as reduce any re-work [41]. BIM tools were created to extensively enhance profitability in the construction industries and make it possible to oversee and manage the information produced through the lifecycle of building structures more efficiently. Therefore, early collaboration is indispensable to guarantee that expertise and information is shared in the beginning. Because of this, it can be contended that the management contract, plan, design, build and partnering approaches are best equipped to manage this as accentuation is on developing a more constructible design which incorporates the association of the supply chain.

3.8 E-Procurement
It has been discussed by researchers that that the need for information frameworks, for example, e-procurement to encourage the coordination of the supply chain is getting more attention and consideration from the construction industries [7,42,43]. The utilization of e-procurement innovated technology decidedly influences administrators' point of view on both procurement practices and procurement performance. There are arrangements at present occurring over the proposed modification
of the EU acquisition orders (OJEU) that, once concurred, should be embraced by the law. This amendment is aimed to rearrange and accelerating current procurement practices. One of the key changes to this requirement is the need for mandatory e-procurement with complete electronic procurement, including the online submission of tenders, being required by certain date and year. However, there is a drawback in this new initiative which is, the utilization of e-procurement stages requires noteworthy interest and investments in both specialist software and staff training. It can be contended that the time and speculation required by providers or organizations may produce a "two-tier" framework, with huge numbers of powerful suppliers investing into e-procurement in accordance with the mandates and leaving aside the individuals who are less capable of meeting the required speculation. The idea of e-procurement can be utilized with most procurement techniques with the exception of the partnering arrangement. This is so because of the way that with banding together, works are either let to contractual workers that are on a long haul structure such as strategic partnering and in this manner assessment is for the most part through small scale rivalries or it depends on pre-tender chosen interviews. In addition, banding together connections are typically shaped between two parties based on trust and transparency and along these lines the e-procurement stage would not be the best way to deal and accelerate effective partnering.

4. Conclusion
In a nutshell, during the past three decades procurement techniques have earned extensive consideration and discussion within the construction management in the industries. This research has contributed a critical review for the status of the best in terms of procurement techniques in the academic field with the objective of setting a fundamental platform for researchers and analysts to acquire more valuable experiences into concerns of procurement techniques. It has determined the research trends in procurement techniques which may enable the modern industrial specialists to appreciate the key research area in their improvement of current standards and procedures, for example, supply chain, sustainability, innovation and technology development, lean construction, constructability, value management, Building Information Modelling (BIM) as well as e-procurement. The supported usage of these standards can go far towards battling short-termism and industry discontinuity after some time. This will directly drive change as customers and their project teams encounter the advantages accomplished through these methods. Eventually, this will compare to a shift towards a more coordinated and integrated industry where accomplishing best value and consistent improvement through team incorporation is of fundamental significance [44]. It is tough to get away from the preface that increased cooperation within the industries. This factor will be essential to accomplish future profits, and for the industry to deliver upgrades on the customers triangulated elements of cost, time and quality. The industry which conveys the best incentive for customers in this evolving world, has the best utilisation and standardisation of data innovation. However, in numerous areas, there appear to be obstructions as far as far reaching appropriation of current method while considering the procurement route for a venture. This is due to the related risk and behaviour towards change. In order to meet the managerial, specialized technical and social barriers in the construction industry, both the industry and its participant need to welcome change and enable innovative procurement techniques to develop. As stated [45], this change should be a customer driven process upheld by strong building team.

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