The effectiveness of project delivery systems in the optimal implementation of green buildings

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Abstract. This research shows a summary of the latest systems of project delivery, which can work on the green building execution to define and processing the inherent complexity in the green building sector represents by cost and time overrun due to the challenges potential in the implementation of such a project. The study focuses on the strength, weaknesses, and intricacies of different types of project delivery systems sensed latest study trends in systems of project delivery, and how they carry out in an environment of green building. This research promotes future work to concentrates on the presentation and quality of green building because these fields are more necessary to the organizational and technological complexities, regular the preliminaries for educational students to discover modern techniques in assessing systems of project delivery in addition to in promoting decision-makers in the appropriate judgments for choosing the delivery system to attain the success of a project.

Keywords: Project delivery systems; Green buildings; Critical factors

1. Introduction
The main participants in any construction project are the owner, the designer (architect or engineer), and the general contractor. The relation between the participants is determined by the project delivery systems used for the project. [1]
The project possessor faces two significant choices respecting the relations between the several groups and the method of payment to the contractor before starting the construction project, and even before choosing the designer. Delivery systems are the basis of the project's contractual relationships, which decide each party's responsibility. As for contracts, they are used to determine how the completely finished construction works of the contractor should be paid. [2] Project delivery systems developed over the years, where the owner appointed the main builder to design and build the entire facility; this system remained popular until the early twentieth century. Continuous technological and building development changes require a considerable amount of design and construction services. Designers and builders started specializing in designing, manufacturing and/or constructing specific construction systems. This led to the traditional design-bid-build delivery system [3].
Since this system required the selection of the lowest bidder on public projects [4]. Moreover, design and construction entities shared information only at the end of the design and during the construction process; communication between the project team was very low, especially during the design phase, resulting in ineffective designs, increased errors and disputes, higher costs and longer time tables at the end. This traditional approach became unacceptable to many clients. The great efforts made by owners to reduce the size of the workforce in managing internal projects, and costly disputes between
design and construction parties, forced many of their owners to contract with a single design and build institutions [3]. However, in recent years, the public sector has begun to experiment with alternative ways to improve the speed and efficiency of project implementation [5].

The term "project delivery method" should be clearly understood with an understanding of the advantages and disadvantages of those methods, skills required; resources and techniques used; challenges and lessons learned from each delivery method so that the owner can choose the best delivery system for the project to achieve its goals. The project has its own characteristics, so it is important to choose the delivery method that suits each project. Deprived of a pure considerate of this concept, it is hard for employers of structure facilities to appreciate the value of the method of particular project delivery for the success of the construction process. The mechanism by which projects are produced and finished, containing how to select the contractor, the range of service delivered, the form of relationship with the owner and how to pay the contractor.

1.2 Delivery systems definition.

PDM is a term used to refer to all roles and responsibilities of the project entities involved in the contractual relationships. Through it, the project is designed and constructed to the owner in a systematic manner including specifying the scope of the project, coordinating the various designers, contractors, and consultants, the sequence of design and construction procedures. Consequently, the PDM is characterized by specific contracts being developed between the owners, the designer, and the contractors [6].

Project delivery systems are not only processes that need to be followed to move the project from the design and planning phases to implementation and the commissioning phases, but delivery systems have also become tools for saving time and money while creating creative design approaches that address the particular challenges of construction projects [7].

1.2.1 Types of delivery systems:

1. Design/bid/build One of the most common delivery systems is Design/bid/build. This method of delivering construction projects is called conventional because it has the best option for many centuries for possessors of many structure projects.[2, 8 and 9] In This method, the owner of a project has separate contracts with a design firm and a construction firm [10] Figure 1, shows a structural diagram that carries out as this prearrangement.

The Owner is generally responsible for: design reviews, design norm discrepancies, errors/omissions found during construction, design build ability, litigation by the third-party, and ensure the performance of the facility[11], while the contractor will be responsible for the integrity of the project site, the coordination of construction, building defects, and inflation, and hence the risks of these components[11]. The general contractor hires the subcontractors and contracts for the project construction, the contractor is not involved during the design stage, which is seen as a downside in this type so it is difficult to make adjustments to the design for reduce building costs and waste and improve the productivity of the project after occupancy, as the owner cannot use the expertise of the contractor to perform a value analysis and a design review, as well as to estimate costs and schedule.[12] The separation between the architect and the contractor allows them to discover the mistakes made by others, most contracts allow them to inform the owner about the errors in order that the effects of these errors can be eradicated or reduced. This method is often criticized for a long time it takes to design and build the project as well as the somewhat hostile relationship between the architect and the contractor, lack of innovation, and cost overruns during design, the architect must estimate the cost of construction. If the actual offer (bid) far exceeds estimates, a long redesign, re-pricing, and contract award period will be required that can lead to design inefficiencies, increased errors and disputes, high costs, and long duration of the project.[13,14, 15]

2. Design-build is one of the delivery systems types, in which the owner signs a contract with the design and construction contractor to design and build the project. The design and construction contractor may have the ability to design within his organization, may choose to enter into a joint venture with a design company. In some projects, a design company, sign the contract and employ a construction company. In this way the aggressive relations between the parties can be eliminated; as
well as reduced the overall time required to complete the project, the project contractor interacts with the owner and oversees the design and construction of the project. This delivery method is used most in projects such as water treatment plants or wastewater treatment [1, 16] The DB approach is especially effective where its scope is clearly established, the design is a normal, iterative design and a tight time schedule, but quality cannot be guaranteed to the owner [17]. Fig.1 shows a structural diagram that applies to such an arrangement.

The main contractor of the DB project is responsible for the leadership of this team of professionals and will work together with other design and construction professionals to achieve the goals of the DB team, ensuring that the project is built in line with good practice and all work will complete within the time and budget constraints of the project [18].

The DB will allow owners to set costs and schedule, encourage creativity, reduce claims, and enhance the team approach, which promotes communication. Effective collaborations between designers and developers usually strengthen their relationships and avoid change orders as the process allows the contractor to detect design or construction problems at an early point in the bidding process. The owner has released from the dilemma (problem) of determining if the contractor or designer is wrong with changes when there is one source of responsibility.

![Figure 1](image)

**Figure 1.** Traditional design–bid–build/ Design–build relationship chart [2]

3. The Construction Manager (CM) consists of one individual or a team of professionals. This varies depending on the expertise of the management team and the time of involvement in the project [19]. The Owner may or may not contract directly with Contractors depending on the contractual arrangement with the Construction Manager (CM). The CM delivery method is defined by cooperation between the owner and a Consultant and construction manager who are working as a team for achieving efficiency in time, constructability and costs, especially during the pre-construction phase of a project, CM is not responsible for the construction but only manage the construction [20]. This method is used for big and complicated projects where the project organization cannot be run by the owner or the time is crucial or design is exceptional or creative and the specifications are uncertain [20, 19].

The CM method of delivery is of two types:

- The Construction Manager (CM) – Advisor or Agency. This is a method the same as the conventional DBB style for which the possessor responsible for designs, bids, and builds the project. The organization of CM nevertheless assumes responsibility for management, buildability issues, and daily activities Fig.2, [21]. The Structure Leader serves as a guide to the possessor for payment, he is an extension lead of the staff of the owner, and affords little risk, excluding in relation to him, to perform his advisory functions [2].
• The construction manager @ Risk Management CMAR. This is the project management system where the construction manager is involved from the beginning of the project, active as an owner advisor, contracting and coordinating with contractors as well as subcontractors. The owner jointly selects the designer and construction manager to complete the design and then builds the project with one or more subcontractors Fig.3. The construction manager contacts the subcontractors and specialists to complete the construction procedures after completing the design [12]. The contract amid the construction manager and the owner is frequently founded on a certain extreme value of the contract. Construction contracts may be contracted either by the construction manager or by the owner [22, 2].

Figure 2. (CM) - Agency or Advisor [19]  
Figure 3. (CM) - @Risk Delivery System [19].

4. Project manager delivery method. The boss of the project bonds with the common servicer and the designer. The project manager might employ a single design-build organization or a construction manager. Fig. 4 shows one possible form of the contractual relationship [2]. The project manager has whole accountability for finishing the project in conformance with all contract requirements within budget and on time [1]. This may be reflected as the greatest alternate once in-house expertise is absent, decreasing staffing are necessary, and subcontracting subjects are accessible [21].

Figure 4. Project manager relationship chart, [2].
The project management's goal is that a project can be effectively managed from its different aspects of cost, quality, and time and to ensure that project meets the cardinal objectives of effective cost management, quality management, and time management. He is appointed by a project owner to coordinate other participants so that design and construction achieve the defined objectives. A project manager may function within any of the other types of project delivery system or maybe an independent type of PDS [23].

5. Separate prime contracts. The owner contracts directly with individual specialist contractors, each of whom can be considered as a "main" contractor because there is not a single general contractor to coordinate their business [2]. The responsibility for the effective achievement of the whole project must be included in the contracts [24]. Multiple prime contractors may be used with sequential design and construction by splitting the plans and specifications into packages [24]. This system is more vulnerable to coordination problems,[19] the multiple prime contractor method places all the risks of managing and coordinating the construction work with the owner. Accordingly, the owner must have extensive experience and internal resources for writing individual trade contracts, facilitating the purchase, checking and processing interim payments, processing and implementing change orders, preparing license issues, insurance claims, safety program disputes and claims that are usually managed by a General contractor or construction manager [25]. as shown in the diagram in Fig. 5.

![Diagram of Multiple Prime Contracting Delivery System](image)

**Figure 5.** Relationships in the Multiple Prime Contracting Delivery System [19]

6. Turnkey projects. Involve the delivery of a complete system and extend the timescale of the project backward to pre-bid activities and forwards beyond the handover stage, [26] such that after completion the employer need only turn the key to commence operation of the constructed facility, placing all design, procurement, and construction responsibilities on one contractor. Thus, there is no need to identify whether a defect has been caused by the defective design or defective construction of the works [27]. This type of project such as a design-build firm. Nevertheless, the possibility of the accountability of contractor is normally larger than main design, structure, and obtaining, as it contains such as facilities as land obtaining and project financing, other responsibilities aren’t commonly inside the scope of design-build [2], and may add the responsibilities of the operation and/or maintenance of the completed project [28]. Once the project is finished, the possessor examines the work, and, if it comes across the necessities, enters the facility and commences operation. If the land acquisition has included in the services of the contractor, the owner literally purchases the entire completed project from the contractor at the end of the project. In the turnkey method, the possessor is certain via an agreement to buy the plan upon achievement, with serious legal consequences for refusing the finished project [2]. The turnkey system generally uses the lump-sum-pricing method.

7. Force Account delivery system is known as “direct labor,” “direct work” or "day-labor construction" [29]. in force account approach the project owner acts as the prime contractor and
carries out the work with its own forces [2] by utilizing its internal resources rather than extracting the work to an external entity [29, 30]) and providing field supervision, materials, equipment, and labor [2] it is a way of payment for structure work where there are no acceptances on cost. There are certain kinds of jobs that can be done better by force account than by construction by contract. Maintenance work for example, or jobs that can be pursued without the necessity of investing heavily inexpensive equipment [31] in small simple projects that are made for the using of possessor somewhat than sold to additional group upon accomplishment [2], and places are remote such that reaching them is difficult [20]. It can be utilized when the customer and contractor are incapable to approve on a lump sum amount or price of unit, or if these means are unviable, such as, once the space and amounts of work are unidentified at the time of offering, or for an order of variation, needful additional, and unexpected work recognized after structure has already initiated [32, 33].

8. The build–own–operate–transfer (BOOT) is a form of a delivery system that promotes public-private partnerships in which a private company is contracted to finance, design, construct and operate the project for a given period of time known as the concession period [20] (usually 15-25 years not including project development time) then transfer the asset to the government free of charge, with a guarantee that it is in satisfactory condition [2]. This is a way of project delivery that extends the owner-contractor relation behind just structure and design. In definite settings, the owner doesn’t possess the economic principle and or proficiency to form and work this kind of facility. The contractor can deliver services of maintenance, facilities of working, and financing to help the owner in assembly their wants. In this situation, a contractor with the correct proficiency, information, and financing can help the possessor in assembly these prolonged wants [34]. This requires that projects should first be viable for revenue generation in order to pay back their debts [20]. And the length of the contract must be sufficient to enable the private partner to realize a reasonable return on its investment through user charges. The possessor transfers cost of a yearly O&M and project for the definite contract interval. If the real prices to work and preserve the facility surpass that of the payment, the contractor pays out of their own pocket; if the real costs are fewer than the payment, the variance is a clean advantage for the contractor. Other awards and disadvantages can be definite in the contract to deliver additional motivations to the team of the project [35]. In this contract, the risks for the investor will be comparatively more [36]. This contracting prearrangement differs importantly from DB and DBB as one existence is contracted in the position of three dispersed objects (the workers, the constructors, the designers, and maintainers), incomes the owner possess a solitary contact point, and the team of the project can connect and coordinate more efficiently, as they are entirely employed beneath the similar contract. Most essentially, this contract delivers enticements for the contractor to scheme and construct the service so as to reduce the costs of working and repairs [35].

1.3 Green building definition
Green building is often mentioned together with sustainable construction, and sometimes these two terms are used interchangeably. The three main pillars of sustainability are environmental, social, and economic impacts are [37]. Lately, the 4th support, the recognized measurement, has earned growing respect (The Commission on Sustainable Development introduced institutions as the fourth See Fig. 6. [38].
There are many various perceptions and many descriptions of green buildings of what creates a green building even if they take part a general emphasis on dropping the ecological influences of the repairs and structure of buildings.” Green or maintainable building is the repetition of making better and more models of resource-efficient of procedure, renovation, construction, repairs, and destruction”.

[39, 40], Green buildings are a basic feature of the greater town sustainability moving, which decreases ecological influences and raises financial reserves and health profits over the term of elongated. Effectiveness and Enhanced design cut bills of energy, procedure overheads, and preservation wants for building possessors and workers in the long term., enhanced indoor air class and entrance to daytime and windows help to help mental and physical well-being [39]. However, green building is not achievable without the adoption of green building technologies (GBTs). GBTs are defined as technological innovations that are incorporated into building design and construction because they insert special building technologies and policies to improve the sustainability of the traditional buildings [41, 42]. GBTs are collected into seven categories: indoor illumination technologies; control technologies; energy and water conservation technologies; renewable energy technologies; energy and water recovery technologies; technologies to ensure air quality; and technologies to maintain comfort zone temperatures [43]. Green structures ought to be a piece of the national technique of any nation having issues in vitality generation, vitality assets, and deficiency in crude material stores. Many countries have adopted a series of GB related policies, including mandatory regulations, financial incentives, and tax concessions depending on the building size and green certification, to promote the development of GB projects [44]. Such as the Air Contamination Control Act in 1955, The Federal pure Air Act in 1970, and Ecological Protection Agency (EPA) in 1971, but took a very slow area for this awareness to spread to the industry of structure. (American Institute of Architects (AIA) made Board on the Setting (COTE) in 1990) Green building moving took an additional turn when the US Green Building Council (USGBC) was made in 1993, and lastly Leadership in Energy and Ecological Design (LEED) principles presented thorough USGBS in 1998. Since then, the green building performs have been earing approval with the maximum growth in the USGBC membership of 60% was extended amid the years of 2000-2007

1.3.1. A Green Building Rating System (GBRS)
Green Building Rating System (GBRS) can be defined as a tool that proportions the working of a building as said by a definite group of principles that commonly covers the substances, position, energy, water, and inside environ quality and extra features of maintainable design. Pointing to the recognize significances for maintainable design, to surround ecological information, and to make a body of information about the influences of buildings on the environ [45]. GPRS can assist to building possessors in the next features containing base lining (i.e., founding a primary dimension contrary to which to adjust future working), benchmarking (i.e., provided that a source for assessment

[Figure 6. Sustainable Frameworks [38]]
with contestants), decision-making (i.e., creating a basis to select amongst diverse solutions), and certification (i.e., interment indication to obey with maintainable sittings and rules) [46].

1.3.1.1. BREEAM (Building Research Establishment’s Environmental Assessment Method)

BREEAM is seen as the major green building rating valuation in the world, started and worked via BRE (Building Research Establishment) in the UK in 1990 [38]. And it is applicable to a variety of building kinds for example industrial units, homes, offices, retail units, and schools. BREEAM has made a basis for the finest repetition in maintainable design leading it to become the greatest active scheme around the world for the dimension and explanation of the ecological working of a building [47]. It is extensively believed that nearly wholly late main green rating systems for example Green Star, LEED, and CASBEE are beneath the BREEAM effect [39]. BREEAM operates via presentation credits in 10 groups for assembly a sequence of working criteria that, if obeyed with, would decrease the building’s negative ecological influence and raise its ecological profits. The whole number of credits gave in all classes is reproduced via an element of ecological allowance, which takes into consideration the relative significance of that class. The class scores are then added together to create a single whole score, utilizes the weighting system (as illustrated in Table 1).

Table 1. BREEAM Certification Level, Categories, Weightings and available Credits [47]

| Certification level | Points |
|---------------------|--------|
| Outstanding         | 85     |
| Excellent           | 70     |
| Very Good           | 55     |
| Good                | 45     |
| Pass                | 33     |

| Categories          | Possible Points | Credits available |
|---------------------|-----------------|-------------------|
| Management          | 12              | 10                |
| Health Wellbeing    | 15              | 14                |
| Energy              | 19              | 21                |
| Transport           | 8               | 10                |
| Water               | 6               | 6                 |
| Materials           | 12.5            | 12                |
| Waste               | 7.5             | 7                 |
| Land Use & Ecology  | 10              | 10                |
| Pollution           | 10              | 12                |
| Innovation          | 10              | 10                |

1.3.1.2. Leadership in Energy and Environmental Design rating system (LEED)

LEED was started via Robert Watson of the United States Green Building Council (USGBC) in 1993, the LEED rating system is a nationally accepted benchmark and involves of a suite of rating systems for the structure, design, and working of high-working green buildings, and serves as a measure of accomplishment [48]. Although it was released after BREEAM, it is considered as the most popular and the most widely adopted rating scheme [38]. LEED is a charitable green building rating system, nevertheless, in definite US states, certification of LEED is required. The modern version of LEED (LEED v3), started in April 2009, accentuated more on CO₂ releases and working of energy via making these criteria required, If a building doesn’t work within the restrictions of its designated level, the building may miss certification of LEED. LEED award 110 points in total to buildings that satisfy specified green building criteria grouped into the following seven major categories Table 2. [49, 50].
### Table 2. LEED Credits Distribution [47]

| Category                        | Possible points |
|---------------------------------|-----------------|
| Sustainable Sites               | 26              |
| Water Efficiency                | 10              |
| Energy and Atmosphere           | 35              |
| Material and Resources          | 14              |
| Indoor Environmental Quality    | 15              |
| Innovation in Design            | 6               |
| Reginal Priority                | 4               |

1.3.1.3 Green Globes rating system

The Green Globes ecological valuation and rating system developed out of BREEAM, which was carried to Canada as BREEAM Canada for Current Buildings in 1996 [48]. Green Globes is an on-line building and administration audit tool planned for use via architects and builders for several size profitable building that helps to measure the ecological working of their buildings alongside best performs in spaces for example Project Management, Site, Energy, Water, Indoor Environment, Resource, Building Materials, and Solid Waste [47] The primary valuation happens when conceptual design and the final assessment happens when the construction documentation stage happens. Green Globes permits its employers to estimate their systems founded on the quantity of applicable accessible points, possessing the choice of "not applicable" in some groups [51]. Projects that are confirmed and possess attained more than 35% of the points can gain a rating of one to four Green Globes approximately match to LEED Bronze, Silver, Gold, and Platinum ratings, respectively [48].

1.4 Green building Implementation phases

1. Design phase design of Green building can be more difficult than what is normally needed for traditional buildings, bearing in mind that the assessment of alternate systems and substances via the team of design is generally essential. In projects of traditional building, graphic designs that be made of overall and easy thoughts of what the buildings will be like are utilized at the starting of the project procedure. Nevertheless, in projects of green building, a rounded and combined scheme procedure is being utilized right at the beginning of the project as green buildings have several exclusive project structures not normally found in traditional buildings and desired deep addition. The cardinal green building scheme types are separated into three general groups – namely building substances, indoor light, and design in Fig. 7. [37].

![Five major elements of green building design](image)

*Figure 7. Elements of green building design [52].*

2. Construction phase sustainable design practices, generally itemized in green building evaluation systems as LEED, must be carried out by green building projects. Waste management strategy to reduce waste generation at the construction site is one example of these activities. Therefore, the principal contractor and project manager must ensure that building contamination is held to the
minimum by sedimentation of water, monitoring soil erosion, and the generation of aerial dust. For traditional buildings, these issues are frequently ignored [37].

3. The closing out and commission Closing and commissioning a project of green building is commonly harder than a traditional one. In particular, whether the developer wants to seek green certification from third parties, like BREEAM, LEED, or Green Mark. This is likewise the accountability for new facilities management teams and end-users to convey an awareness of green building structures to ensure sustainable growth Fig. 8. Therefore, simple maintenance must be assured [37].

### Table 3. The summary of the Theoretical study for factors affecting the choice of project delivery systems for green building in the construction projects. (Researcher)

| Categories                                      | Factors influencing green building projects                              |
|-------------------------------------------------|-----------------------------------------------------------------------|
| 1. Factors related to the owner or his representative | 1-1. Delaying approval of design drawings and material specifications [37] |
|                                                  | 1-2. Insufficient experience for the owner [55, 41]                   |
|                                                  | 1-3. The resources available to the owner to verify the               |
| 1- Factors associated with the owner | 1. Quality of the design |
|-------------------------------------|-------------------------|
| 1-4. Choose an inefficient design team [44] | 1-4. Choose an inefficient design team [44] |
| 1-5. The ability or desire of the owner to take responsibility for design management [56] | 1-5. The ability or desire of the owner to take responsibility for design management [56] |
| 1-6. The authority of the owner's staff regarding project management [56] | 1-6. The authority of the owner's staff regarding project management [56] |
| 1-7. Hiring an inefficient contractor [54, 44]. | 1-7. Hiring an inefficient contractor [54, 44]. |
| 1-8. Owner's participation in project details (Does the owner want to get full participation in project details)? [57]. | 1-8. Owner's participation in project details (Does the owner want to get full participation in project details)? [57]. |
| 1-9. Existence of a system for training employees at the owner [56, 43]. | 1-9. Existence of a system for training employees at the owner [56, 43]. |
| 1-10. Inaccuracy in costing before signing the contract [33]. | 1-10. Inaccuracy in costing before signing the contract [33]. |
| 1-11. Provides financial liquidity and bank accounts for the owner [55, 43, 37]. | 1-11. Provides financial liquidity and bank accounts for the owner [55, 43, 37]. |
| 1-12. Misunderstanding of the project scope by the owner [55, 54]. | 1-12. Misunderstanding of the project scope by the owner [55, 54]. |
| 1-13. Achieving owner satisfaction in general [43]. | 1-13. Achieving owner satisfaction in general [43]. |
| 1-14. The possibility of cost savings | 1-14. The possibility of cost savings |
| 2- Factors associated with the designer | 2-1. The degree of impact of the complexity of the project [55, 54, 57]. |
| 2-2. Use of advanced modern software to prepare designs [56, 43]. | 2-2. Use of advanced modern software to prepare designs [56, 43]. |
| 2-3. The effect of having previous experience in similar projects [55, 57]. | 2-3. The effect of having previous experience in similar projects [55, 57]. |
| 2-4. Misunderstanding of owner requirements by design team [54]. | 2-4. Misunderstanding of owner requirements by design team [54]. |
| 2-5. There is high monitoring and follow-up in the project [57]. | 2-5. There is high monitoring and follow-up in the project [57]. |
| 2-6. There is a difference between the design plans of all kinds [55]. | 2-6. There is a difference between the design plans of all kinds [55]. |
| 2-7 The flexibility of the project against changes during the construction period [55]. | 2-7 The flexibility of the project against changes during the construction period [55]. |
| 3- Factors associated with the contractor | 3-1 Availability of qualified contractors, subcontractors, suppliers and craftsmen who have sufficient qualifications [54, 43]. |
| 3-2 Repeated change of secondary contractors due to their inefficient work | 3-2 Repeated change of secondary contractors due to their inefficient work |
| 3-4 The disputes of sub-contractors during the implementation period | 3-4 The disputes of sub-contractors during the implementation period |
| 3-5 The contractor does not have the financial ability [43]. | 3-5 The contractor does not have the financial ability [43]. |
| 3-6 Not having developed a project risk management plan [37]. | 3-6 Not having developed a project risk management plan [37]. |
| 3-7 Weak management and supervision on site by the contractor for quality work [37]. | 3-7 Weak management and supervision on site by the contractor for quality work [37]. |
| 4- Contract-related factors | 4-1 The effect of the size of the project on the choice of the method of implementation [54]. |
| 4-2 Use negotiation for the team selection process, and contractual relationships between the owners and project participants [54, 58]. | 4-2 Use negotiation for the team selection process, and contractual relationships between the owners and project participants [54, 58]. |
| 4-3 Legal disputes between the contractor and the owner | 4-3 Legal disputes between the contractor and the owner |
| 4-4 The impact of legal requirements, especially in the construction of public buildings [54]. | 4-4 The impact of legal requirements, especially in the construction of public buildings [54]. |
1.6 Methodology

To achieve the desired objectives of the research, the research methodology is divided into:

1.6.1 Preliminary interviews (open questionnaire)

In this research personal interviews were conducted with a group of experts (six engineers), who have more than fifteen years’ experience in construction projects. They are working in the field of design, planning, management, and execution of the construction projects, in the private and public sector companies. The diversity of expert’s competence and their role in the project was important to ensure that the different aspects of the questionnaire have been reviewed and judged; others suggested inserting a general explanation of the green building and delivery systems in order to clarify the concept generally the participants in the Preliminary interview.

1.6.2 The Final questionnaire

Included a closed questionnaire, and an electronic survey was conducted to collect professional opinions, suggestions, and priorities for factors affecting delivery systems. The target group for the electronic survey was professionals with whom the researcher had difficulty communicating. The survey was conducted in an easy, simple, concise, and focused manner, the following items:

1. Part I: consist of two-part
   1. The first part includes a brief explanation of the green building and delivery systems in construction projects.
   2. The second part is related to the personal information of the respondent about his scientific and professional expertise, experience in the field of green buildings and delivery systems, the role in the institution in which he works, and the specialization of the institution. This information is very important in assessing the importance of the respondent's opinion and his or her scientific and professional knowledge about the answers to the questionnaire.

2. Part II: This section of the questionnaire was for the important assessment of the factors and their effect on the delivery systems. The number of factors is 37 with 5 delivery systems for each. The responder asked to assess the importance by Likert scale in ascending order

3. Part III: This section is about the knowledge level in the field of green buildings, whether theoretical or academic, as well as the number of previous projects and sustainability assessment systems that have been adopted. This information is very important in assessing the extent of knowledge of green buildings and the factors affecting them according to the participant's experience.

1.7 Analysis and Discussion the Questionnaire Form

The next step is to find a specified method for statistical analysis and procedures to perform calculations, using various statistical techniques including Calculate the arithmetic mean for ranking
the answers (AM) the validity, and reliability test analysis (α), The Chi-square test. SPSS for Windows version 25 and MS Excel were the basic software tools used to analyze raw data as (equ.1 – 3).

\[
AM = \frac{\sum (Weight \ Value \times Number \ of \ frequencies)}{Total \ number \ of \ the \ answers} \tag{1}
\]

\[
\alpha = \left[ \frac{k}{k-1} \right] \times \left[ \frac{\sum_2 s}{(s_{sum})^2} \right] \tag{2}
\]

\[
Chi – square(x^2) = \sum_{i=1}^{k} \frac{(O_i-E_i)^2}{E_i} \tag{3}
\]

1-Design- bid- build According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha (α) for the list of factors affecting the green building connection systems in construction projects and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the table if the design -bid -build delivery system is used where the factor (The contractor does not have the financial ability) has a higher effect, followed by (The occurrence of economic crises in the country during the implementation of the project) and followed by (Choose an inefficient design team) Table 4.

| No | The effected factors                                                                 | AM   | S.D  | α    | Effect Level | RII % | Category                  |
|----|-------------------------------------------------------------------------------------|------|------|------|--------------|-------|---------------------------|
| 1. | The contractor does not have the financial ability                                  | 4.17 | .873 | .950 | High         | 83.4  | the contractor             |
| 2. | The occurrence of economic crises in the country during the implementation of the project | 4.17 | 1.152| .950 | High         | 83.4  | Other factors              |
| 3. | Choose an inefficient design team                                                   | 4.15 | .975 | .950 | High         | 83    | the owner or his representative |
| 4. | Hiring an inefficient contractor.                                                   | 4.10 | .955 | .951 | High         | 82    | the owner or his representative |
| 5. | Provides financial liquidity and bank accounts for the owner                       | 4.10 | 1.127| .950 | High         | 82    | the owner or his representative |
| 6. | The effect of having previous experience in similar projects                        | 3.97 | .800 | .950 | High         | 79.4  | the designer               |
| 7. | The disputes of subcontractors during the implementation period                    | 3.97 | 1.073| .950 | High         | 79.4  | the contractor             |
| 8. | Availability of qualified contractors, subcontractors, suppliers and craftsmen who have sufficient qualifications | 3.90 | .981 | .950 | High         | 78.0  | the contractor             |
| 9. | Delaying approval of design drawings and material specifications                   | 3.90 | 1.007| .952 | High         | 78.0  | the owner or his representative |
| 10.| Inaccuracy in costing before signing the contract                                  | 3.90 | 1.107| .950 | High         | 78.0  | the owner or his representative |
According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha (α) for the list of factors affecting the green building connection systems in construction projects Table 5, and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the table if the design-build delivery system is used where the factor(The contractor does not have the financial ability) has a higher effect, followed by (The effect of having previous experience in similar projects) and followed by (The occurrence of economic crises in the country during the implementation of the project).

**Table 5. The green building connection systems**

| No | The effected factors                                                                 | AM   | S.D | α   | Effect Level | RII % | Category                |
|----|--------------------------------------------------------------------------------------|------|-----|-----|--------------|-------|-------------------------|
| 1. | The contractor does not have the financial ability                                    | 4.22 | .891| .937| High         | 84.4  | the contractor           |
| 2. | The occurrence of economic crises in the country during the implementation of the project | 4.15 | 1.075| .936| High         | 83.0  | Other factors            |
| 3. | The effect of having previous experience in similar projects                          | 4.02 | .891| .937| High         | 80.4  | the designer             |
| 4. | Hiring an inefficient contractor.                                                     | 4.00 | .905| .938| High         | 80.0  | the owner or his representative |
| 5. | Choose an inefficient design team                                                     | 3.95 | 1.259| .937| High         | 79.0  | the contractor           |
| 6. | The disputes of subcontractors during the implementation period                       | 3.90 | 1.032| .936| High         | 78.0  | Other factors            |
| 7. | Provides financial liquidity and bank accounts for the owner                         | 3.87 | 1.042| .937| High         | 77.4  | the owner or his representative |
| 8. | Legal disputes between the contractor and the owner                                  | 3.87 | .965| .937| High         | 77.4  | Contract                 |
| 9. | Use of advanced modern software to prepare designs                                    | 3.82 | .812| .938| High         | 76.4  | the designer             |
| 10.| Not having developed a project risk management plan                                   | 3.82 | .902| .937| High         | 76.4  | the contractor           |

According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha (α) for the list of factors affecting the green building connection systems in construction projects Table 6, and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the table if the Turnkey delivery system is used where the factor(The occurrence of economic crises in the country during the implementation of the project) has a higher effect, followed by (The contractor does not have the financial ability) and followed by (The effect of having previous experience in similar projects).

**Table 6. The green building connection systems**

| No | The effected factors                                                                 | AM   | S.D | α   | Effect Level | RII % | Category                |
|----|--------------------------------------------------------------------------------------|------|-----|-----|--------------|-------|-------------------------|
| 1. | The occurrence of economic crises in the country during the implementation of the project | 4.00 | 1.132| .939| High         | 80.0  | Other factors            |
| 2. | The contractor does not have the financial ability                                    | 3.97 | 1.120| .939| High         | 79.4  | the contractor           |
The effect of having previous experience in similar projects

4. Hiring an inefficient contractor.

5. The effect of the size of the project on the choice of the method of implementation.

6. Use of advanced modern software to prepare designs

7. Working to coordinate between all parties to determine the time necessary to provide the materials or services as soon as needed

8. Weak management and supervision on site by the contractor for quality work

9. Inaccuracy in costing before signing the contract

10. Repeated change of secondary contractors due to their inefficient work

4-BOOT. According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha ($\alpha$) for the list of factors affecting the green building connection systems in construction projects Table 7, and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the table if the BOOT delivery system is used where the factor(The occurrence of economic crises in the country during the implementation of the project) has a higher effect, followed by (The contractor does not have the financial ability) and followed by (Hiring an inefficient contractor).

| No | The effected factors                                                                 | AM  | S.D  | Effect | $\alpha$ | RII % | Category            |
|----|-------------------------------------------------------------------------------------|-----|------|--------|---------|-------|---------------------|
| 1  | The occurrence of economic crises in the country during the implementation of the project | 4.07| 1.163| High   | .944    | 81.4  | Other factors       |
| 2  | The contractor does not have the financial ability                                   | 3.85| 1.051| High   | .944    | 77.0  | the contractor      |
| 3  | Hiring an inefficient contractor.                                                    | 3.82| 1.034| High   | .944    | 76.4  | the owner or his representative |
| 4  | The effect of having previous experience in similar projects                         | 3.72| 1.012| High   | .946    | 74.4  | the designer        |
| 5  | Legal disputes between the contractor and the owner                                  | 3.70| .882 | High   | .946    | 74.0  | Contract            |
| 6  | Not having developed a project risk management plan                                  | 3.67| .944 | High   | .945    | 73.4  | the contractor      |
| 7  | The effect of the size of the project on the choice of the method of implementation. | 3.67| 1.047| High   | .945    | 73.4  | Contract            |
| 8  | Availability of qualified contractors, subcontractors, suppliers and craftsmen who have sufficient qualifications | 3.65| .948 | High   | .944    | 73.0  | the contractor      |
5- construction manager. According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha (α) for the list of factors affecting the green building connection systems in construction projects and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the Table 8, if the construction manager delivery system is used where the factor (The occurrence of economic crises in the country during the implementation of the project) has a higher effect, and followed by (The contractor does not have the financial ability) and followed by (Availability of qualified contractors, subcontractors, suppliers and craftsmen who have sufficient qualifications).

Table 8. The green building connection systems

| NO | The effected factors                                                                 | AM  | S.D  | Effect Level | α     | RII % | Category                  |
|----|--------------------------------------------------------------------------------------|-----|------|--------------|-------|-------|---------------------------|
| 1  | The occurrence of economic crises in the country during the implementation of the project | 4.12| 1.042| High         | .947  | 82.4  | Other factors             |
| 2  | The contractor does not have the financial ability                                    | 3.90| 1.057| High         | .948  | 78    | the contractor             |
| 3  | Availability of qualified contractors, subcontractors, suppliers and craftsmen who have sufficient qualifications | 3.75| 1.080| High         | .947  | 75    | the contractor             |
| 4  | Provides financial liquidity and bank accounts for the owner                          | 3.70| 1.343| High         | .947  | 74    | the owner or his representative |
| 5  | Choose an inefficient design team                                                     | 3.67| .997 | High         | .948  | 73.4  | the owner or his representative |
| 6  | The effect of having previous experience in similar projects                          | 3.67| .883 | High         | .947  | 73.4  | the designer               |
| 7  | Working to coordinate between all parties to determine the time necessary to provide the materials or services as soon as needed | 3.67| 1.185| High         | .948  | 73.4  | Other factors             |
| 8  | Not having developed a project risk management plan                                   | 3.62| .896 | High         | .948  | 72.4  | the contractor             |
| 9  | The disputes of subcontractors during the implementation period                       | 3.60| .928 | High         | .947  | 72    | the contractor             |
| 10 | Weak management and supervision on site by the contractor for quality work            | 3.57| .957 | High         | .947  | 71.4  | the contractor             |
green buildings in construction projects as shown in the Table 9, if the project manager delivery system is used where the factor (The occurrence of economic crises in the country during the implementation of the project) has a higher effect, followed by (The contractor does not have the financial ability) and followed by (the effect of having previous experience in similar projects).

Table 9. The green building connection systems

| No | The effected factors                                                                 | AM  | S.D  | Effect Level | α   | RII % | Category          |
|----|-------------------------------------------------------------------------------------|-----|------|--------------|-----|-------|-------------------|
| 1  | The occurrence of economic crises in the country during the implementation of the project | 3.97| 1.097| High         | .928| 79.4  | Other factors     |
| 2  | The contractor does not have the financial ability                                  | 3.82| 1.009| High         | .929| 76.4  | the contractor    |
| 3  | The effect of having previous experience in similar projects                         | 3.72| .933 | High         | .929| 74.4  | the designer      |
| 4  | Inaccuracy in costing before signing the contract                                    | 3.65| 1.144| High         | .928| 73.0  | the owner or his representative |
| 5  | There is a difference between the design plans of all kinds                          | 3.62| 1.004| High         | .929| 72.4  | the designer      |
| 6  | Working to coordinate between all parties to determine the time necessary to provide the materials or services as soon as needed | 3.62| .978 | High         | .931| 72.4  | Other factors     |
| 7  | Repeated change of secondary contractors due to their inefficient work              | 3.60| 1.032| High         | .928| 72.0  | the contractor    |
| 8  | The degree of impact of the complexity of the project                               | 3.57| .930 | High         | .929| 71.4  | the designer      |
| 9  | The flexibility of the project against changes during the construction period       | 3.57| .930 | High         | .930| 71.4  | the designer      |
| 10 | Weak management and supervision on site by the contractor for quality work          | 3.57| .843 | High         | .929| 71.4  | the contractor    |

7-Separate contractor According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha (α) for the list of factors affecting the green building connection systems in construction projects and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the Table 10, if the Separate contractor delivery system is used where the factor (Provides financial liquidity and bank accounts for the owner) has a higher effect, followed by (There is a difference between the design plans of all kinds) and followed by (Repeated change of secondary contractors due to their inefficient work).

Table 10. The green building connection systems

| No | The effected factors                                                                 | AM  | S.D  | Effect Level | α   | RII % | Category             |
|----|-------------------------------------------------------------------------------------|-----|------|--------------|-----|-------|----------------------|
| 1  | Provides financial liquidity and bank accounts for the owner                         | 3.77| 1.208| High         | .962| 75.4  | the owner or his representative |
| 2  | There is a difference between the design plans of all kinds                           | 3.77| .999 | High         | .962| 75.4  | the designer          |
| 3  | Repeated change of secondary contractors due                                        | 3.77| 1.049| High         | .963| 75.4  | the contractor        |
to their inefficient work

4. The contractor does not have the financial ability. The occurrence of economic crises in the country during the implementation of the project. Inaccuracy in costing before signing the contract.

5. High

6. Other factors

7. the contractor

8. Other factors

9. the owner or his representative

10. the owner or his representative

8-FORCE ACCOUNT According to the engineer’s opinion, after using the statistical program (SPSS) to calculate the (AM) and (SD) and the value of Cronbach Alpha (α) for the list of factors affecting the green building connection systems in construction projects and it was concluded that there were (10) key factors who had a high impact on choosing the appropriate delivery system for implementing green buildings in construction projects as shown in the Table 11, if the force account delivery system is used where the factor (Provides financial liquidity and bank accounts for the owner) has a higher effect, followed by (The effect of having previous experience in similar projects) and followed by (The occurrence of economic crises in the country during the implementation of the project).

Table 11. The green building connection systems

| No | The effected factors | AM  | S.D  | Effect Level | α   | RII % | Category            |
|----|----------------------|-----|------|--------------|-----|-------|---------------------|
| 1. | Provides financial liquidity and bank accounts for the owner. The effect of having previous experience in similar projects. The occurrence of economic crises in the country during the implementation of the project. The ability or desire of the owner to take responsibility for design management. Achieving owner satisfaction in general. Choose an inefficient design team. Not having developed a | 3.92 | 1.308 | High | .964 | 78.4 | the owner or his representative |
| 2. | | 3.82 | 1.129 | High | .964 | 76.4 | the designer |
| 3. | | 3.80 | 1.417 | High | .964 | 76.0 | Other factors |
| 4. | | 3.75 | 1.103 | High | .965 | 75.0 | the owner or his representative |
| 5. | | 3.65 | 1.231 | High | .964 | 73.0 | the owner or his representative |
| 6. | | 3.62 | 1.054 | High | .966 | 72.4 | the owner or his representative |
| 7. | | 3.57 | 1.083 | High | .964 | 71.4 | the contractor |
project risk management plan

8. Inaccuracy in costing before signing the contract
   3.55  1.239  High  .965  71.0  the owner or his representative

9. Misunderstanding of the project scope by the owner
   3.52  1.198  High  .964  70.4  the owner or his representative

10. Delaying approval of design drawings and material specifications
    3.50  1.086  High  .966  70.0  the owner or his representative

1.8 Conclusions
The most important results were extracted from this research based on the results of field studies analysis as follows:

1. The most influencing factors in choosing the best method for implementing green buildings are the lack of financial capacity of the contractor, the occurrence of economic crises in the country during the implementation of the project, the selection of an inefficient design team, contracting with an inefficient contractor, the lack of financial liquidity and bank accounts for the owner, possession of previous experience in similar projects, The occurrence of disputes between subcontractors during the implementation period, availability of qualified contractors, subcontractors, suppliers and craftsmen with adequate qualifications, inaccuracy in calculating the cost before signing the contract

2. Engineers working in the construction industry do not have a clear vision of delivery methods and how to choose the appropriate system

3. The lack of a clear vision for the engineers working in construction projects on the issue of green buildings.

4. The most common delivery system for construction projects is a design bid building followed by a turnkey system

5. There is no real system applied in most construction projects to choose the best way to implement green buildings.

6. In most construction projects, coordination between all parties is required in the early stages of the project.

7. Choosing the appropriate project implementation method has a significant impact on the success of task management in the construction project and the high quality, cost and time required to complete the construction project.

1.9 Recommendations
Based on the research results, the following points are suggested as recommendations for the research:

1. Training and qualification of engineering personnel and the conclusion of scientific conferences by the government to increase awareness of the principles of green buildings and the future environmental benefits of green buildings.

2. Increasing government or higher support to implement green building principles in construction projects and providing raw materials for green building projects in the local markets. Moreover, activation of relevant laws and regulations by the government that helps to spread them in construction projects.

3. The use of the latest information and communication technologies in construction projects will contribute to reducing the problems of delivery methods and increasing coordination between all project parties.

4. It is recommended that the project manager, design team and contractor are adequately qualified from the beginning of the construction project life cycle to its end, as it has contributed to the achievement of the project objectives.

5. The necessity of early participation of contractor and suppliers in the project (informally or contractually) at the design stage
6. Emphasize the importance of contracting with subcontractors for mechanical and electrical works to design better performance at lower cost
7. Not only is the experience of a designer and a contractor important, but the role and experience of the owner are crucial as well.
8. Leadership is an important feature of all contracting parties involved in green design projects
9. A well-defined scope of work is important in all green design projects.
10. Adequate funding and budget for a given scope of work are important for green design projects.
11. Project complexity and flexibility are some of the project features most specific to green design projects.

References
[1] Schaufelberger, J. E., & Holm, L. 2017. Management of construction projects: a constructor's perspective. Taylor & Francis.
[2] Bennett, F. 2007. The Management of Construction: A Project Life Cycle Approach, Journal of Chemical Information and Modeling, vol 53. Issue 9, pp. 12-36.
[3] Konchar, M., & Sanvido, V. 1998. Comparison of US project delivery systems. Journal of construction engineering and management, 124(6), pp. 435-444.
[4] Vahid NIKOU GOFTAR1, Mourir EL ASMAR2, and E. B. 2014. Construction Research Congress 2014 ©ASCE 2014 140. Construction Research Congress., 1389-1398.
[5] Trauner Consulting Services, Inc. 2007. Construction Project Delivery Systems and Procurement Practices: Considerations, Alternatives, Advantages, Disadvantages.
[6] Touran, A., Gransberg, D. D., Molenaar, K. R., & Ghavamifar, K. 2011. Selection of project delivery method in transit: Drivers and objectives. Journal of Management in Engineering, 27(1), pp. 21-27.
[7] Francom, T., Asmar, M. E., & Ariaratnam, S. T. 2014. Using alternative project delivery methods to enhance the cost performance of trenchless construction projects. In Construction Research Congress 2014: Construction in a Global Network, pp. 1219-1228
[8] Nassim, M. G., & Mahmoud, E. H. 2009. Managing Airports’ Construction Projects, an Assessment of the Applicable Delivery Systems. In International Conference on Aerospace Sciences and Aviation Technology vol. 13, no. Aerospace sciences & aviation technology, asat-13, may 26–28, 2009, pp. 1-10. The Military Technical College
[9] British Columbia Construction Association manual. 2012. Recommended Guidelines for the Selection of a Construction.
[10] Yates, J. K., & Battersby, L. C. 2003. Master builder project delivery system and designer construction knowledge. Journal of Construction Engineering and Management, 129(6), pp. 635-644.
[11] Neill, A., PMP, P. E., & Leader, M. S. 2011. Compare Risk Allocation for Different Project Delivery Methods in Canada. Conference and exhibition of the transportation association of Canada.
[12] Gajurel, A. 2014. Performance-based contracts for road projects: Comparative analysis of different types, pp7-28, Springer India.
[13] Mahdi, I. M., & Alreshaid, K. 2005. Decision support system for selecting the proper project delivery method using analytical hierarchy process (AHP). International journal of project management, 23(7), pp. 564-572.
[14] Hanna, A. S. 2016. Benchmark performance metrics for integrated project delivery. Journal of Construction Engineering and Management, 142(9), 04016040.
[15] Dessa, A.,2003,Claims in Ethiopian construction industry, a thesis presented to school of graduate studies in partial fulfillment of the requirement of the degree of master of science in civil engineering (structures), Addis Ababa university .faculty of technology
[16] An Investigative Analysis of Skill Sets for Different Delivery Methods in the Building Industry.
[17] Al Khalil, M. I. 2002. Selecting the appropriate project delivery method using AHP. International journal of project management, 20(6), pp. 469-474.
[18] Gransberg, D. D., Koch, J. E., & Molennar, K. R. 2006. Preparing for Design-Build Projects: A Primer for Owners, Engineers, and Contractors, pp1-29, ASCEPress.
[19] Col Debella, D. M. 2004. Construction Delivery Systems: A Comparative Analysis of the Performance of Systems within School Districts, AThesis Submitted to the Graduate Faculty of School of Engineering in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, University of Pittsburgh).
[20] Mesfin, A., 2014, A Study on Construction Contract Risk Management Practices in Ethiopian Building Construction Projects. A Thesis submitted to School of Graduate Studies in partial fulfillment of the requirements of the Degree of Master of Science in Civil Engineering, Addis Ababa University (Construction Technology and Management)
[21] Pakkala, P. 2002. Innovative project delivery methods for infrastructure. Finnish Road Enterprise, Helsinki, 19.
[22] Fetters, D. S. 2000. The Owner’s Level of Effort in Design-Build Contracts.
[23] Raimi, T. I. 2016. Application of Construction Management, Procurement and Project Delivery Systems by Private Housing Developers in Nigeria for Sustainable Development.
[24] Almazroa, D. A. 2004. Project Delivery System Decision Framework Using the Weighting Factors and Analytic Hierarchy Process Methods, AThesis Submitted to the Graduate Faculty of The School of Engineering in partial fulfillment of the requirements for the degree of Doctor of Philosophy, University of Pittsburgh.
[25] AIA. 2007. Integrated Project Delivery: A Guide. American Institute of Architects, 1–62. https://doi.org/10.1016/j.autcon.2010.09.002
[26] Ahola, T., Laitinen, E., Kujala, J., & Wikström, K. 2008. Purchasing strategies and value creation in industrial turnkey projects. International Journal of Project Management, 26(1), pp. 87–94.
[27] Huse, J. A. 2002. Understanding and negotiating turnkey and EPC contracts. Sweet & Maxwell.
[28] Kelley, G. S. 2012. Project Delivery Systems. Construction Law, 39–49. https://doi.org/10.1002/9781118359150.ch4.
[29] Bidding, I. C. 2014. Project Administration Instructions. August, 1–9.
[30] PPDA, 2003. Amendments to the PPDA Law: Execution of Works by Force Account Amendments to the PPDA Law : Execution of Works by Force Account.
[31] Newland, J.G. 1968. Benefits of the Contract Method to County Highway Programs.pp. 186–192.
[32] Bruk, Y. 2019. SCHOOL OF GRADUATE STUDIES Addis Ababa University Addis Ababa Institute of Technology School of Graduate Studies School of civil and environmental engineering.
[33] Molenaar, K., Harper, C., & Yugar-Arias, I. 2014. Guidebook for selecting alternative contracting methods for roadway projects: Project delivery methods, procurement procedures, and payment provisions. Transportation Pooled Fund Program Study TPF-5 (260), 410.
[34] Ohrn, L. G., & Rogers, T. 2008. Defining project delivery methods for design, construction, and other construction-related services in the United States. In International Proceedings of the 44th Annual Conference.
[35] Dahl, P., Hornman, M., Pohlman, T., & Pulaski, M. 2005. Evaluating design-build-operate-maintain delivery as a tool for sustainability. Construction Research Congress 2005: Broadening Perspectives, pp. 1-10.
[36] Bashiri, M., Ebrahimi, S., Fazlali, M., Hosseini, S. J., Jamal, N., & Salehvand, P. 2011. Analytical comparison between BOT, BOOT, and PPP project delivery systems. In sixth International Project Management Conference. At Tehran: Iran.
[37] Hwang, B. G., & Tan, J. S. 2012. Sustainable project management for green construction: challenges, impact and solutions. In World construction conference. pp. 171-9
[38] Doan, D. T., Ghaffarianhoseini, A., Naismith, N., Zhang, T., Ghaffarianhoseini, A., & Tookey, J. 2017. A critical comparison of green building rating systems Dat. Building and Environment, 123, pp.243–260.
[39] Cidell, J., & Beata, A. 2009. Spatial variation among green building certification categories: Does place matter? Landscape and Urban Planning, 91(3), pp.142–151.
[40] Ashuri, B., & Durmus-Pedini, A. 2010. An overview of the benefits and risk factors of going green in existing buildings. *International Journal of Facility Management*, 1(1).

[41] Chan, A. P. C., Darko, A., & Ameyaw, E. E. 2017. Strategies for promoting green building technologies adoption in the construction industry-An international study. *Sustainability* (Switzerland), 9(6), 969.

[42] Yas, Z., & Jaafer, K. 2020. Factors influencing the spread of green building projects in the UAE. *Journal of Building Engineering*, 27, 100894.

[43] Darko, A., Chan, A. P. C., Ameyaw, E. E., He, B. J., & Olanipekun, A. O. 2017. Examining issues influencing green building technologies adoption: The United States green building experts’ perspectives. *Energy and Buildings*, 144, pp.320-332.

[44] Li, Y., Song, H., Sang, P., Chen, P. H., & Liu, X. 2019. Review of Critical Success Factors (CSFs) for green building projects. *Building and Environment*, 158, pp. 182-191.

[45] Gou, Z., & Lau, S. S. Y. 2014. Contextualizing green building rating systems: Case study of Hong Kong. *Habitat international*, 44, 282-289.

[46] Shan, M., & Hwang, B. G. 2018. Green building rating systems: Global reviews of practices and research efforts. *Sustainable cities and society*, 39, pp. 172-180.

[47] Alyami, S. H., Rezgui, Y., & Kwan, A. 2015. The development of sustainable assessment method for Saudi Arabia built environment: weighting system. *Sustainability Science*, 10(1), 167-178.

[48] Michael, B. 2013. Assessment and adaptation of an appropriate green building rating system for Nigeria. *Journal of Environment and Earth Science* Vol, 3.

[49] Sinha, A., Gupta, R., & Kutnar, A. 2013. Sustainable development and green buildings. *Drvna Industrija*, 64(1), 45–53. https://doi.org/10.5552/drdn.2013.1205

[50] Nguyen, T. H., Toroghi, S. H., & Jacobs, F. 2016. Automated green building rating system for building designs. *Journal of Architectural Engineering*, 22(4), A4015001.

[51] Alyami, S. H., Rezgui, Y., & Kwan, A. 2015. The development of sustainable assessment method for Saudi Arabia built environment: weighting system. *Sustainability Science*, 10(1), 167-178.

[52] Fowler, K. M., & Rauch, E. M. 2006. Sustainable building rating systems summary (No. PNNL-15858). Pacific Northwest National Lab. (PNNL), Richland, WA (United States).

[53] Ragheb, A., El-Shimy, H., & Ragheb, G. 2016. Green architecture: A concept of sustainability. Procedia-Social and Behavioral Sciences, 216(6).

[54] Robichaud, L. B., & Anantatmula, V. S. 2011. Greening project management practices for sustainable construction. *Journal of management in engineering*, 27(1), pp.48-57.

[55] Korkmaz, S., Riley, D., & Horman, M. 2010. Piloting evaluation metrics for sustainable high-performance building project delivery. *Journal of Construction Engineering and Management*, 136(8), 877-885.

[56] Bilec, M., & Ries, R. 2007. Preliminary study of green design and project delivery methods in the public sector. *Journal of Green Building*, 2(2), pp. 151-160.

[57] Zhang, J., Li, H., Olanipekun, A. O., & Bai, L. 2019. A successful delivery process of green buildings: the project owners’ view, motivation and commitment. *Renewable energy*, 138, 651-658.

[58] Lipinski, A. R., Horman, M. J., & Riley, D. R. 2006. Lean processes for sustainable project delivery. *Journal of construction engineering and management*, 132(10), pp. 1083-1091.

[59] Korkmaz, S., Horman, M., & Riley, D. 2009. Key attributes of a longitudinal study of green project delivery. In Construction Research Congress 2009: Building a Sustainable Future (pp. 558-567).

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