International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:13, No:8, 2019

The Relationship between Procurement Strategies and Sustainability Outcomes: A Systematic Literature Review

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Abstract**—**This study examined and identified the inconsistencies, relationships, gaps and recurring themes in literature regarding the relationship between procurement strategies employed in the construction projects for sustainable buildings and realization of sustainability goals. A systematic literature review of studies on the relationship between various procurement strategies and attainment of sustainability outcomes was conducted. Using specific terms, papers published between 2002 and 2018 were identified and screened according to an inclusion and exclusion criteria. Current findings reveal that, although the attainment of sustainability goals is achievable with both traditional and contemporary procurement strategies, only projects delivered using modern procurement strategies are capable of meeting and exceeding targeted sustainability objectives. However, traditional procurement strategy remains the preferred method for most green building construction projects. The results suggest implications for decision makers in considering the impact of selected procurement strategies on targeted sustainability goals, in the early stages of sustainable building construction projects. The study shows that there is a gap between the reported appropriate procurement strategies and what is being practiced currently. Theoretically, the study expands on the literature on adoption and diffusion of contemporary procurement strategies, by consolidating existing studies to highlight the current gaps. While the study is at the literature review stage, deductions will serve as basis for field work involving empirical data.

Keywords**—**Green building, green construction, procurement method, procurement strategy, sustainability objectives, sustainability outcomes.

I. Introduction

DISCOURSE on the relationship between procurement methods for green building projects and sustainable outcomes achieved on such projects has grown since the introduction of green buildings in the early 2000 [1]. Reference [2] suggests that after project owner's commitment, the next strongest determinant for the fulfilment of sustainability goals is the project delivery method [3]-[5].

Project delivery method is defined as the comprehensive process through which designers, contractors and other consultants provide services for design and construction services to deliver a complete project to the owner [6]. According to [3] and [9], project delivery methods define the timing for the involvement of major project participants, contractual relationships amongst parties and contract conditions such as risk sharing, incentives and liabilities.

Project delivery methods are usually categorized into traditional (conventional or design bid build (DBB)), and modern procurement methods. Modern procurement methods include several innovative procurement methods with varying levels of collaboration and integration.

Reference [1] argued that the high performance buildings also known as green buildings are best delivered using modern procurement delivery methods such as design build (DB) which foster synergy between the designers and the builders, unlike the DBB methods which exacerbate the antagonism between designers.

Recent studies conducted on the subject agree with the early studies that more integrated and collaborative procurement methods are more suited to the successful delivery of sustainable outcomes on green buildings construction projects. This stance is in line with the general consensus in the industry advocating the adoption of modern and innovative procurement methods, and moving away from the traditional procurement method. According to [7] project delivery methods affect project outcomes through level of integration in the project delivery service. The study recommends the use of DB for successful sustainable outcomes. Reference [2] recommends the use of another modern collaboration based delivery system i.e. integrated project delivery (IPD) for net zero buildings due to its propensity to accommodate innovation, high collaboration and fostering contractual commitments to same goals amongst project participants. However, in practice, the use of traditional procurement strategy still dominates construction projects [2], [10]-[12]. A similar trend is also being observed on green buildings construction projects. In China, most green building projects are delivered using the DBB method [13]. Likewise in South Africa, traditional procurement is the most utilized project delivery method on green buildings construction project by substantial margin according to reference [14].

References [2], [6]-[8], [20], [58], [67] have recommended various procurement delivery methods to optimize the sustainability outcome on sustainable buildings construction projects. This study aims to synthesize these studies and identify the most appropriate procurement delivery method. The study also aims to explore how favorable sustainability outcomes are measured and if there is consistency in the performance measures used in the existing studies.

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Section II gives an overview of project delivery methods and their distinguishing features. This is with a view to identify the appropriate procurement method in relation to the measurement of sustainability outcomes and the relevant performance indicators. The latter part of Section II attempts to define the term sustainability outcomes by linking the concepts of project outcomes and sustainability. This is followed by a description of social, environmental and economic sustainability outcomes. Section III describes the methodology followed by the systematic literature review conducted. The results of the systematic literature review are reported in Section IV. The final section concludes the paper by discussing the findings, identifying the gaps in literature, and areas for further research.

II. Basic Concepts

A. Procurement Delivery Methods

In literature the term "procurement system" is also known by the following terminologies, procurement system; procurement route and project delivery method [15]. There are several known definitions of the term in literature with slight differences. Reference [16] defines procurement system "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". Meanwhile [18] defines project delivery method as "the comprehensive method of assigning contractual responsibilities for designing and constructing a project which should include definitions of project scope, contractual responsibilities, interrelationships of parties, and processes for managing time, safety and quality. According to [19], project delivery methods are concerned with both the organization and management of the design and construction process of a built facility.

Procurement Delivery Methods and Their Distinguishing Features

Most literature categorizes project delivery methods according to similar attributes. Reference [17] classifies project delivery methods according to the three most common methods i.e. DBB; construction manager at risk (CMR) and DB. The rest are called variants to these three procurement routes. In the recent years a new procurement strategy which aims for more collaboration known as IPD has been developed and added to these classifications [21].

Reference [17] classifies procurement according to the level of integration of both project phases and project teams. They include the following categories i.e. fragmented, partially integrated, fully integrated and procurement methods with partnering philosophy.

Reference [22] classifies procurement methods into traditional (separated); design & construct (integrated); management (packaged) and collaborative (relational) categories.

The commonly known procurement strategies include

Separated or Fragmented

This refers to the procurement strategy that separates the main elements of the construction project phases [23]. The strategies in this category are known as traditional, conventional or DBB. Upon identifying a need, the client develops a brief and then appoints the professional team, usually led by the architects to develop detailed designs. The appointment of the professional team is on a fee basis. At the completion of the design, tender documents are prepared for the bidding process usually through competitive tendering process. Reimbursement to the contractor is usually on admeasurements or lump sum basis. The contractor enters into a legal agreement with the client, subsequently the subcontractors' legal contract remains with the main contractor.

The sequential nature of traditional procurement presents the following notable shortcomings in the project delivery process. It is considered time consuming as the design needs to be complete before construction takes place [23], [24]. If the design is not complete when tendering commences, it opens up the project to contractor's claims when the design is firmed which leads to disputes and adversarial relationships [25]. The separation of the process leads to poor communication and loss of contractor input in the design phase. However in practice, the traditional method is preferred because it is considered the least risky approach as it is associated with a higher level of certainty on cost & quality [23], [25]. Due to the bidding process that this strategy follows, i.e. all contractors bidding on the same basis, this acts as an assurance to the clients that they are getting the most competitive offering. For the public clients, the strategy fulfils transparency which required for public scrutiny [25]. According to [23], the priced bill of quantities makes it easier to carry out interim variations. Traditional procurement method is also considered easy to use, tried and tested method which the industry is very familiar with [22].

Fully Integrated Strategies

The main aspect of the strategies in this category is single point responsibility; the client has one point of contact with the construction team. A single organisation is responsible for both the design and construction project phases and there is an overlap of these phases. According to [23], the three fundamental characteristics of fully integrated strategies include (i) one organisation takes responsibility of the project; (ii) reimbursement is generally by means of a fixed lump sum; (iii) the project is designed and built according to clients' specifications. Reference [24] suggests that this procurement strategy is preferable with client organisations that do not have the expertise and also for functional and simple buildings, rather that complex and prestigious [22]. The main form of this category is the DB with variants such as novated design and build, package deal, develop & construct and turnkey. Other offshoots include build-own-operate (BOO); build-own-transfer (BOT) and build-own-operate-transfer (BOOT).

The main advantage of this approach is the single responsibility, which allows for an overlap of the construction and design phases, resulting in contract duration reduction.

Secondly, there is great price certainty when the client's performance requirements are clearly stated. Lastly, the introduction of the contractor early in the process ensures their contribution during the design phase. The disadvantages of these strategies include problems such as difficulties to evaluate proposals which occurs when client's brief is not clear therefore enough time to prepare the brief needs to be set aside. Another difficulty linked with the evaluation of bids is due to the different designs and programmes that are presented by the different bidders. Secondly, the strategy does not provide a level of flexibility to the client as they must commit to a concept design early in the process. Other drawbacks of using this strategy is availability of DB contractors, there are only a few companies that offer pure design and build services; therefore, this strategy may prove costly especially when fragmented design and build contractors are used. Lastly, less attention is given to lifecycle costs, the strategy can also result in inflated cost since bidding is carried out with minimal design [27].

IPD

IPD also falls under the fully integrated procurement delivery methods since all parties sign one contract. The project owner, design team and the contractors work collaboratively in setting the price for the project. According to [28], IPD is based on the Australian alliancing model. The whole team manages the project collectively and share risks.

Partially Integrated or Management Strategies

These strategies involve the inclusion of a contractor who is paid a management fee at a preconstruction phase. The strategies' main selling point is fast tracking achieved because the design work does not have to be complete before construction work commences [25]. The various work packages are tendered out as the designs become complete. There are two variations of this category, i.e. construction management and management contracting. The main difference between construction management and management contracting relates to the type of relationship between the manager who is usually the main contractor and work package sub-contractors. The main problems associated with these approaches include price uncertainty; it requires that the client be very proactive and engaged with the process. Reference [23] also points out that the higher project costs are incurred under management contracting than traditional approach due to the onerous obligations that are expected to be met by the management contractor.

Relational or Collaborative Strategies

Relational strategies refer to various approaches whose primary aim is to "harness the combined skills expertise and efforts of all involved in the project to ensure successful project completion" [2]. Unlike the other strategies which may be a once off collaboration, this approach focuses on risk and rewards sharing on a long term basis [22]; supply chain members buying into the project rather than just submitting tenders [17] and agreeing common goals or mutual objectives.

Examples of such approaches include Private Public Partnerships (PPP); alliances; partnering; Private Finance Initiatives (PFI), joint ventures and other collaborative work relationships. There is another school of thought that does not consider partnering as a separate strategy, but rather a philosophy that can be applied in the rest of the strategies [24]. Partnering requires that the project procurement shifts from the focus on the hard issues i.e. contracts and scope of works, to softer issues such as attitudes, culture, commitment and capability to align values of the various project team members for a win-win solution. Despite increased interest in the concept of partnering, findings by [29] suggest that the concept is still in its infancy in many countries and where it is practised, it is only limited to the relationship between the client and the main contractors and does not include the entire supply chain. These differences between the various types of procurements methods emanate from the attributes that are highlighted in Table I. The interplay amongst these aspects defines the procurement strategy that is used on the project.

TABLE I
VARIATIONS WITHIN PROCUREMENT DELIVERY METHODS

Risk allocation amongst the different project actors	[15], [26], [30], [32
The degree of involvement and control of that the client has over the design and construction process	[19]
The stage at which key actors are involved and the nature of interaction of the key actors	[19], [32]
Allocation of responsibilities for design and construction which is also related to the number of contracts held by the project owner	[19]
Selection criteria for service providers	[26], [19].
Procurement practices for soliciting bids	[19]
Payment terms	[19], [32]
Extent of the design process at tender	[26]

Despite different classifications, the boundaries between the different procurement strategies are not rigid. Procurement strategies are usually placed in a in a continuum between the two opposite ends of the aspects described earlier. From this ongoing discourse on procurement strategies, it is apparent that despite the common understanding that there are specific procurement strategies which are desirable or otherwise for particular construction projects, the boundaries between procurements strategies are not clear cut. Different attributes of procurement strategies can apply to all the procurement strategies with varying degrees. Reference [31] concluded that the choice of procurement method is irrelevant but rather the how the procurement method enhances or inhibits team members' to maximize their constructive input to achieve project goals.

B. Construction Project Sustainability Outcomes

The recognition of the need to attain sustainable development in the built environment has led to increased interest on the discourse of sustainability considerations as one of the most important construction project outcome. The concept sustainability outcome can be situated in the expansive body of knowledge of construction project performance or project success. In literature, the terms project success, project outcomes and project objectives are

inextricably linked. Reference [33] defines project outcome as the extent to which an operation's major relevant objectives have been achieved. Reference [34] equates project success as a favorable project outcome. According to [35], project outcome is often referred to loosely as project success (or failure). Thus, the understanding of this study is that where perceived performance is aligned with project objective then the project has a favorable outcome or is a success.

The subject of project success has been widely researched [37]. The most common threads in the subject include:

a. Defining Project Success: To date there is no clear agreement as to what can be defined as project success [37]. This remains the case because the success means different things to the various project actors involved in the construction process. As such there is no defined standard to identify project success but rather measured according to the specific actor's expectation
b. Approaches to Measure Project Success: Under this sub-topic the term project success criteria were coined. Project outcome is expressed by either project success criteria or project success metrics. According to [38] project success criterion is the measure by which the successful outcome of a project is measured.
c. Project Success Factors: According to [40] project success criteria and project success factors are the two components of project success in project management literature. Characteristics of projects which possess the ability to influence the success of a project are known as project success factors.

To determine the outcome of a project, it is very pertinent that criteria which are used are well understood, such that there has been considerable debate on the subject of project success criteria. The different perspectives of these debates include the need to extend the project success criterion beyond the traditional iron triangle i.e. completing a project within duration, within budget and according to specifications [34]. A second perspective in this debate included considering project success measures throughout the project lifecycle unlike the traditional approach which only considers the implementation phase. This perspective led to the inclusion of user satisfaction as a project success factor.

The next perspective that was introduced to the subject was considerations from both macro and micro points view, where macro point view considers whether the original concept has been achieved whilst micro point view considers project success in smaller component levels [36]. These considerations introduced success measures such as utility and operations performance at project completion. Some additional success criteria and the iron triangle criteria are categorized as objective, since mathematical formulae can be used to calculate and determine successive value. Other criteria are subjective as they depend on the opinions of project stakeholders [39]. These debates led to the increase in the number of known project success criteria from the traditional three in the iron triangle. Reference [34] developed a set of nine key performance indicators as well as the practical approach to measure the indicators.

By reviewing existing literature on the subject, [41] identified 27 measures that are used to express project outcomes. This paper has categorized these measures into the following criteria:

a. Traditional Criteria: These refer to the three traditional criteria also known as the iron triangle (time, cost and quality) [34]
b. Second Generation Criteria: These include criteria which were added in to ensure that the views of all project participants are considered and also success is measured on all phases of the project lifecycles [36]
c. Third Generation Criteria: This category considers criteria that are linked to the concept of sustainable development which encompasses equitable and lasting development.

TABLE II
CATEGORIES OF PROJECT SUCCESS CRITERIA [41]

Traditional (Iron Angle) Criteria
Project is complete within schedule
Project is complete within budget
The deliverable is meeting technical specifications
The deliverable is meeting functional specifications
2nd Generation Success Criteria
The project management process is adequate
Project risks are managed adequately
The cooperation of parties and individuals is good
The project is performed with high standards of work quality
The customer is using the deliverable (after completion)
The deliverable is solving a customer's problem
The project sponsor/ end user/ suppliers are satisfied with the project
3rd Generation Success Criteria
Other stakeholders are satisfied with the project
The business objectives of the project are met
The business objectives of the suppliers/contractors are met
The deliverable creates value a larger market share of the customer organization
The project prepares the organization for the future
The project contributes to the development of participating organizations & individuals
The project earns public recognition
The project reduces waste
The project creates a positive economic impact on society
The project creates a positive social impact on society
The project creates a positive environmental impact on society

To gain more in depth knowledge on sustainability objectives, the concept of sustainability needs to be explored. The term sustainability comes from the concept of sustainable development which is defined in the 1987 report commissioned by the United Nations World Commission on Environment and Development known as Our Common Future. In the report sustainable development was defined as "the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of the future generations to meet their own needs" [42]. Although the understanding of sustainable development is wide, diverse, context and subject dependent, in the report the sustainability concept considers three main dimensions; economic environmental and social. Reference [43] writes: "sustainable development refers to the process of development

in a sustainable manner by integrating economic, social and ecological dimensions of objectives". The authors assert that balance priority of these dimensions would result in sustainability. Thus sustainability outcomes can be classified along the same lines i.e. economic outcomes; environmental outcomes and social outcomes.

Reference [55] presents five dimensions i.e. biological, economics, sociology, environmental ethics and planning whilst [44] presents a more comprehensive outlook as shown in Table III.

Setting of sustainability objectives upon which sustainable outcomes would be measured on a construction project, involves the incorporation of these dimensions of sustainability. Reference [45] developed a framework which lists sustainability objectives on a brown field development. The framework also included practical steps through which these objectives are delivered. Despite the framework being able to illustrate whether the objective was met or not, it is unable to show how this was measured since it does not have weightings and thus cannot score.

C. Economic Sustainability Outcomes

In sustainability literature, the definition of economic sustainability means different things to different groups of people [43], [45]. Apart from definitions such as maintaining economic welfare right into the future [43], other viewpoints include providing financial resources for technical advance required to solve environmental problems and overcome poverty and a radical change in the growth paradigm and resource technology. In the built environment this aspect can be achieved by actions such as involving local businesses in the construction process, providing local employment and by building efficiently and minimizing waste. According to [43], the outcome performance measures for economic sustainability include gross domestic product (GDP) and employment figures.

D. Social Sustainability Outcomes

According to [45], social outcomes refer to the economic, environmental or community benefits that occur from the development of a built asset. Social objectives for a construction project include conservation of local culture and heritage; and integration of the developed facility within the locality. The articulation of social sustainability has remained a challenge in literature. Reference [47] suggests that social sustainability is largely neglected because it is difficult to formulate performance criteria. According to [46], tangible social sustainability outcomes on a construction projects include increased efficiency and reduced work time which could result in financial saving. Outcomes are also exhibited as value created by considering social sustainability objectives [48]. The indicators for this value include sense of community and neighborly behavior, reduced crime and press coverage.

E. Environmental Sustainability Outcomes

Environmental Sustainability Outcomes refer to the end result from the prudent use of natural resources, protection of ecosystems and biodiversity [45]. The environmental aspect is the most researched in literature. On a construction project environmental sustainability objectives include minimizing use of resources, minimizing pollution and protecting the biodiversity and the environment. The success measures for environmental sustainability are easier to identify in literature since they can be benchmarked against conventional buildings. They include criteria such as decreased operating costs for the built facility by 8-9% [43]; energy efficiency values compared to the conventional buildings [49]. Environmental sustainability also has intangible success performance measures such as occupants' general satisfaction and greater productivity rates.

TABLE III
DIMENSIONS OF SUSTAINABILITY [41]

Sustainability dimensions	Considerations
Economic	considers economic effects and benefits
Social	considers human and societal interests
Ecological	considers effect on nature and earth
Time	considers long term effect
Values	understands sustainability as a normative concept
Geographical	considers both local and global effects
Performance	considers failure and non-performance a waste of resources and energy
Participation	considers including and participation of stakeholders
Waste Reduction	considers reducing and prevention of waste
Transparency	open and proactive sharing of information with stakeholders
Accountability	willing and available to be held accountable for decisions and actions
Cultural	considers respecting differences in cultures and values
Risk reduction	reducing and avoiding certain risks
Political	considers recognizing differences in interest of stakeholders

The literature that has been reviewed in this section suggests that many researchers have made the link between realization of sustainability objectives and the procurement delivery method used on sustainable buildings construction project [2], [5], [11], [63], [68], [70]. Despite its continued use on such project, traditional procurement is rarely recommended. References [4]-[9], [58]-[60] and [71] recommend other procurement strategies. However, no consensus has been reached on the most appropriate procurement strategy. This study proposes a systematic literature review of existing studies to the most appropriate procurement strategy to meet and exceed sustainability goals on a project. Secondly, despite the link made between procurement delivery methods and favorable sustainability objectives, there is a paucity in literature on the success criteria used for measuring sustainability favorable outcomes. Information is required from extant literature on the subject identify sustainability success criteria.

III. RESEARCH METHODS FOR THE SYSTEMATIC REVIEW

To study what is known in the literature on the subject, the inquiry has adopted the systematic literature review (SLR) approach. The study aims to identify gaps in the literature and other aspects requiring further research. According to [50] a

SLR is a secondary level of analysis that brings together findings from primary research and thus identifies what is known, how it has become known as well as what remains unknown.

To achieve the objectives of this study, an SLR was conducted in order for a synthesis of existing studies to produce clear and unbiased results. Unlike historical, narrative and integrative literature reviews, SLR involves explicit and rigorous methods which can be duplicated and verified by other researchers. The transparency of the process and its capability for replication render such studies scientific credibility. According to [51], the following steps are involved a qualitative SLR

1. Performing scoping searches, identifying review questions and writing protocol for the review
2. Literature searching, screening titles and abstracts
3. Obtaining papers
4. Selecting full text papers
5. Establishing theoretical standpoint and analysis plan
6. Data extraction and quality assessment
7. Analysis and synthesis
8. Writing up

Fig. 1 outlines the steps taken to conduct the SLR. The process was developed in order to answer the question "what has been shown to be the appropriate procurement sustainability outcomes on high performance construction project?" The second question that this SLR will attempt to answer is "how are sustainability outcomes measured to define a successful project?"

As the study intended to understand the relationship between procurement strategies and sustainability outcomes, the follow specific keywords were used for the literature search: procurement delivery, procurement strategy, procurement method, green building, high performance building, sustainable building, and net zero building.

Using Boolean operators the search term was used in the relevant industry related data bases:

"(("project delivery" OR "procurement strategy" OR "procurement method") AND ("green building" OR "high performance building" OR "sustainable building" OR "net zero building"))"

The search formula ensured the simultaneous checking of all keywords in various combinations throughout the database searches. The databases include ScienceDirect, ASCE, Springer, Taylor & Francis, Scopus, Compendex/Engineering Village, Emerald, Proquest, Web of Science, ICE and JSTOR.

The study was limited to industry related databases to narrow down to journals which are specific to the construction industry and the built environment. Due to the intensified interest in the subject of sustainability in academic research, open databases such as Google Scholar would have returned literature from large volumes of unpublished papers which are excluded from the SLR.

For the purpose of this study, the scope was focused on green building projects. Therefore the search was limited to studies between 2002 and 2018 since green building ratings systems were first introduced late 1990s [55], [74].

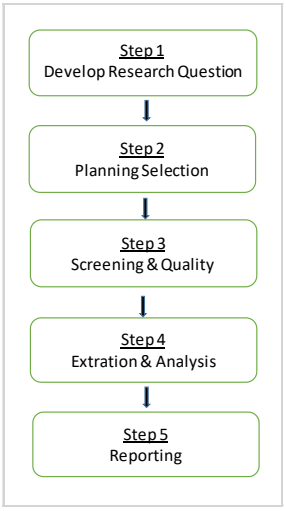

Fig. 1 Step by step process followed during the SLR

The search took place in July 2018 and resulted in 1188 hits, which represented related documents. Screening and quality procedures included reviewing of all titles; reviewing all abstracts and eliminating abstract only entries, and removing duplicated papers and unpublished articles. Lastly, the remaining 138 full articles were studied, and articles that were not aligned to the objectives of the current study were removed. At the completion of the screening and quality check 56 peer-reviewed and published papers were retained for analysis. 56 papers were categorized and analyzed using descriptive and thematic analyses. The next section describes the findings from these analyses.

IV. Findings from the Review

A. Descriptive Analysis

The papers selected for the study span 2003 to 2018 (Fig. 2), the number of publications increased significantly from 2010 onwards. This is in line with the increase in sustainable building discourse and activities, particularly green buildings, as noted by [52].

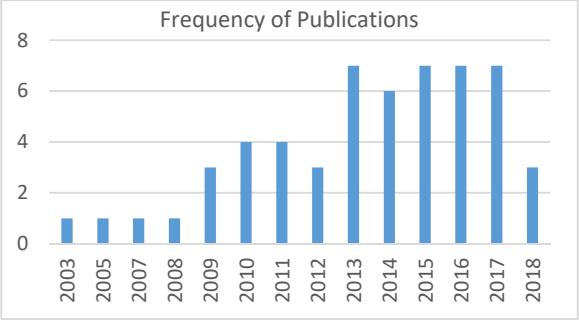

Fig. 2 Frequency and timeframe of the selected publications

The papers that were reviewed were found in various journals, with the highest number of publications (10) published in the Journal of Construction Engineering and Management, see Fig. 3. This result is consistent with the findings of [53] that research related to green building delivery concentrates on the management and delivery of green building projects.

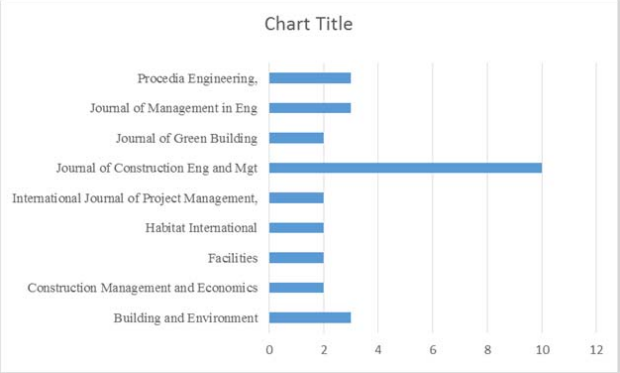

Fig. 3 Sources and their relative distribution of the volume of articles

Apart from six papers that were literature reviews, 51% of the paper were based on United States (US) context whilst the rest of the papers were roughly spread across the following contexts, United Kingdom (UK), Finland, Australia, Europe, Singapore, Norway, China, Turkey, Italy, Spain and Bahrain. The proliferation of studies on US context is logical considering that Leadership in Energy and Environmental (LEED) which was developed in the US has been identified as the most cited rating system globally [54] and the most used rating system globally [55].

B. Thematic Analysis

A review of the selected studies highlighted some recurrent themes which have been categorized into three major research streams that are discussed hereunder.

Appropriate Procurement Delivery Method to Achieve Sustainability Outcomes

An examination of the content in the selected studies in order to determine the most appropriate procurement delivery method has shown that there is no single coherent consensus on a specific procurement strategy that would result in optimum sustainability outcomes. Most studies compare the performance of two or more different procurement delivery methods in a study and the suitable method selected. Reference [56] identified Design and Build as a favorable method because it provided an opportunity for main contractors to embark on a joint venture with leading firms in sustainable technologies. Reference [57] recommends the use of DB where performance risk is transferred to the DB contractors unlike in the DBB method where the risk lies with the project client hence contractors are not incentivized to present innovative sustainable technologies. A variant of DB i.e. Design Build Operate Maintain (DBOM) is recommended by [58] as it encourages the project team to aim for lifecycle costing and reduce operations and maintenance costs. Reference [59] recommended another variant of DB i.e. Design & Construct (DC) and Management Contracting (MC) due to characteristics such as single point responsibility and early involvement of contractor. A study by [9] demonstrates that DB and CMR have better chances of meeting sustainability objectives than DBB. More recent studies, however, identify IPD as the most appropriate procurement strategy to achieve sustainable outcomes [2], [12], [49], [60]-[64]. IPD has been recommended by many authors owing to its attributes which engender the implementation of sustainability considerations (i) the use of multiparty agreement which facilitates the alignment of team goals and sharing of incentives (ii) increased collaboration from design stage [12], [65] (3) inclusion of liability waivers which encourages innovation [2]. Further to these findings there is a different line of thinking developing that IPD is not necessarily a procurement delivery method because it involves multiparty contracts, but that it can be used with other procurement methods [2]. According to [62], attributes of IPD e.g. integrated design can be overlaid on procurement strategies such as DB and CMR.

Despite no agreement from scholars on a specific procurement strategy being identified as a panacea for optimizing sustainability outcomes, almost all studies agree that that the fragmented procurement strategies that are conventional or DDB are not favorable. The limitations of fragmented procurement strategies in respect of sustainability outcomes originate from its linear and sequential approach which among other factors precludes the early involvement of project participants and does not provide enough opportunity for interaction and integration [9].

A synthesis of selected studies suggest that the question should not be on the appropriate procurement strategy suited to deliver maximum sustainability outcomes per se, but rather the procurement strategies which can accommodate factors which are instrumental in realizing sustainability outcomes [59].

Project Delivery Method - A Critical Success Factor

The second research stream running through the selected papers recognizes project delivery methods as one of the critical success factors for the attainment of sustainability outcomes.

Despite most studies recognizing client's motivation and commitment towards sustainability as the paramount influencer for the delivery of sustainability outcomes [66], procurement delivery methods feature highly on the list of variables that affect the implementation of sustainability consideration on a project. Reference [7] explored factors that could increase chances of success of green building projects and project delivery methods came second after owner characteristics. Other factors included project team procurement approach, contractual relationships, design integration and project team characteristics [4]. Analysis of the selected studies shows that literature is consistent on the inclusion of project delivery method as a critical success factor

for sustainable projects. However, more recent studies, however, have cautioned against judging the sustainable performance of a project based on individual attribute. They assert that the sustainability outcomes are as a result of the interplay amongst the several attributes [3], [5] and sustainability outcomes are a cumulative result of all these attributes.

Performance Indicator or Metric for Sustainability Outcomes

Under project success and project outcomes discourse, two important concepts i.e. project success criteria and project success metrics are used to express project outcome. The section above shows that the project success criteria for sustainable projects are fairly established in literature. However, this literature review shows that there is no consensus on what aspects should be used to demonstrate whether the sustainability outcome is favorable or not.

Firstly, there was no consistency amongst the selected studies pertaining to the success metrics used. In addition to the traditional metrics mentioned elsewhere in this paper, project success metrics to demonstrate sustainability outcomes from the selected studies include

- Post occupancy evaluation, level of green, high performance green [5].
- Sustainability performance [67].
- Percentage reduction in carbon emissions (measured against building regulation) [68].
- Financial savings from energy efficiency strategies [49], [57], [58], [69].
- Achievement of the minimum score that provides the desired sustainability certification [63].
- Environmental performance metrics (total value of construction material waste in tonnes and percentage of waste recycled as opposed to waste sent to landfills) [60].
- Achievement of green credentials (star rating achieved); rating score achieved, effectiveness of Green Star Accredited Professional [59], [70].
- Mechanical system cost growth and yearly energy savings [20].
- Level of green or sustainability (achieved LEED points against available LEED points); high performance green index (achieved IEQ & energy LEED points/available IEQ & energy points available in the rating system); the difficulties faced in the submittal process (under quality metric) [9], [71].
- Owner performance of buildings 'actual performance on water consumption, energy, occupant turnover rate, absenteeism, general satisfaction, acoustic quality, ventilation, controllability, lighting and thermal comfort [4], [7], [8].

Compliance with Building Energy Model [72]

Reference [47] developed sustainability framework with the following sustainability indicators; energy, water, materials & design, biodiversity and land use, clean air, public facilities, security, indoor climate & comfort, acoustics, noise & vibration, healthy lifestyle, emancipation & equality, measures that stimulate social cohesion, labour and human rights, local and societal needs, involvement is decision making, systemic change. However performance success measures of these indicators are not given.

Whereas the objective traditional performance criteria are clear, measurable and transferable from project to project, sustainable criteria are yet to achieve that maturity. This trait affects the efficacy of some projects to realize sustainable outcomes. As noted by [47] "social sustainability is largely affected because it is difficult to formulate social sustainability criteria". The challenges in establishing performance measures also have an effect of procurement delivery method that requires measurable performance indicators e.g. PPP and PFI [47], [68].

The literature review has also highlighted the scarcity of social sustainability outcomes in the studies reviewed (less than 10% of the papers reviewed included social sustainability outcomes in their studies). The sustainability measure that was featured highly in the studies was the environmental sustainability aspect. The frequently featured performance measure was energy efficiency which relates to both the environmental and economic aspects of sustainability. This could be due to established benchmarks and baselines of energy performance data.

Another important finding relates to the use of green building rating systems as sustainable outcome measure. Across the board, the majority of the studies used various rating certification as a measure of sustainable performance especially LEED certification. This study however posits that the use of a certification system as sustainable outcome is inadequate for varied reasons. The emphasis of most rating systems is on the environmental aspect of sustainability objectives [73]. Thus, using them as indicators of sustainable outcomes will perpetuate the exclusion of social sustainability objectives and outcomes.

Secondly a few authors have argued that attaining green building or sustainable building rating certificate does not necessarily mean that the built facility has met its energy efficiency or environmental targets [55], [57], [68]. Issues which have been raised concerning rating tools include: (i) The subjectivity that exists across different rating systems; (ii) poor implementation of the sustainability rating systems which may result in "masked sustainability"; (iii) assessment on new buildings being made on basis of potential performance and not actual the performance of a building.

The literature review has also identified an emergent viewpoint within the studies related to procurement delivery methods and sustainability outcomes. Whilst a common view illustrated in this study shows that the procurement delivery method influences the sustainability outcomes on a project, emerging literature shows that the relationship is not unidirectional. Sustainability objectives also influence the dynamics in the project procurement dynamics. A study by [74] demonstrates the effect of sustainability requirements on the extent of collaboration within the project. THE AUTHORS argue that regardless of the procurement method

applied, projects with sustainability requirements such as green building certification encourage collaboration. A study by [72] on a new building regulation to reduce energy consumption and carbon emissions from new building identified effects of the new law on construction practices such as procurement delivery methods among others. According to [72], the new building regulations would extend the practice of novating designers to the Design and Build contractor to ensure single point responsibility. This emergent discourse can be used to explore the possibility of driving collaboration and integration in construction projects through the inclusion of sustainability goals.

V. Conclusion

This research study examined published literature on the subject of the relationship between procurement delivery methods and sustainability outcomes. Through the SLR of published papers between 2002 and 2018, the two research questions posed at the onset of the study have been answered. Despite the extreme care taken to assure that the study methodology is rigorous and can be replicated, search results may vary if the electronic search is conducted on a different day which may result in different results compared to the results presented in this paper.

The literature review revealed two significant findings. From the review of the selected studies it is evident that the lack of consensus on the appropriate procurement strategy that is suitable for the realization of intended sustainability outcomes emanates from the interplay of the aspects differentiating the procurements strategies. The extent to which aspects such as level of integration & collaboration, early stakeholder involvement, extent of design at tender, risk allocation and others are the influential factors in the realization of sustainability outcomes. Thus there is a possibility that the ability of all procurement strategies including the DBB may be enhanced for maximal sustainability outcomes by introducing the above mentioned aspects.

The second significant finding made relates to the vagueness in the measure used to assess sustainability outcomes particularly for social sustainability. Whereas a considerable number of environmental outcomes and measurement criteria are identifiable in existing literature. However, there are remarkable inconsistencies in how economic and social sustainability objectives are articulated. Similarly the study has failed to identify distinct success performance criteria for economic and social sustainability.

Arguably, the study has value as it identifies the incoherence on the most appropriate procurement method for sustainable construction projects and key performance criteria for measuring sustainability success in extant literature. The emergent viewpoint which suggests that sustainability considerations can influence collaboration on a project should be explored in order to advance the integration agenda which has been experiencing low uptake. The literature review only focused on identifying existing sustainability performance measures. Further research could include the formulation of sustainability performance measures that can be empirically tested.

The current study is at a literature review phase in a doctoral research project. The next steps will involve further exploration of the identified gaps, and the organization of an appropriate framework for the acquisition and testing of empirical data, to compliment the theoretical study.

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