

Article

Decision-Making Framework for Construction Clients in Selecting Appropriate Procurement Route

Muhammed Bolomope ^{1,*}, Abdul-Rasheed Amidu ², Saheed Ajayi ³ and Arshad Javed ⁴¹ Department of Land Management and Systems, Lincoln University, Lincoln 7647, New Zealand² Department of Property, The University of Auckland, Auckland 1010, New Zealand³ School of Built Environment, Leeds Beckett University, Leeds LS1 3HE, UK⁴ School of Economics and Finance, Massey University, Palmerston North 4442, New Zealand

* Correspondence: muhammed.bolomope@gmail.com

Abstract: Procurement decision-making is a crucial determinant of project success. Although several objective, stage-based models have been proposed to guide clients' procurement choices, little emphasis has been made on the subjective nature of construction clients. Recognizing the role of clients' experiences in justifying procurement routes, this study develops a decision-making framework that is capable of guiding construction clients in making informed procurement choices. Adopting a mixed-method approach, comprising semi-structured interviews and multi-objective optimization, relevant procurement options were appraised based on clients' specifications and project deliverables. The lived experiences of construction clients and the importance they attach to pre-defined selection rating criteria were subsequently evaluated, using a template that enables clients to prioritize procurement methods for different project types. The resultant framework offers a holistic, practical, and collaborative procurement selection process that promotes the efficient delivery of construction projects by reducing the cost overrun and delays associated with uninformed client decisions in construction procurement.



Citation: Bolomope, M.; Amidu, A.-R.; Ajayi, S.; Javed, A. Decision-Making Framework for Construction Clients in Selecting Appropriate Procurement Route. *Buildings* **2022**, *12*, 2192. <https://doi.org/10.3390/buildings12122192>

Academic Editors: Davide Settembre-Blundo and Jorge Pedro Lopes

Received: 26 October 2022
Accepted: 5 December 2022
Published: 12 December 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: construction; decision-making; construction clients; construction procurement

1. Introduction

Decision-making in construction procurement is multi-faceted. It is influenced by different factors arising from clients' specifications, project peculiarities, and procurement options [1]. According to [2], the choices made by clients regarding the optimal procurement route remain a crucial, yet difficult hurdle in achieving overall project success. While there are active debates on construction project underperformance [3–5], previous studies have revealed that the basis of project inefficiency can be traced to the conception stage, when procurement decisions are made [6–8]. Consequently, scholars have emphasized the need for efficient procurement routes in the construction industry [1,4,9–11].

Aside from the objective procurement determinants of cost, quality, and time, Ref. [7] noted that client characteristics also influence procurement choices. The authors of [5,12] argued further that construction clients' (CCs') innovation in the procurement process is often driven by subjective feelings, knowledge, or past experiences on similar projects. Therefore, instead of evaluating procurement routes purely on objective models, the need for a subjective approach that assesses the distinct peculiarities of each project has been suggested [5]. According to [13], efforts should be made to develop decision-making tools that could match a range of project performance indicators to project peculiarities and client demands in order to achieve overall project success.

While many construction professionals believe overall project success to be a comprehensive assessment arising from the consensus of all key stakeholders [12], others believe that project success is much more complex [4,14] and that client's satisfaction with the

final outcome is perhaps the most critical indicator of whether a project can be considered successful or not [15,16]. Although several scholars have attempted to simplify the construction procurement process [1,10,11,17], gap remains regarding the role and impact of CCs' subjective attributes in selecting suitable procurement routes for different project types. The main objective of this paper is, therefore, to explore the impact of CC's subjective experience in procurement selection and subsequently develop a framework that could guide CCs toward making informed procurement choices as they align their perceptions and experiences with the objective reality of the procurement selection process.

This study was executed in two stages. The first stage involved in-depth qualitative interviews which focused on understanding the impact of CCs' peculiar beliefs, experiences, and perceptions regarding the procurement selection process. Subsequently, the CCs were assigned the task of prioritizing different project parameters that inform their procurement decisions for different project types. The combined approach resulted in the development of a framework that could enhance the procurement selection process based on the robust consideration of client characteristics, goals, and project peculiarities. The remainder of the study is organized into six sections. The extant literature on procurement and construction clients was reviewed in Section 2, followed by the presentation of the adopted methodology in Section 3. The data collection and analysis were outlined in Section 4. Sections 5 and 6 outline the study findings and discussion, respectively, while the study culminates in Section 7.

2. Procurement and Construction Clients

2.1. Construction Clients

Unlike other industries, clients in the construction industry dictate the organizational and management pattern of project delivery [18,19]. Whereas there are standard practices and methods of delivering projects in industries like manufacturing and automobile [14], selecting procurement routes in the construction industry remains ambiguous [17,20]. According to [13], the procurement process in the construction industry is client-centered. CCs are individuals or organizations responsible for the provision, maintenance, and disposal of construction projects [21], and their actions or inactions influence the overall project outcome [7,15]. Further, CCs have different perspectives through which they assess construction procurement [22–24]. Ranging from the basic project requirements of cost, quality, and time, CCs' considerations have emerged to include factors such as project variation, risk perception, and end-user satisfaction [9,14].

According to [21], CCs are traditionally divided into two categories; public and private clients, but it has also been acknowledged that subdivisions of these two major categories exist based on clients' experiences and whether they are primary or secondary constructors [23]. The publications, 'Constructing the Team' [25], and 'Rethinking Construction' [26] have also evaluated the categorization of CCs to include expert, inexperienced, etc. According to [12], the innovative role of CCs in the procurement process can be multi-dimensional. It could be an assertive role, where the client drives innovation; a cooperative role, where the construction team and the client jointly drive innovation; or a passive role, where the construction team drives innovation [2,14,19]. Appendix B-Figure A2 illustrates the various categorization of CCs.

As CCs consider project feasibility in the procurement process, they are also faced with some elements of project uncertainties [1]. Therefore, aside from focusing solely on project objectives and client attitude to risk, factors like clients' resources, peculiar project characteristics, ability to make changes, and ethical considerations have consistently influenced clients' innovation in the procurement process [23]. While these factors affect projects differently, based on their magnitude and complexity, the preferred procurement choice is often determined based on the factors that are of the most importance to the client [18]. Scholars have therefore, emphasized that there should be a harmonization of clients' objectives, the attributes of available procurement alternatives, and the expected project outcome [17].

According to [9], when clients' goals are clearly defined, selecting a procurement route should be a purely logical process. CCs should be able to choose project delivery options that suit their project expectations with ease [21]. However, the reality of clients' subjective attributes vis-a-vis the complexity of modern construction makes this unrealistic [14,23]. The demand for contemporary construction varies with clients' expertise and has continued to widen the gap between experienced and inexperienced clients [7]. Only clients that are up to date with the latest innovation and best practices are relevant in today's construction industry. This explains the difference in various clients' perspectives when rationalizing procurement options [5,18].

While the experienced client appreciates the significance of collaboration and sustainability in the overall project outcome [15], the inexperienced client may not emphasize these factors in selecting a project delivery route. However, irrespective of the categorization, CCs do not fully explore the procurement variants available to them [22]. Instead, they often rely on past occurrences, feedback from other stakeholders, and the impact of external factors like legal framework and public perception [13,15]. Unfortunately, this approach does not adequately appraise the peculiarity of particular projects, and it could lead to uninformed decisions by clients, which could ultimately result in poor quality of construction, cost overrun, or delay in project delivery [18]. In order to avert the consequences of inefficient decisions and their subsequent impact on the project outcome, it is essential that decision-making tools are made available to the clients, as is being suggested in this study.

2.2. Construction Procurement

CCs see procurement as a sequence of calculated risks that should be evaluated in order to emerge with a project that is safe, cost-effective, and fit for purpose [27]. This perspective has significantly influenced the evolution of construction procurement and has resulted in various forms of procurement options that have been mainly driven by project needs and clients' specifications [3,13]. However, rather than limiting the description of procurement as the process of acquiring with ease [22], the definition of procurement has remained dynamic and robust as an integral part of the project delivery process [6,17,28]. According to [29] (p. 107), procurement is "the acquisition of new buildings, or space within buildings, either by directly buying, renting, or leasing from the open market or by designing and building the facility to meet a specific need". The procurement process has also been described by [10] as a clear approach to achieving clients' goals regarding project delivery over a given period, based on a mechanism that coordinates all stakeholders throughout the project lifecycle. As construction procurement continues to evolve, scholars are unanimous in the view that the selection of an appropriate procurement route is a major determinant of overall project outcome [1,6,9,16,30].

According to [5] (p. 20), an appropriate procurement selection technique involves a "set of rationalistic decisions within a closed environment, aiming to produce generic, prescriptive rules for clients and advisers to use to select the 'best' procurement route for their project." This process can be simply described as a framework within which construction is acquired or secured [31]. Although the outcome of previous construction project decisions could be extremely insightful in supporting CC's decision regarding similar projects [23], Ref. [32] argues that there are several procurement options available to the client. Within each procurement option, there are several variants, each of which may be possibly refined to accommodate client needs and project specifics [31]. Some of such procurement routes and their variants as they apply to clients in the construction industry are discussed below. Ref. [21] classified construction procurement options into four major groups as follows: (1) Separated or traditional procurement systems, (2) Design and build procurement systems, (3) Management-oriented procurement systems, and (4) Partnering/collaborative systems.

2.2.1. Separated or Traditional Procurement Systems

The evolution of project delivery routes has gone through different stages over the years [31,33]. Many projects constructed before the Second World War were procured through “traditional” means, which has remained in existence for more than 150 years [31,34]. Known as the oldest form of documented procurement option, Ref. [35] describes the traditional procurement route as having design as a separate function from construction. In adopting traditional procurement, the design is completed before the selection of a contractor to build the works [13], which is seen as the least-risk approach for the client as there is an inherent level of certainty about the project quality and construction duration if it is properly implemented [28]. Based on this, and assuming no variations are introduced, overall project costs can be determined with reasonable reliability before construction begins [34]. While lots of construction projects have been successfully delivered across the globe using traditional procurement [13], there are numerous reports of post-contract changes and delays, which often result in increased project costs and time overruns [17].

2.2.2. Design and Build Method

The end of the Second World War ushered in a season of consistent economic growth and human capital development [21]. To meet the societal demand at that time, there was a need for the timely delivery of public facilities, hence, the adoption of an integrated procurement strategy that combines the design and construction functions involved in project delivery [31]. This procurement option is termed “design and build” [35].

According to [13], design and build is a route wherein a single contractor assumes the risk and responsibility for the design and construction of projects, usually in return for a pre-determined price. It is generally regarded as a fast-track route because construction often commences before the comprehensive design is completed, with the contractor finalizing the design as the work progresses [35]. It can be deduced from the definition that this method reduces project time, assures cost certainty, and encourages integrated contractor contribution to the design and project planning [36]. A shift to design and build translates to the transfer of design responsibility from direct client control to organizations, whose core businesses are profit-focused [31]. The client in the design and build arrangement passes the legal obligation for both design and construction to an independent contractor [35]. This single contractor can be either an integrated firm with an in-house design and construction delivery team or a consortium of various design and construction firms, brought together for a particular bid [36]. While significant progress regarding the timely delivery of projects and cost certainty resulted from the evolution of the design and build procurement approach [13], there have been reported deficiencies in the quality of projects delivered through this route [18]. The need to advance the design and build procurement method led to other integrated forms of procurement.

2.2.3. Management-Oriented Method

The concept of management-oriented procurement was conceived to bridge the gap between traditional procurement and design and build [35]. This method evolved from the United Kingdom in the 1970s [21]. In adopting this procurement style, the CCs devolve the management of the design and construction of projects to an expert who acts as a management consultant on behalf of the client [31]. Management-oriented procurement enhances project quality and also accommodates design changes [36]. It ensures that the appointed managing consultants are responsible for the construction tasks without actually performing any of that work [13], at a cost to the client. This means that the consultants take over the construction process and ensure value for money on the project. The variants of management-based procurement include management contracting and construction management, with both sharing the main characteristic of appointing a managing party [31]. In construction management, the client appoints a construction manager (CM) to oversee the design and construction activities, using their expertise and experience to deliver the project for an agreed sum [36]. The role of the CM is mainly to ensure compliance to project

specifications without any contractual link with the design team and contractors [22]. All contractual agreement remains between the client and the trade contractors [13]. However, for management contracting, the consultant bears part of the construction risk because they have an established contractual link with the package contractors [35]. A major benefit of management-oriented procurement is the participation of the expert consultant in the design and project planning [21,28]. Although uncertainty about project cost at the initial stage of the procurement is a major disadvantage of this option [22], early consultant involvement reduces the risk of project overrun while accommodating later design decisions as construction progresses. The use of more integrated procurement methods otherwise referred to as partnering, emerged in the early-90s [13].

2.2.4. Partnering/Collaborative Method

“Partnering in construction procurement is a structured management approach that enables teamwork, trust, long-term commitment, open culture, mutual objectives, customer focus, and innovation between contractual parties” [28] (p. 5). Apart from driving innovation through agreed mutual objectives, devising ways for conflict resolution, commitment to continuous improvement, measuring performance, and sharing gains [26], partnering suggests that efficient project outcome is better achieved through the collective effort of all stakeholders involved in project delivery [13,31]. Partnering, therefore, provides the premise required for the adoption of PPP (Public-Private Partnership) and PFI (Private Finance Initiative) procurement options.

According to [3], the fundamental rationale for PPP/PFI procurement is to establish a platform where the public and private sectors work together to realize optimum project outcomes while also managing project risks and disputes. Despite acknowledging that PPP/PFI procurement provides a wide range of benefits through innovative and collaborative practices amongst stakeholders in the delivery of public projects [13], scholars are of the view that the crucial considerations for successful PPP/PFI projects require appropriate risk assessment and allocation, transparency, adequate stakeholder engagement, strong legal framework, and availability of finance [3].

2.3. Factors Governing Procurement Route Selection

The selection of an appropriate construction procurement path is directly linked to project objectives [2,4,32]. While there are various procurement routes available for CCs to choose from, challenges arising from the dynamic construction environment, changing client objectives and expectations, increasing project complexity, lack of effective communication and disintegration within the construction industry have resulted in the constant debate on selecting appropriate procurement routes for construction projects [7,17]. For a suitable procurement choice to be made, it is essential to clearly understand the project objectives and relate their significance to the overall project’s success [24,30]. Although comprehending CCs’ rationale for undertaking construction projects may be complicated, the relevance of existing decision-making tools in selecting procurement routes also remains ambiguous [5,20]. To clearly address the complexity of construction procurement, it is essential to:

- Describe CCs and categorize them based on their relevance in the construction industry.
- Understand the rationale for clients’ objectives and the resultant effect on project outcomes.
- Understand the dynamic nature of the construction procurement process.

Having previously identified various client types and procurement options, the characteristics, and expectations of specific projects are also expected to be clarified in order to differentiate the strengths and weaknesses of each procurement route. As shown in Table 1, studies that have previously investigated CCs and their attributes have established a set of commonly considered factors for construction procurement. Nevertheless, the selection of an appropriate procurement strategy has two components [13], viz:

1. Evaluating and establishing priorities for the project objectives and clients’ attitudes to risk, and

2. Reviewing possible procurement options and selecting the most appropriate.

Table 1. Review of Factors Influencing Clients' Procurement Choices.

Source	Time	Cost Certainty	Quality	Risk	Complexity	Flexibility	Accountability	Competition	Dispute Resolution
[9]	✓	✓	✓	✓	✓	✓	✓	✓	-
[32]	✓	✓	✓	✓	✓	✓	-	✓	-
[8]	✓	✓	✓	✓	✓	✓	-	✓	✓
[37]	✓	✓	✓	-	✓	-	-	✓	-
[11]	✓	✓	✓	✓	✓	-	✓	-	-
[21]	✓	✓	✓	✓	-	-	✓	-	✓
[38]	✓	✓	✓	✓	✓	✓	✓	-	-
[39]	✓	✓	✓	-	-	✓	✓	✓	-
[12]	✓	✓	✓	✓	✓	-	✓	✓	✓
[27]	✓	✓	✓	✓	-	-	✓	-	✓
[40]	✓	✓	✓	✓	✓	✓	✓	✓	✓
[41]	✓	✓	✓	✓	-	-	-	-	-
[42]	✓	✓	✓	✓	✓	-	✓	-	-
[43]	✓	✓	✓	✓	✓	-	✓	✓	✓
[17]	✓	✓	✓	✓	✓	✓	✓	-	-
[44]	✓	✓	✓	✓	✓	✓	-	✓	✓

These two components are expected to be accessed holistically in line with best practices to develop a framework that could assist clients in making informed decisions.

While reflecting on, and corroborating the argument of [17] (p. 310) that “as far as known, apart from the work of [32], all other procurement decision-making charts were developed over a decade ago”, Table 1 includes the recent work of [44] and [8] in providing an up-to-date review of factors influencing clients' procurement choices. Whereas all the studies suggest the significance of cost certainty, quality, and timely delivery of construction projects as major factors that influence CCs procurement choices, the reality of modern procurement also involves the consideration of factors such as risk, complexity, accountability, flexibility, and competition as shown in Table 1. According to [13], when the client type has been established, factors like the client's resources, project characteristics, ability to make changes, risk management, cost issues, timing, and quality assurance should be considered when evaluating the most appropriate procurement strategy. Although some of the factors may be in conflict and priorities need to be set, procurement route selection should consider the factors that are most important to the client [20,27,32].

The consideration for project factors in simplifying the procurement selection process can be traced to the National Economic Development Office report [42]. Subsequently, several studies including [27,37,43], have leveraged the NEDO report in proposing strategies that could be explored by CCs in rationalizing the construction procurement selection process. As shown in Table 1 scholars have established major factors that influence CCs' procurement choices and have subsequently proposed models to simplify the procurement selection task. For instance, Ref. [38] explored the effectiveness of a hierarchical process and multi-criteria screening in construction procurement evaluation, while [40], established the fuzzy function of different procurement selection criteria as a tool for improving procurement selection. Molenaar [41] also leveraged a multi-attribute analysis and regression model in predicting design and build procurement for public sector projects, and Ref. [39] clarified the objective relationship between financing, risk, and construction procurement in their study on private financing of construction projects and procurement systems. However, despite offering notable contributions that could ease construction procurement decision-making, the aforementioned studies are predominantly premised on the logical, systematic evaluation of project factors with limited consideration of the dynamic nature of CCs' motivation, experience, and subjective project requirements.

Nevertheless, few studies acknowledge the important role of client experience in procurement decision-making. According to a study on the participatory approach in the procurement selection of social infrastructure that was carried out by [32], it was established that efficient procurement decision-making require decision-makers to consistently reflect and evaluate project outcomes. The need to value client experience in analysing construction procurement options was also highlighted by [17]. However, while Ref. [32] focused on a particular client type, Ref. [17] did not clarify how CCs' experience could be integrated into the procurement selection process. Therefore, in advancing the current debate on construction procurement selection, this study proposes a holistic framework that recognizes and integrates different client types (as discussed in Section 2.1) with feasible procurement options (as discussed in Section 2.2), based on the project factors that have been established in the literature (as highlighted in Table 1) and listed as follows.

- Time Certainty
- Cost Certainty
- Project Quality
- Risk Evaluation
- Project Complexity
- Design Flexibility
- Accountability
- Competitive Bidding
- Dispute Resolution

To achieve the study objective, the highlighted factors above were considered alongside client expectations and project requirements through the briefing process described in the methodology section.

3. Methodology

A mixed-method approach involving qualitative interviews and multi-objective optimization (MOO) protocol was adopted in exploring the significance of CCs' perceptions in selecting procurement routes. This approach is particularly relevant to this study because it integrates the subjective influence of CCs' experience with the objective reality of the procurement selection process. The qualitative aspect of this study involved fourteen purposefully selected CCs across the public and private sectors in the United Kingdom (UK), with experiences spanning the various construction procurement phases highlighted previously. Their perception and assessment of different procurement routes were collated through in-depth semi-structured interviews. The UK is particularly suitable for this study because of its global influence in construction procurement innovation and its multiplicity of client types. The participants' sample size conforms with the suggestions of [45], with details of the interview respondents provided in Table 2. Further to the client categorization highlighted in Appendix B-Figure A2, the research participants were grouped into Public Experienced Primary Client (PEPC), Public Experienced Secondary Client (PESC), Private Experienced Primary Client (PrEPC), and Private Inexperienced Secondary Client (PrISC).

Following the qualitative aspect of the study, a decision-making chart illustrated in Appendix A-Figure A1 was used in collecting numeric data relating to the significance of various project factors to different client types through MOO. According to [46] (p. 82), multi-objective optimization requires the "definition of appropriate decision variables, objective functions and constraints, and finally, the selection of appropriate solution techniques." Unlike single-objective optimization, which sets out to identify the best amongst a series of alternatives, thereby recommending the superlative option, multi-objective optimization involves a more detailed comparison of various attributes of the available alternatives before choices are made [4,47]. For instance, instead of making a project decision based solely on cost consideration, MOO evaluates various dimensions of project expectations like cost reduction, timely delivery, quality assurance, best practice, safety considerations, etc., before substantiating a preferred procurement route. This further cor-

roborates the opinion of [46] that MOO leads to various alternative solutions to a problem, with a compromise reached among the objectives considered.

Table 2. Background of research participants.

Respondents	Sector	Experience (Years)	Qualification	Current Position
PEPC-R1	Public (Housing)	33	BSc Civil Engr	Facilities Manager
PEPC-R2	Public (Energy)	19	BSc Building Tech	Project Manager
PEPC-R3	Public (Transport)	28	BTech Civil Engr	Project Director
PEPC-R4	Public (City Council)	14	MSc Civil Engr	Procurement Strategist
PESC-R5	Public (Health)	11	BSc Property	Asset Manager
PESC-R6	Public (Transport)	23	BSc Project Mgt	Project Manager
PESC-R7	Private (Retail Developer)	18	Diploma Project Mgt	Facilities Manager
PrEPC-R8	Private (Property Developer)	30	BSc Civil Engr	Construction Manager
PrEPC-R9	Private (University)	24	MSc Property	Project Manager
PrEPC-R10	Private (Housing Agency)	13	BSc Commerce	Portfolio Manager
PrEPC-R11	Private (Real Estate Investor)	17	BSc Property	Asset Manager
PrEPC-R12	Private (Transportation)	11	MBA Management	Investment Manager
PrISC-R13	Private (Individual)	9	BSc Arch	Chief Executive
PrISC-R14	Private (Individual)	12	MSc Construction Mgt	General Manager

MOO has been widely used in facilitating objective decision-making in mathematics, business, science, and engineering [47–49]. It is also popular among scholars in the construction industry who have evaluated various aspects of decision-making [4,17]. In addressing the focus of this study, the MOO strategy relies on the client’s prioritization of project deliverables with reference to the available procurement options. Being an objective decision-making strategy, MOO, therefore, complements the subjective opinion of CCs in rationalizing procurement routes.

4. Data Collection and Analysis

The identified research participants highlighted in Table 2 were engaged in a series of face-to-face discussions, and their experiences across various project types and procurement strategies were collated via recorded telephone interviews. The interviews were recorded to ensure a comprehensive data collection process and the research participants were assured of their confidentiality and anonymity. Details regarding how CCs make procurement decisions, factors that influence their procurement decisions, and the reason for their procurement preferences were collected and subsequently analyzed thematically. According to [50], thematic analysis recognizes flexibility in the data collection and reporting process by identifying direct and indirect ideas emanating from the data. Following the stage-based process suggested by [51], the recorded interviews were transcribed, and initial codes were identified. As stated by [52], codes are keywords or phrases that form the basis of participants’ opinions, which are emphasized because they reflect the participants’ intentions. The identified codes were evaluated and merged into initial themes reflecting participants’ unique perspectives toward construction procurement through a process described by [51] as mapping.

As shown in Table 3, the initial set of themes was reviewed, paraphrased, and consolidated to create a set of robust, coherent, and established themes. The major themes that emerged from the analysis suggest that CCs’ procurement decisions are influenced by their cognitive abilities, access to relevant information, and the dynamism of the built environment. These themes are subsequently discussed with reference to relevant quotes from the interview.

Further to the collation of qualitative data, CCs’ ability to select appropriate procurement routes was assessed using MOO. In adopting MOO, researchers have proposed different stage-based approaches, which involve establishing a set of factors that influence the project outcome, evaluating these factors through aggregation, ranking, or weight-based techniques, and eventually choosing the most appropriate option among the available al-

ternatives [48]. As previously demonstrated by [4], the MOO approach to this study was carried out in phases through the development of a decision-making chart. The decision-making chart was designed (as illustrated in Appendix A-Figure A1) as a working template for integrating and aligning client objectives and project peculiarities to appropriate procurement options. The decision-making chart comprises two sections, with the data collection process in section one entirely based on clients' input and requirements, in line with the project objectives. Section two involves the review of information provided by the CCs and the subsequent alignment of clients' preferences to create a pattern that suggests a suitable procurement route. Input from construction professionals in guiding CCs toward the most appropriate procurement route is considered at this stage through a briefing process. According to [53], the briefing process integrates the fragmented construction variables by evaluating client needs, project specifications, and professional inputs, toward the realization of an optimum project outcome.

Table 3. Factors that influence respondents' procurement preferences based on their experiences.

PEPC	PESC	PrEPC	PrISC	Code	Initial Theme	Established Theme
✓	✓	✓	-	Experience	Lessons from previous projects	
✓	✓	✓	✓	Perception	Personal conviction or belief	Construction client's cognition
✓	✓	✓	✓	Sentiment	Institutionalized preference	
✓	✓	✓	-	Bias	Process skipping	
✓	✓	✓	✓	Professionals	Availability of relevant skills	
✓	✓	✓	✓	Collaboration	Team influence	Access to relevant information
✓	✓	✓	✓	Legislation	Prevailing rules and regulations	
✓	✓	✓	✓	Demographics	Market or end-user projection	
✓	✓	✓	✓	Technology	Efficiency and adaptability	
✓	✓	✓	✓	Flexibility	Adjusting to market demand	Dynamic environment
✓	✓	✓	✓	Location	Project environment	
✓	✓	✓	✓	Disruptions	Uncertain events	

The decision-making chart drives the briefing process and provides a premise for actualizing the aim of this study, which is the development of a framework that is capable of guiding clients in making informed procurement choices. Based on the technique adopted from [17], the chart was used in evaluating clients' responses to questions pertaining to specific project factors identified in Table 1. Whereas the decision-making chart advances the previous works of [11,12] by collating data relating to basic project objectives, the project samples and factors highlighted in this study are illustrative, not exhaustive. These factors could be updated based on project complexity.

According to [21], the specifications of CCs could vary across project criteria and expectations. For instance, if the value for money spent (i.e., quality) is the crucial consideration for a particular project, CCs would rate the procurement criterion "quality" higher than the other criteria like timeliness and cost. Consequently, this study collated objective responses to structured questions from the research participants. The structured questions were asked across the various categorization of clients and different project types, as shown in the first and second rows of Appendix A-Figure A1, respectively. CCs' responses to the questions raised in the first section of the table were subsequently evaluated and coded. As suggested by [4], detailed and logical rules were set to analyse and code clients' influence on the various project objectives. This includes using numeric weighting techniques, as previously demonstrated by [9] and [49]. Weight was, therefore, assigned to each of the factors that influence the client's goals by using a numerical scale ranging from 0 to 100. Based on client's expectation and project peculiarity, CCs are expected to assign utility scores to each question in section 1 of Appendix A-Figure A1. In this study, utility scores are described as the values attached to the significance of project parameters by decision-makers. CCs' answers to questions on procurement factors were eventually coded, depending on how

important the factors are to them. A response of 50 and below translates to “NO”, while a response of 51 and above means “YES”, as illustrated in Figure 1.

5. Findings

All the respondents except the PrISC acknowledged that they had procured several projects using various procurement strategies. Reflecting on their previous projects and their understanding of the procurement process, they emphasized that their experience is the major factor that influenced their procurement choices irrespective of the logical justification of the alternative procurement routes. The outcome of the qualitative analysis, which rationalizes the gap in this study, suggests that the relevance of CCs’ experiences in making procurement decisions for different project types is influenced by their cognition, access to relevant information, and the dynamism of the built environment as clarified below.

5.1. Construction Client’s Cognition

According to the respondents, individual and organizational perception, sentiment, or bias towards a specific procurement choice is responsible for most of their previous procurement decisions. Having operated in the construction industry for a long time, the participants argue that rather than concentrating on procurement choices, they focus on contractors’ competence and adherence to due process. While some CCs argue that the consideration of some procurement routes often leads to a waste of valuable time as they are not relevant within their project scope, others believe that there are several routes toward achieving the same outcome. CCs, therefore, believe that less emphasis should be made on justifying a procurement preference over another as the ultimate assessment of project success is highly subjective. Referencing the construction of retail centers across the UK, R7 noted that:

“Design and build should not be considered a procurement option, in my opinion.”

According to him, project complexity and stakeholder expectation make it unrealistic to entrust the credibility of such projects to an entity. Based on his experience, he suggested management contracting as a more appropriate procurement option that encourages collaborative inputs in the delivery of quality retail centers that are useful for their intended purpose.

R4 also stated thus:

“Everything comes down to value for money. Whichever procurement option that offers that is appropriate.”

He noted that CCs are interested in the project outcome and how they can achieve the best result with the available resources. They, therefore, skip processes in evaluating procurement preferences based on their past experiences, available resources, and project deliverables. As a result, CCs often deviate from the logical, stage-based procurement selection process and rely on their cognition in selecting procurement routes.

5.2. Access to Relevant Information

The participants also revealed that the availability and access to relevant information affect their ability to make procurement decisions. They noted that the multiplicity of data available in today’s built environment makes it difficult for CCs to be objective in making procurement decisions. Arising from different project stakeholders (e.g., contractors, local council, end-users, etc.), respondents argued that evaluating the variety of data in a timely and efficient way is unrealistic in an ideal situation. Respondents, therefore, stated that they engage in mental shortcuts, while accessing information for procurement purposes. Relying on their experience, they noted that negotiations and consistent stakeholder engagement influence their procurement preference. According to R6:

“It is not practicable to consider all the known factors that influence project success. Over the years, we have learnt to focus on the crucial factors that emerge from our consistent deliberations with stakeholders when making procurement decisions.”

To the respondents, relevant information can only be timely and not absolute. It is, therefore, not feasible for them to follow a logical process when making procurement decisions. Their ability to reflect on previous experiences and anticipate possible challenges makes it easier for them to focus on pertinent information regarding project deliverables as they distinguish feasible procurement routes for different project types. According to R1:

“Accessing the right information is key. Various factors inform procurement choices, but a typical client will focus more on end-user satisfaction and project flexibility. Both of which cannot be measured objectively.”

5.3. Dynamic Environment

The respondents noted that the management of construction projects is a very dynamic and unpredictable practice that requires a value chain of activities across various sectors. As a result, it is often not realistic to make conclusive procurement decisions from the outset. Rather, clients' decision-making is premised on emerging project demands, as informed by current reality and inputs from other stakeholders. According to R14:

“Deciding on a procurement route is not a rigid process; it emerges with current reality.”

With technology, climate change, demographics and legislations constantly disrupting the procurement process, clients noted that the peculiarity of their immediate environment, their ability to adapt to possible changes, and the extent of competition in the delivery of similar projects are critical in the selection of procurement routes. In order to ensure that effective procurement choices are made amidst uncertainties, some respondents stated that they encourage collaborative practices with other stakeholders (e.g., construction professionals, contractors, suppliers, etc.) in the form of a special purpose vehicle (SPV), which often result in the adoption of a specific procurement route across various projects. Their experience in delivering previous projects, therefore, impacts their procurement preference, with minimal emphasis on logical assumptions. While narrating his experience, R9 opined that:

“... our organization works with a dedicated team of professionals with a track record of successful project delivery. Despite the variation in project complexity, our preference for management contracting is borne out of the success we have recorded in previous projects.”

Complementing the outcome of the qualitative study, respondents were assigned the task of selecting suitable procurement routes for different projects by following the logical, stage-based procedure highlighted in Appendix A-Figure A1. For clarification, using a PEPC as an example, responses from the client concerning the procurement of a prison facility are illustrated in the second column of the decision-making chart. The PEPC assigned values of 65, 50, and 88 to indicate their consideration of basic project factors of time, cost, and quality, respectively. The PEPC also acknowledges the complexity involved in prison construction and is willing to pay for the inherent risk, necessary expertise, and the possibility of project variation. The value of 90 provided by the client at the tendering stage suggests that the PEPC is solely responsible for the choices made, and his reluctance to explore competitive bidding was demonstrated in his preference for 40 as the benchmark for competition. Consideration for dispute resolution was subsequently deemed important by the PEPC, with a value of 55 assigned accordingly. The allotted values by the PEPC were converted to “YES” or “NO” and subsequently used to establish a procurement route.

This decision-making chart compliments the subjective nature of CCs and, therefore, forms the basis for a robust decision-making framework for CCs, which is the focus of this study. As shown in Figure 1 below, sample responses of different clients to project objectives were linked to relevant procurement options. For instance, the example illustrated above aligns with a management-oriented procurement option.

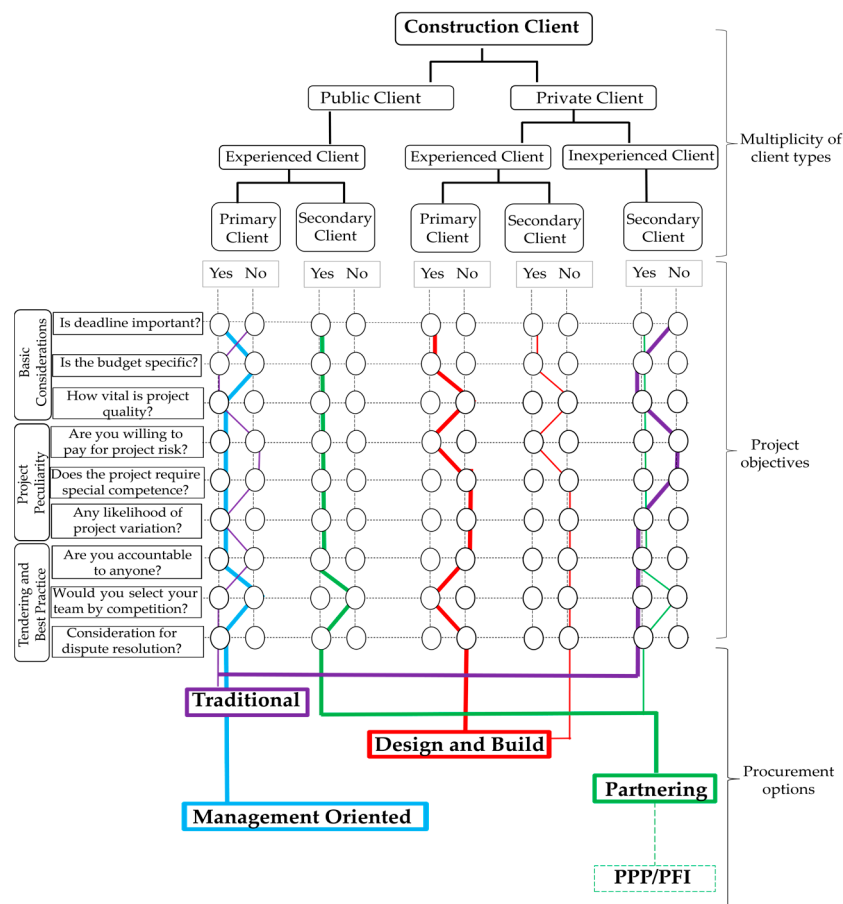


Figure 1. Decision-Making Framework for Construction Clients.

6. Discussion

A significant number of CCs rely on their experiences in selecting procurement methods. This is because the multi-dimensional relationship between clients' expectations, project specifications, project deliverables, and procurement routes often complicate the procurement selection process. Although the use of firm, process-based procurement practices have worked in other industries [14], the possible variation in project scope makes it unrealistic to adopt a rigid approach in the construction sector [27]. Scholars have, therefore, consistently emphasized the need to simplify the construction procurement process by aligning clients' subjective attributes to project deliverables and complexities [7,32], thus, providing a mechanism for efficient decisions to be made.

Whereas existing studies have attempted to model construction procurement by focusing primarily on client classification [12,18,42], project type [4], and methodological contributions [48], this study offers a more robust and practical framework that is universally applicable to all client categories and project types, irrespective of the complexity involved. The adopted data collection process also advances the hypothetical techniques previously explored by [17] by making use of qualitative interviews that complement the practicality of the research outcome.

As shown in Figure 1, the output of this study, which is the decision-making framework, is comprised of three distinct sections:

- Multiplicity of client types
- Project objectives
- Procurement options

Following the client classification by [21], the subjective nature of CCs, resulting from their cognitive ability, access to relevant information, and the dynamic nature of the built environment was explored in the prioritization of various project deliverables. The objective

responses of CCs to structured questions regarding the project factors highlighted in Table 1 and outlined in the decision-making chart were also collated and coded accordingly, as part of the briefing process. The information provided on the decision-making chart was then aligned across the project objectives to arrive at suitable procurement routes for specified projects. Depending on the CCs' response to the basic project objectives of cost, quality, and time, "traditional" or "design and build" procurement options can be recommended for simple projects. However, for specialized projects that require unique expertise, collaborative practices, variation, etc., a more in-depth consideration of project aim and professional advice is essential.

Although clients' responses to the project brief suggest a procurement option, the decision-making chart also acknowledges the significance of professional advice in exploring the variants of the main procurement options. According to [33], expert advice in exploring the optimality of procurement options is vital for overall project success. This is particularly true for inexperienced clients, undertaking a complex construction project for the first time. The decision-making chart, therefore, accommodates informed professional expertise and advice on complex procurement issues relating to contracts, tendering, collaboration, and dispute management. For instance, to encourage collaboration and drive value for money, partnering could be recommended for large government projects. Experts' inputs in guiding CCs also serve as a medium for encouraging best practices across various procurement options. Advancing the view of [17] in their study of modern selection criteria for procurement methods in construction, this paper has been able to leverage CCs' subjective viewpoint in developing a decision-making framework that offers feasible procurement routes for different project types. The study outcome is also useful in comparing procurement preferences across various categories of CCs.

7. Conclusions

Scholars agree that the process of selecting construction procurement routes is not straightforward. Rather, it varies with project complexity, client type, and access to requisite information that drives project objectives. Understanding that the ability of CCs to make appropriate investment decisions is a critical factor that determines project success, the decision-making framework developed in this paper is capable of guiding CCs toward making informed decisions. This paper explored the literature to review the various categorizations of CCs, factors influencing the selection of procurement options, and some of the procurement choices available to CCs. It attests to existing arguments that there is a possibility of having more than one procurement route that will match specific client requirements.

While scholars have attempted to simplify the decision-making process for CCs, the practicality of the existing techniques have been challenged due to the dynamic nature of client objectives and the complexity of modern construction projects. Unlike previous scholarly contributions that are premised solely on clients' objectivity, this study acknowledges that clients' objectives are not static, and the reality of today's environment requires a flexible approach to CCs' decision-making. Therefore, adopting a mixed-method approach involving qualitative interviews and the MOO technique, this study leveraged CCs' experiences in selecting procurement routes through the value they attach to different project factors. Following the multiplicity of data gathered and evaluated in this study, this paper has achieved its aim of developing a framework (as shown in Figure 1) that provides different alternative routes to CCs, based on their experience and responses to the decision-making chart, used in rationalizing the significance of various procurement factors to specific project types.

The proposed framework applies to different real-life projects irrespective of project complexity and client categorization. It offers CCs a practical opportunity to be involved in the procurement process through a more in-depth approach that drives increased project success through effective collaboration and sustainable practices. Thus, enhancing and deepening their understanding of different procurement routes and their consequent

contribution to project outcome. The framework also contributes to the ongoing debate on simplifying the construction procurement process by offering a platform for construction professionals and academics to drive innovation and best practices as a way of ensuring value for money in construction procurement.

Although this study offers a practical framework that is capable of guiding clients in selecting appropriate procurement options for different project types, the significance of the framework was not explored beyond the procurement context. The study scope is also limited to CCs in the UK and the decision-making framework itself will benefit from wider evaluation and validation across various case scenarios and different stages of project lifecycle. The effect of social, environmental, technological, and economic disruptions on the client's objectives and procurement path were also not covered in this research. Future studies should, therefore, consider the applicability of this framework across specific projects as a measure of the viability of project outcomes when compared to purely objective models. Researchers are also encouraged to investigate the effect of disruptions on CCs' procurement choices.

Author Contributions: Conceptualization, M.B.; methodology, M.B.; software, M.B.; validation, M.B., S.A. and A.-R.A.; formal analysis, M.B. and A.J.; data curation, M.B., A.-R.A., S.A. and A.J.; writing—original draft preparation, M.B.; writing—review and editing, M.B., A.-R.A., S.A. and A.J.; supervision, A.-R.A.; project administration, M.B. and S.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Decision-making Chart

DECISION-MAKING CHART FOR BRIEFING CONSTRUCTION CLIENT ON THE APPROPRIATENESS OF AVAILABLE PROCUREMENT OPTIONS

INTERVIEW GUIDE

CLIENT TYPE	PEPC	PESC	PrEPC	PrISC
PROJECT SAMPLE	PRISON	LOCAL HOSPITAL	TEMPORARY HOUSING	OFFICE BLOCK
SECTION 1				
STAGE A: BASIC OBJECTIVES				
Is deadline important?	65	80	70	45
Is there a specific budget?	50	75	75	87
Do you require quality design and construction?	88	70	50	80
STAGE B: PROJECT PECULIARITY				
Are you willing to pay for the inherent project risk?	85	60	55	45
Does the project require any special competence?	88	60	44	50
Is there a likelihood of project variation?	82	55	40	55
STAGE C: TENDERING AND BEST PRACTICE				
Are you accountable to anyone other than yourself?	90	90	48	90
Would you choose your team by competition?	40	50	91	60
Consideration for dispute resolution?	55	78	50	75
SECTION 2				
OBSERVATION	Client's response to the brief is evaluated and linked to a procurement option			
ADVICE	Issues relating to project complexity, contract and dispute resolution are explored			
REVIEW	Best practices and modern procurement options are evaluated			
RECOMMENDATION	Most suitable procurement option is recommended			

Note: The overall score for each question is 100 and a response of 50 and below translates to "NO" while a response above 50 means "YES"

Key: PEPC (Public Experienced Primary Client)
 PESC (Public Experienced Secondary Client)
 PrEPC (Private Experienced Primary Client)
 PrISC (Private Inexperienced Secondary Client)

Figure A1. Decision-Making Chart.

Appendix B

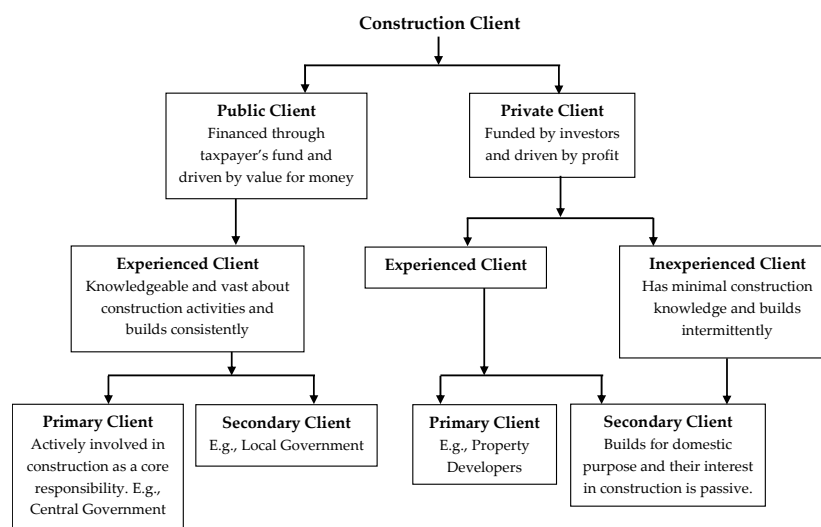


Figure A2. Client Categorization Adapted from [21].

References

- Rajeh, M.A.; Tookey, J.; Rotimi, J. Procurement selection model: Development of a conceptual model based on transaction costs. *Australas. J. Constr. Econ. Build.-Conf. Ser.* **2014**, *2*, 56–63. [\[CrossRef\]](#)
- Cheung, S.O.; Lam, T.I.; Leung, M.Y.; Wan, Y.W. An analytical hierarchy process-based procurement selection method. *Constr. Manag. Econ.* **2001**, *19*, 427–437. [\[CrossRef\]](#)
- Bolomope, M.T.; Awuah, K.G.B.; Amidu, A.R.; Filippova, O. The challenges of access to local finance for PPP infrastructure project delivery in Nigeria. *J. Financ. Manag. Prop. Constr.* **2020**, *1*, 63–86. [\[CrossRef\]](#)
- Li, T.H.; Thomas Ng, S.; Skitmore, M. Modeling multi-stakeholder multi-objective decisions during public participation in major infrastructure and construction projects: A decision rule approach. *J. Constr. Eng. Manag.* **2016**, *142*, 04015087. [\[CrossRef\]](#)
- Tookey, J.E.; Murray, M.; Hardcastle, C.; Langford, D. Construction procurement routes: Re-defining the contours of construction procurement. *Eng. Constr. Archit. Manag.* **2001**, *8*, 20–30.
- Asiedu, R.O.; Manu, P.; Mahamadu, A.M.; Booth, C.A.; Olomolaiye, P.; Agyekum, K.; Abadi, M. Critical skills for infrastructure procurement: Insights from developing country contexts. *J. Eng. Des. Technol.* **2021**. [\[CrossRef\]](#)
- Manley, K.; Chen, L. The impact of client characteristics on the time and cost performance of collaborative infrastructure projects. *Eng. Constr. Archit. Manag.* **2016**, *23*, 511–532. [\[CrossRef\]](#)
- Tang, Z.W.; Ng, S.T.; Skitmore, M. Influence of procurement systems to the success of sustainable buildings. *J. Clean. Prod.* **2019**, *218*, 1007–1030. [\[CrossRef\]](#)
- Cheung, S.O.; Lam, T.I.; Wan, Y.W.; Lam, K.C. Improving objectivity in procurement selection. *J. Manag. Eng.* **2001**, *17*, 132–139. [\[CrossRef\]](#)
- Naoum, S.; Egbu, C. Critical review of procurement method research in construction journals. *Procedia Econ. Financ.* **2015**, *21*, 6–13. [\[CrossRef\]](#)
- Skitmore, M.; Marsden, D. Which procurement system? Towards a universal procurement selection technique. *Constr. Manag. Econ.* **1988**, *6*, 71–89.
- Gibb, A.G.; Isack, F. Client drivers for construction projects: Implications for standardization. *Eng. Constr. Archit. Manag.* **2001**, *8*, 46–58. [\[CrossRef\]](#)
- Morledge, R.; Smith, A.; Kashiwagi, D.T. *Building Procurement*, 1st ed.; Blackwell Pub: Malden, MA, USA, 2006.
- Havensvid, M.I.; Hulthén, K.; Linné, Å.; Sundquist, V. Renewal in construction projects: Tracing effects of client requirements. *Constr. Manag. Econ.* **2016**, *34*, 790–807. [\[CrossRef\]](#)
- Durdyev, S.; Ihtiyar, A.; Banaitis, A.; Thurnell, D. The construction client satisfaction model: A PLS-SEM approach. *J. Civ. Eng. Manag.* **2018**, *24*, 31–42. [\[CrossRef\]](#)
- Love, P.E.D.; Skitmore, M.; Earl, G. Selecting a suitable procurement method for a building project. *Constr. Manag. Econ.* **1998**, *16*, 221–233. [\[CrossRef\]](#)
- Naoum, S.G.; Egbu, C. Modern selection criteria for procurement methods in construction: A state-of-the-art literature review and a survey. *Int. J. Manag. Proj. Bus.* **2016**, *9*, 309–336. [\[CrossRef\]](#)
- Masterman, J.W.E.; Masterman, J. *An Introduction to Building Procurement Systems*; Routledge: London, UK, 2013.
- Windapo, A.; Adediran, A.; Rotimi, J.O.B.; Umeokafor, N. Construction project performance: The role of client knowledge and procurement systems. *J. Eng. Des. Technol.* **2021**, *20*, 1349–1366. [\[CrossRef\]](#)

20. Perera, G.P.P.S.; Tennakoon, T.M.M.P.; Kulatunga, U.; Jayasena, H.S.; Wijewickrama, M.K.C.S. Selecting suitable procurement system for steel building construction. *Built Environ. Proj. Asset Manag.* **2020**, *11*, 611–626. [[CrossRef](#)]
21. Masterman, J.W.E. *An Introduction to Building Procurement Systems*, 2nd ed.; Spon Press: London, UK, 2002.
22. Ashworth, A.; Hogg, K.; Willis, C.J. *Willis's Practice and Procedure for the Quantity Surveyor*, 12th ed.; Blackwell: Oxford, UK, 2007.
23. Briscoe, G.H.; Dainty, A.R.; Millett, S.J.; Neale, R.H. Client-led strategies for construction supply chain improvement. *Constr. Manag. Econ.* **2004**, *22*, 193–201. [[CrossRef](#)]
24. Othman, A.A.E.; Youssef, L.Y.W. A framework for implementing integrated project delivery in architecture design firms in Egypt. *J. Eng. Des. Technol.* **2020**, *19*, 721–757. [[CrossRef](#)]
25. Latham, S.M. *Constructing the Team: Final Report*; H.M.S.O-1: London, UK, 1994.
26. Egan. *Rethinking Construction: The Report of the Construction Task Force*; DTI (URN 98/1095), Construction Task Force; Department of Trade and Industry (DTI): London, UK, 1998.
27. Kumaraswamy, M.M.; Dissanayaka, S.M. Developing a decision support system for building project procurement. *Build. Environ.* **2001**, *36*, 337–349. [[CrossRef](#)]
28. Ruparathna, R.; Hewage, K. Review of contemporary construction procurement practices. *J. Manag. Eng.* **2015**, *31*, 04014038. [[CrossRef](#)]
29. Mohsini, R.; Davidson, C.H. Building procurement—Key to improved performance: Owner's procurement decisions have very real effect on the performance of the design team as it carries out various stages of building design and construction process. *Build. Res. Inf.* **1991**, *19*, 106–113. [[CrossRef](#)]
30. Luu, D.T.; Ng, S.T.; Chen, S.E. Formulating procurement selection criteria through case-based reasoning approach. *J. Comput. Civ. Eng.* **2005**, *19*, 269–276. [[CrossRef](#)]
31. Rahmani, F.; Maqsood, T.; Khalfan, M. An overview of construction procurement methods in Australia. *Eng. Constr. Archit. Manag.* **2017**, *24*, 593–609. [[CrossRef](#)]
32. Love, P.E.D.; Irani, Z.; Sharif, A. Participatory action research approach to public sector procurement selection. *J. Constr. Eng. Manag.* **2012**, *138*, 311–322. [[CrossRef](#)]
33. Yap, J.B.H.; Lim, B.L.; Skitmore, M.; Gray, J. Criticality of project knowledge and experience in the delivery of construction projects. *J. Eng. Des. Technol.* **2021**, *20*, 800–822. [[CrossRef](#)]
34. Greenhalgh, B.; Squires, G. *Introduction to Building Procurement*; Routledge: London, UK, 2011.
35. NEC. *NEC3 Procurement and Contract Strategies*; Thomas Telford: London, UK, 2009.
36. Morris, P.; Pinto, J.K. (Eds.) *The Wiley Guide to Project Technology, Supply Chain, and Procurement Management (Vol. 7)*; John Wiley and Sons: Hoboken, NJ, USA, 2010.
37. Franks, J. *Building Procurement Systems*; Chartered Institute of Building: Ascot, UK, 1990.
38. Alhazmi, T.; McCaffer, R. Project procurement system selection model. *J. Constr. Eng. Manag.* **2000**, *126*, 176–184. [[CrossRef](#)]
39. Chege, L.W.; Rwelamila, P.D. Private financing of construction projects and procurement systems: An integrated approach. In Proceedings of the CIB World Building Congress, Wellington, New Zealand, 4–6 April 2001.
40. Ng, T.; Luu, D.; Chen, S. Decision criteria and their subjectivity in construction procurement selection. *Constr. Econ. Build.* **2002**, *2*, 70–80. [[CrossRef](#)]
41. Molenaar, K.R. Selecting appropriate projects for design-build procurement. In *Profitable Partnering in Construction Procurement*; Routledge: London, UK, 2003; pp. 219–225.
42. National Economic Development Office N.E.D.O. *Thinking about Building*; H.M.S.O: London, UK, 1985.
43. Rowlinson, S. Selection criteria. In *Procurement Systems: A Guide to Best Practice in Construction*; Routledge: London, UK, 1999; pp. 276–299.
44. Walker, A. *Project Management in Construction*; John Wiley & Sons: Hoboken, NJ, USA, 2015.
45. Creswell, J.W.; Poth, C.N. *Qualitative Inquiry and Research Design: Choosing among Five Approaches*; Sage Publications: Thousand Oaks, CA, USA, 2017.
46. Asadi, E.; Da Silva, M.G.; Antunes, C.H.; Dias, L. Multi-objective optimization for building retrofit strategies: A model and an application. *Energy Build.* **2012**, *44*, 81–87. [[CrossRef](#)]
47. Muramatsu, M.; Kato, T. Selection guide of multi-objective optimization for ergonomic design. *J. Eng. Des. Technol.* **2019**, *17*, 2–24. [[CrossRef](#)]
48. Sariyildiz, I.S.; Bittermann, M.S.; Ciftcioglu, O. Multi-objective optimization in the construction industry. In Proceedings of the AEC 2008: 5th International Conference on Innovation in Architecture, Engineering and Construction, Antalya, Turkey, 23–25 June 2008.
49. Salama, T.; Moselhi, O. Multi-objective optimization for repetitive scheduling under uncertainty. *Eng. Constr. Archit. Manag.* **2019**, *26*, 1294–1320. [[CrossRef](#)]
50. Noble, H.; Smith, J. Qualitative data analysis: A practical example. *Evid.-Based Nurs.* **2014**, *17*, 2–3. [[CrossRef](#)] [[PubMed](#)]
51. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [[CrossRef](#)]
52. Feldman, G.; Shah, H.; Chapman, C.; Pärn, E.A.; Edwards, D.J. A systematic approach for enterprise systems upgrade decision-making: Outlining the decision processes. *J. Eng. Des. Technol.* **2017**, *15*, 778–802. [[CrossRef](#)]
53. Kamara, J.M.; Anumba, C.J.; Evbuomwan, N.F. Assessing the suitability of current briefing practices in construction within a concurrent engineering framework. *Int. J. Proj. Manag.* **2001**, *19*, 337–351. [[CrossRef](#)]