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Analyzing Performance of Building Projects in Terms of Project Delivery Methods

by

Rana Muhammad Attique Ur Rehman

A thesis submitted in partial fulfillment for the
degree of Master of Science

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This thesis is dedicated to:

My Parents & Teachers

For unwavering support, guidance, and encouragement and driving force behind my academic journey. Thank you for instilling in me the value of education and for being my constant source of inspiration. I am forever grateful for the support.



CERTIFICATE OF APPROVAL

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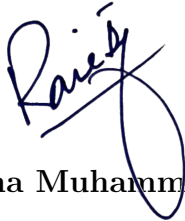
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Acknowledgement

I am dedicating all my thesis work to Allah Almighty, indeed his mercy prevails over his wrath. In addition, to **Muhammad (PBUH)**, the Divine servant Leader, who has changed my life.

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Rana Muhammad Attique Ur Rehman

Abstract

This research explores the impact of various project delivery methods on the performance of the building construction industry. Project delivery methods define the framework for planning, designing, and executing construction projects, influencing factors such as cost, time efficiency, quality, risk management, and stakeholder collaboration. Selecting the appropriate delivery method is crucial, as it determines the roles and responsibilities of all parties involved and affects overall project success. Traditional methods, such as Design-Bid-Build (DBB), follow a linear approach where design and construction are separate phases, often leading to longer project timelines but providing cost certainty. On the other hand, Design-Build (DB) integrates design and construction under a single contract, promoting faster project completion and improved coordination. Alternative approaches like Construction Manager at Risk (CMAR) and Integrated Project Delivery (IPD) emphasize collaboration, risk-sharing, and innovation to enhance efficiency and project outcomes. The research assesses how these methodologies influence key performance metrics, including cost overruns, schedule adherence, quality standards, and sustainability considerations. It investigates how stakeholder engagement, risk allocation, and contractual structures shape project efficiency and long-term viability. Additionally, the study explores emerging trends, such as digitalization and sustainable construction practices, to determine how project delivery methods can evolve to meet industry demands. By analyzing case studies and industry best practices, this research provides insights into optimizing project delivery strategies to enhance the productivity, sustainability, and resilience of the building construction industry. The findings aim to guide industry professionals and policymakers in selecting the most effective delivery methods for different project types, ultimately improving construction performance and economic development.

A thorough literature review is the first step in the research process because it provides an initial grasp of the issue and places the study subject in the context of current knowledge. Finding ways for projects delivery methods to improve the

performance of building projects is the main objective of the study. A questionnaire comprising of 192 experts-clients, CEOs, consultants, contractors, suppliers, architects, and managers from the public and private sectors, was created based on the identified factors of sustainability and stakeholders. The survey was conducted online and the responses were gathered. Then different tests were performed: normality and non-parametric tests using SPSS and Excel. The Relative Importance Index (RII), a non-parametric method was used to assess the data and to evaluate the ranking of the most important parameters for construction project success and the realization of all project delivery methods. The goal of this strategy is to select the suitable project delivery method for building projects.

Finally, the results are that innovation takes top place along with new technology and processes. The second priority is the employee health and safety. The third factor is technology, which boosts production and reduces costs. Capital is the fourth most important factor in ensuring cost overruns. The fifth priority is the diversity and inclusion, which promotes an engaged workforce. Land is the sixth most essential factor for better management, which made it easier to execute corrective actions at the planning and strategy level.

Keywords: PDMs, Design-Build, Design-Bid-Build, Construction Manager at Risk, Integrated Project Delivery, Building Project Performance, SPSS

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Abbreviations and Symbols

BIM	Building Information Modeling
CM	Construction Manager
CMAR	Construction Manager at Risk
DB	Design Build
DBB	Design Build Built
GC	General Contractor
GMP	Guaranteed Maximum Price
IPD	Integrated Project Delivery
PDM	Project Delivery Method
QM	Quality Management
RFP	Request for Proposal
SPSS	Statistical Package for the Social Sciences

Chapter 1

Introduction

1.1 Background

This chapter explores the essential principles of project delivery methods (PDMs) within the construction sector. This examination delves into the evolution of various delivery methods, highlighting their importance and influence on project outcomes. An analysis of various project delivery methods, including Design-Bid (DB), Design-Bid-Build (DBB), Construction Manager at Risk (CMAR), and Integrated Project Delivery (IPD), is conducted to assess their effectiveness in the efficient delivery of construction projects.

This chapter also evaluates the advancements achieved in implementing innovative delivery methods, especially in light of contemporary challenges like heightened project complexity, sustainability demands, and the digital transformation within the construction sector. An in-depth analysis of the advantages and limitations of each method is conducted to assess their appropriateness for various project types and industry requirements.

In recent years, major transformations in infrastructure have been experienced due to the expansion of the construction industry as well as the provision of important services to society in general. There has been an upsurge in the rate of construction activities due to phenomena like an increase in population, an increasing degree of urbanization, and new advancements in technology [2].

These activities range from the construction of infrastructural facilities such as roads, bridges, and airports to housing units and commercial and industrial buildings. As their nature and scale grow, these projects become even more difficult to implement. Problems like quality differences or standard deviations, budget overrun, and schedule slippage have become the norm and compromise not only the financial feasibility of the undertaking but the satisfaction of the project stakeholders too. The conceptual model proposed in this study involves 10 performance metrics. The key performance domains are, client relations, safety, timeline, expenses, quality, financial management, communication and teamwork, environmental impact, efficiency, and stakeholder contentment are recognized as contributing factors to project success, as depicted in Figure 1.1 [1].

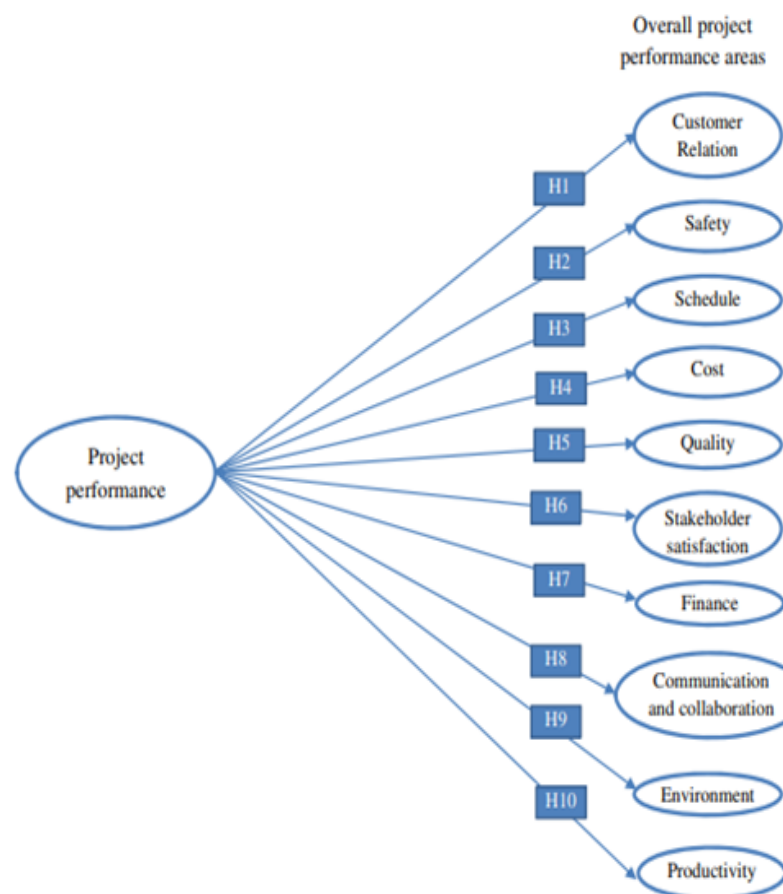


FIGURE 1.1: Conceptual Model of Project Performance matrix [1]

Owing to these problems, the choice of the best project delivery method (PDM) is becoming ever more critical for the success of a project. A project delivery method summarizes the contractual provisions, the organizational setup, and the

procedures for controlling the design or construction stages of the project. Common PDMs are Design-Build (DB), Design- Bid-Build (DBB), Construction Management at Risk (CMAR), Integrated Project Delivery (IPD) etc. Every one of these approaches has different characteristics and practices of project operations, project risk management, and stakeholder participation [4]. For example, the sequential aspect of the process may result in a longer project schedule because each party's contract is completed, creating the need for both the design and construction aspects to be covered, which is usually the case with DBB. In contrast, DB integrates the design and construction process related to the project under one contract. Thus, this may result in a quicker completion of the project, but the exposure of contractors is higher who are constructing the projects [1].

The selection of a specific PDM greatly affects the overall success of construction. Performance in terms of construction project management is evaluated based on four main attributes: stakeholders contentment, cost control, timelines, and compliance with quality standards. Projects completed within the stipulated timeframe, within budgetary allocation, and built according to the required standards more often than not enhance the relationship with clients and other stakeholders of the projects and so add up to the success of the project [3]. However, there is a non-linear correlation in PDM with project performance as certain factors or variables, such as the management approach of the project, come into play. One of the factors that can guarantee the success of construction project management is, project management competence. The word efficiency in project management means the integration of resources in the implementation of activities, organization of efforts, and mitigation of risks throughout the project lifecycle. Successful project management strategies can produce improved communication within the team, better resource management, and more adaptability to unexpected challenges [3]. The efficiencies are often such potential mediators and, as such, will assist in achieving better project output for those objectives that are expected from the particular project delivery method employed.

Cities continue to grow wider, and construction companies build bigger and more complex structures. This warrants the need for specialized approaches to perform and complete large- scale infrastructure projects. Selecting the Project Delivery

Method (PDM), in this case, becomes critical as it extends to the efficiency and the success of the project as well. When PDM is selected, the goals of the project, the resources available, and the risks associated with the various phases of the project are taken into consideration [4]. With the development of construction projects, their complexity keeps on increasing, and thus the need for PDMs that are more adaptable, foster creativity, and control risks are increasingly sought. It is imperative to know these factors to understand how the PDMs ensure the timely execution of projects while meeting the set standards of quality and costs, which aim at the success of construction projects today [5]. More specifically, selecting a particular PDM, can help mitigate some of the issues, such as time overruns, upsurges in costs, and poor construction quality, that are quite common in every other construction project. For instance, Design-Bid-Build (DBB) results in long project duration since the design phase is done separately from the construction phase, while Design-Build (DB) combines the two phases, thereby shortening project durations but with contractors incurring higher risks [5]. Each project delivery method (PDM) has distinct attributes concerning cost management and responsibility, and the nature of these relationships significantly influences stakeholder satisfaction. The level of stakeholder involvement varies across different PDMs, impacting not only their engagement and satisfaction but also the trust between contractors and clients. Selecting an appropriate PDM, therefore, requires balancing effectiveness, accountability, and collaboration.

Figure 1.2 illustrates the flowchart of the Progressive Design-Build (PDB) process. During the programming services phase, the owner and design-builder collaborate on the design, verifying the design-builders program in the RFP, defining the project scope, establishing a preliminary schedule, and identifying key trades. The design may be divided into multiple packages, each with target estimates or budgets. As the design advances, progressive estimates are developed through competitive bids and price negotiations with key trades and suppliers.

At the completion of each design package, the design-builder provides preliminary pricing, enabling early construction starts for completed packages and accelerating overall project completion. Since price negotiations are linked to specific design

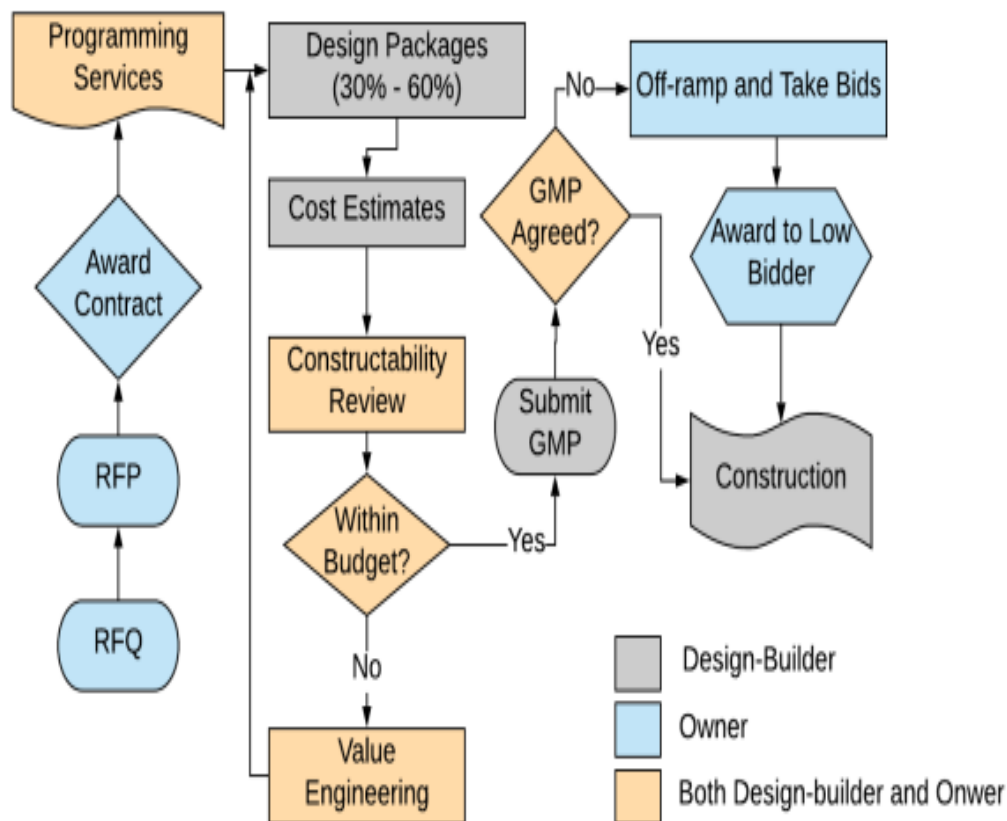


FIGURE 1.2: Progressive design built flow chart [1]

packages and work quantities, the process simplifies progressive estimate preparation by narrowing the scope of each negotiation. Throughout this process, if estimates exceed target budgets, the owner is promptly informed, allowing time for value engineering adjustments. Additionally, this phased approach helps assess and manage risks more accurately for each package.[1].

Changes in the timing of project delivery have forced some more unity in the accomplishment of project objectives; for example, an Integrated Project Delivery (IPD) approach that has early engagement of all stakeholders and the risk and rewards are shared [6][7]. IPD promotes transparency and collaboration [8], addressing problems and disputes with fewer misunderstandings [9]. This method is appropriate for large, complex, and high-value projects [10] where integration of all stakeholders efforts is of utmost importance [11][12]. Construction Management at Risk (CMAR) is another method of PDM [13][14] that has a higher level of control over project budget, but there is still a certain level of trade-off in terms of risk management [15]. Construction managers at risk (CMAR) take a substantial

amount of risk regarding cost and time, which is a good exposure to clients as it guarantees cost and time efficiency.

1.2 Problem Statement

Although there are a variety of project delivery methods (PDMs) available yet construction projects, often face negative outcomes such as schedule delays, exceeding the budget, compromising on quality, and customer dissatisfaction. The one critical thing is that construction professionals often don't understand how different PDMs are related to nature or efficiency introduced to a project, and these dimensions of the project can be very significant. In the fast-paced construction industry, where deadlines and budgets are strict and cannot be reasonably extended, there is little or no historical data to help project Managers and other stakeholders select the right PDM for their projects. Therefore, as there is this uncertainty, poor decisions on the PDM selection criteria are likely to be made resulting in undesirable management practices and wastage of resources. For instance, a project may adopt a PDM like Design-Bid-Build (DBB) whereas the nature of the project is not appropriate for such a PDM, and this could cause communication breakdown and project delays. Conversely, during a low nature project, an IPD method could be employed where more appropriate methods would be enough creating unnecessary headaches and costs.

Due to the complexity of construction projects, standard project management approaches often fall short, highlighting the need for tailored solutions based on scope, technical demands, and legal constraints. However, the impact of project nature on the relationship between Project Delivery Methods (PDMs) and performance remains underexplored. This gap hinders professionals from selecting the most suitable PDM without a guiding framework. This research aims to examine how different PDMs influence project performance, considering project nature as a moderating factor and effective management as a mediator. The findings will support better decision-making, improved outcomes, and greater client satisfaction in the construction industry.

1.3 Research Questions

The following are the research questions:

1. **RQ1:** What effects do various project delivery methods (e.g., DB, DBB, CMAR, IPD) have on the timeliness, cost, quality, and satisfaction of stakeholders of construction projects?
2. **RQ2:** How do project delivery methods impact the effectiveness of project management in scheduling, risk reduction, and resource coordination?
3. **RQ3:** In what ways does project nature act as a moderator in the association between construction project performance and project delivery methods?

1.4 Research Motivation

The construction sector consistently faces challenges such as project delays, cost overruns, quality problems, and difficulties in stakeholder management, all of which substantially affect project outcomes and overall construction industry efficiency. Notwithstanding technological developments and improved management practices, efficient coordination among various stakeholders, adherence to regulations, and risk reduction continue to be essential issues. The selection of suitable Project Delivery Methods (PDMs) is a critical aspect affecting project success, since they establish the framework for the planning, execution, and completion of construction projects. The intended results of these systems are influenced by numerous external and internal elements, such as scheduling limitations, budget management, quality control, and stakeholder involvement. Given these complexities, understanding the strategic alignment between project goals and the chosen delivery method becomes increasingly important. Current gaps in studies evaluating the effectiveness of PDMs in different project environments highlight the need for further investigation. This research provides insights that can guide decision-makers in selecting optimal PDMs to improve overall project performance.

1.5 Overall Objective and Specific Aim

The following are the objectives:

- Examine the impact of various project delivery methods (e.g., DBB, DB, CMAR, IPD) on key project outcomes, including timeliness, cost, quality, and stakeholder satisfaction.
- Analyze how project delivery methods affect project management efficiency, particularly in terms of scheduling, risk mitigation, and resource coordination.

The following are the specific aims:

To investigate the impact of various Project Delivery Methods (PDMs) on essential project performance metrics and to determine best practices that improve project outcomes, reliability, and success.

1.6 Scope of Work and Study Limitations

This study aims to explore the influence of various project delivery methods (PDMs) on the performance of building construction projects. Specifically, it will evaluate methods such as Design-Bid-Build (DBB), Design-Build (DB), Construction Manager at Risk (CMAR), and Integrated Project Delivery (IPD). The performance of these methods will be measured across key parameters, including time, cost, quality, and stakeholder satisfaction. Additionally, the study will investigate how project management efficiency acts as a mediating factor in the relationship between PDMs and construction performance. By addressing these aspects, the research seeks to provide a comprehensive understanding of how different delivery methods impact project outcomes.

Furthermore, the research aims to offer practical recommendations for improving the selection and implementation of delivery methods tailored to various building construction projects. Ultimately, the findings are expected to contribute valuable insights for building construction stakeholders, enabling them to enhance project performance through more effective delivery strategies for building projects.

1.7 Significance of the Study

This is important because it can help in knowledge creation regarding project delivery methods, which are not well explored by scholars, stakeholders, and construction practitioners. Time, money, and quality constraints are always the norm for many projects, and hence, one has to know the impact of the PDM employed on the performance of the project [53]. This research proposes to resolve the conflicting cases considering PDM selection and implementation that construction experts face in their day-to-day practice by understanding how PDMs and project nature relate to project management efficiency. This focused strategy increases the chances of improving project outcomes, which in turn improves the clients and stakeholders satisfaction. Such outcomes may have shorter lead times than before, reduced expenditure, and higher quality deliverables [54].

1.8 Brief Methodology

This study's methodology is meticulously crafted to analyze the impact of project delivery methods on the performance of construction projects, organized into several essential stages. The process initiates with the gathering of data, where primary data is obtained through existing literature, while secondary data is derived through surveys and questionnaires, including journals, articles, and databases like Google Scholar and Science Direct, and Sci-Hub. A thorough literature review is performed to create a theoretical framework, pinpoint research gaps, and comprehend the existing knowledge regarding project delivery methods and their effects on construction project performance. The chosen research topic, "Analyzing the Influence of Project Delivery Methods on Construction Project Performance," is selected due to its importance and relevance in the construction industry, shaping the entire research endeavor. A structured questionnaire is created for data analysis to gather information on project delivery methods, management effectiveness, and project performance. This is succeeded by a pilot survey aimed at validating and refining the instrument. The final survey is disseminated to an expanded group

of construction professionals, and the gathered data undergoes analysis through statistical methods to uncover patterns, relationships, trends, and to rank the influencing factors. Software tools like IBM SPSS Statistics and MS office excel are employed for the purposes of data processing, analysis, and visualization. The findings are outlined, emphasizing the influence of various project delivery methods on the performance of construction projects, and analyzed in relation to the research aims and current literature. Ultimately, suggestions are offered for stakeholders in the construction sector to enhance project outcomes through the selection of suitable delivery methods, accompanied by ideas for future investigations. This organized methodology guarantees a methodical and thorough approach, providing significant insights for both scholarly inquiry and practical application in the industry.

1.9 Thesis Outline

This research thesis is organized into five chapters to lead readers through the investigative process and fulfill the study's aims.

Chapter 1: Introduction presents the background, purpose, and context of the study regarding construction project delivery methods. It details the research goals, scope, limitations, and provides an overview of the methodology employed.

Chapter 2: Literature Review offers an in-depth examination of current studies regarding both conventional and novel project delivery methods, their influence on project outcomes, and highlights deficiencies in the existing body of work, underscoring the significance of project characteristics and management efficiency.

Chapter 3: Methodology outlines the research design, data collection methods, and analysis techniques, emphasizing a quantitative approach to investigate the relationships among delivery methods, management effectiveness, and performance outcomes. **Chapter 4:** Results and Discussion provides an analysis of the findings, examining the impact of various delivery methods on project success, the mediating role of management effectiveness, and the moderating influence of project nature, while also offering comparisons across different project types. In

conclusion, **Chapter 5:** encapsulates the study's findings, presents actionable recommendations for stakeholders in the construction sector, and proposes avenues for future inquiry to deepen the comprehension and selection of the most effective project delivery methods.

Chapter 2

Literature Review

2.1 Introduction

Project outcomes are determined by project management efficiency as well as the intricacy of the project. Factors such as multiple dependencies, technological challenges, varied stakeholder interests, and legal constraints are features of complex projects. Such intricacy may contribute to additional risk levels, which makes it necessary to be able to manage projects exceptionally well [16]. The performance of PDMs may vary concerning the nature of the project; a particular method may prove to be effective for simple projects but inappropriate for complex ones. This risk particularly extends the other dimension of the study as to how PDMs, project nature, and project efficiency altogether influence project performance.

The need to go back and rethink the traditional ways of delivering projects as concerns over sustainability are coming to the fore in the construction industry [17]. However, the construction industry is under pressure to evolve in such a way that more economically efficient, socially responsible, and environmentally friendly techniques are employed. In this regard, it highlights the importance of the selection of the delivery systems [18], which not only achieve the project objectives but also the achievement of wider goals of sustainability [19]. To this extent, Integrated Project Delivery (IPD) is gaining popularity as a collaborative approach that fosters innovation and teamwork, which may lead to better sustainable outcomes. An increasing number of studies address the four aspects of construction

performance quality standards, client satisfaction, resource allocation & risk management and project delivery methods, although the relationship between these factors and the nature of the project and its management has not been adequately explored. Construction professionals wanting to increase project performance and minimize the inherent risks due to the nature of the projects should understand these relationships [20].

Therefore, the purpose of this study is to enhance the knowledge base regarding the impact of different project delivery methods (PDM) on the outcome of construction projects with an emphasis on project nature as a moderating factor and project management efficiency as a mediating factor. This research intends to provide an integrated cognitive schema for comprehending and enhancing construction project performance in the increasingly complex and dynamic paradigm by considering these interrelated factors [12]. To sum up, the selection of PDM has a significant influence on the project outcome performance and general objectives of sustainability and innovations in the construction sector, which is in an interesting phase [16]. As the growth and intricacy of building endeavors increase, it is imperative now more than ever to understand the factors that enable success. Providing the stakeholders of the industry with the tools and the information needed to cope with the demands of modern construction requires investigation into these aspects of project delivery methods and their effects on the efficient supervising of construction activities [19].

2.2 Project Delivery Methods

2.2.1 Design Build Method (DB)

In Design-Build (DB) contracts, the general contractor submits a firm, fixed price based on technical specifications developed by the designer, who is also responsible for the projects design. This integration makes design details a crucial element of the DB process, requiring the contractor to manage the projects schedule and budget while maintaining the required quality standards.

To ensure alignment with budget, technical, and timeline constraints, it is essential for the project owner to provide clear and comprehensive construction requirements in the Request for Proposal (RFP). A key challenge in this model is accurately defining project requirements, including the distribution of quality management responsibilities between the owner and contractor.

Quality management is typically overseen by a specialized entity, often referred to as the Engineer, appointed and funded by the project owner. The Engineer ensures that project quality meets the specifications outlined in the RFP. For project success, collaboration between the Engineer and contractor is crucial in establishing Quality Assurance/Quality Control (QA/QC) plans and a well-defined Quality Management (QM) approach within the bid documents, ensuring a shared understanding of quality expectations among all parties involved. [21] The model of QA for a DB-type construction contract is presented in Fig. 2.1. The design-build

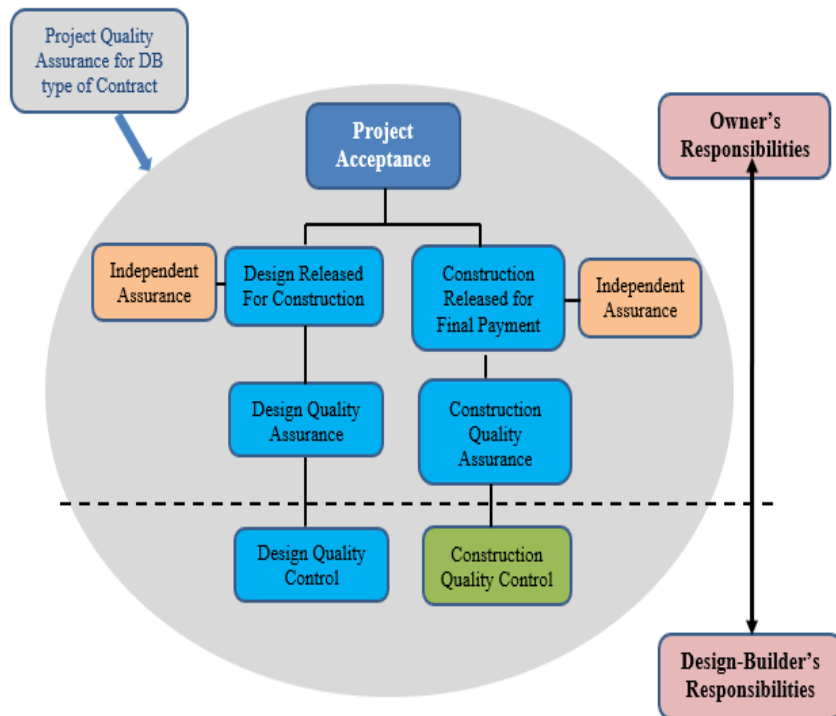


FIGURE 2.1: Design-Build Method [22]

delivery method is becoming more common in many developed countries because of the various benefits it offers to projects. A key issue related to design-build delivery is the procurement method used to select the design-build team. This is a crucial decision that involves several key stakeholders, such as the owner, designer,

and contractor organizations, and requires the owner to make a careful choice regarding which procurement method to use in selecting the team that will execute the project. a quantitative analysis is conducted [17], to examine the relationship between different design-build procurement methods and the performance of design-build projects, focusing on cost, time, and quality metrics. The procurement methods evaluated include sole source, qualifications-based, best value, and low bid selection. Additionally, the research highlights the impact of project-specific factors and guidelines, offering valuable insights to help owners choose the procurement method that best aligns with their project objectives [17].

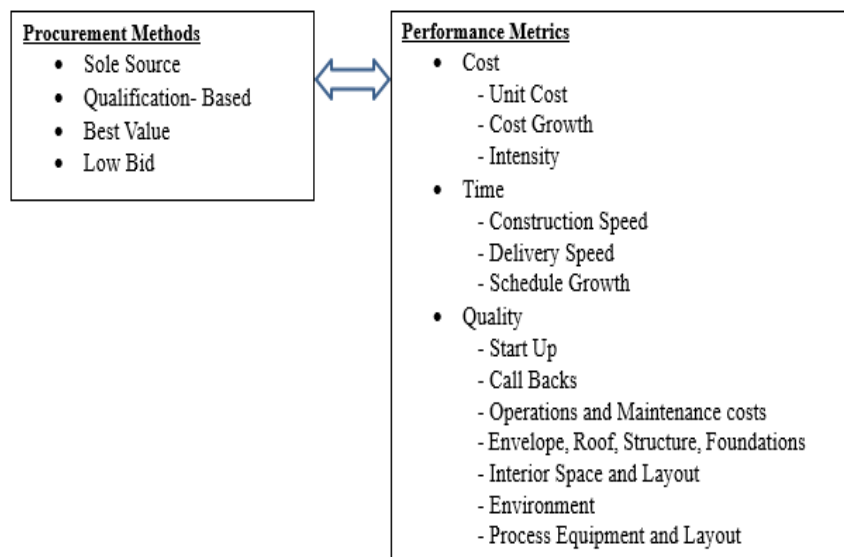


FIGURE 2.2: Primary variables for design-build procurement method study [23]

2.2.2 Design Bid Build Method (DBB)

The Design-Bid-Build (DBB) method is a traditional construction project delivery approach where the process is divided into three sequential phases: design, bidding, and construction. First, the owner hires a designer (architect or engineer) to create complete project plans and specifications. Once the design is finalized, it is put out for competitive bidding, and a contractor is selected, often based on the lowest responsible bid. The contractor then constructs the project strictly according to the design documents. This method offers clear roles, competitive pricing, and strong control over the design but can be time-consuming and may

lead to challenges if changes are needed during construction. The DBB method provides a structured, transparent process where the owner maintains control over the design and contractor selection. However, its sequential nature and lack of early collaboration between designers and builders can introduce challenges in terms of time, cost, and efficiency.

The Design-Bid-Build (DBB) contract process follows a sequential approach, starting with the design phase, followed by bidding (or tendering), and concluding with construction. The owner or their representatives such as a consultant or engineering firm oversees the project, and a separate consulting firm may be appointed for construction supervision.

During the bidding phase, the architect and owner coordinate to finalize bid documents, which are then released to general contractors (see Fig. 2.3). The owner retains overall responsibility for design quality assurance. In the construction phase, quality assurance may either remain under the owners control or be assigned to an independent engineer responsible for supervising construction to ensure compliance with quality standards, budget, and schedule.

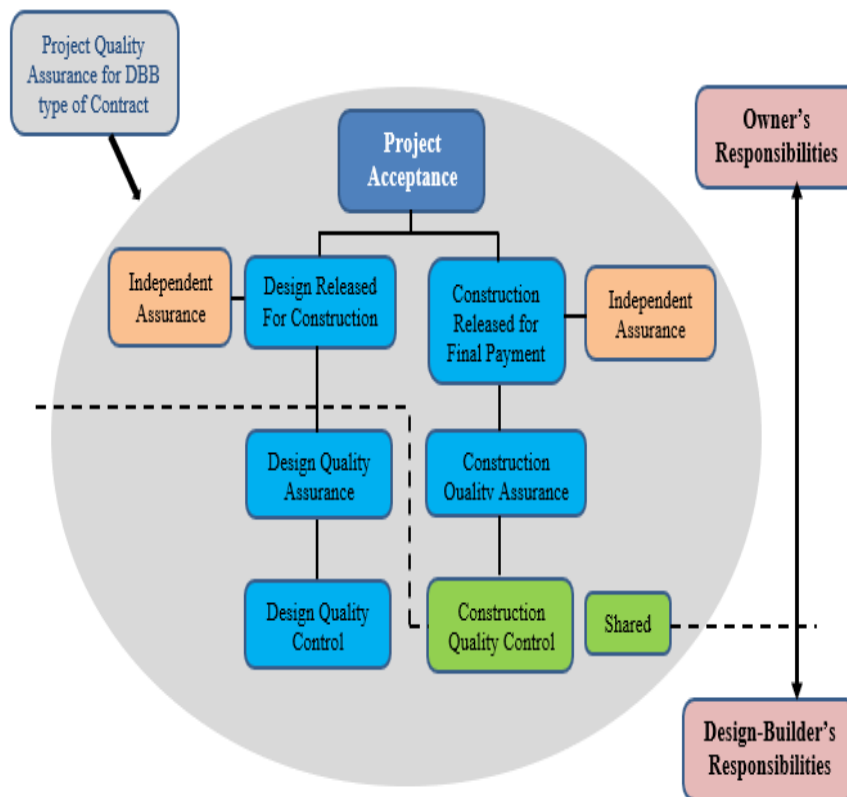


FIGURE 2.3: Design-Bid-Build Method [23]

This independent engineer's role may extend into the defect notification period, typically lasting 12 to 24 months after project completion. During this period, any major construction defects that arise fall under the contractors warranty obligations, ensuring the work aligns with the original design and specifications [21].

2.2.3 Construction Manager at Risk (CMAR)

The Construction Manager at Risk (CMAR) method is a collaborative project delivery approach where the construction manager acts as both a consultant during the design phase and the general contractor during construction. The owner hires the Construction Manager (CM) early in the project, often before the design is fully complete, to provide preconstruction services such as cost estimation, constructability reviews, and scheduling. Once the design is finalized, the CM commits to delivering the project within a Guaranteed Maximum Price (GMP), which limits the owners financial risk while providing flexibility in project execution.

In the preconstruction phase, the CM works closely with the designer and owner to identify potential issues, optimize construction methods, and refine the budget. This collaboration ensures that the design aligns with the projects budget and schedule. The CM also handles subcontractor bidding and selects trade partners, often with input from the owner. By being involved early, the CM helps reduce design conflicts, minimize delays, and improve cost predictability.

During the construction phase, the CM transitions into the role of the general contractor, managing day-to-day construction activities, subcontractors, and overall project execution. The CM assumes the risk of delivering the project on time and within the agreed GMP. Any costs exceeding the GMP are the CMs responsibility unless caused by changes requested by the owner or unforeseen conditions.

The CMAR method offers several advantages, including early cost certainty, enhanced collaboration, and reduced risk of change orders. It is particularly suitable for complex projects where the owner values input during the design phase and needs assurance of cost control. However, it can sometimes result in higher upfront

fees compared to traditional methods and requires careful selection of a qualified construction manager to ensure project success.

In the 1970s, concerns arose among project owners regarding the effectiveness of the Design-Bid-Build (DBB) delivery method in delivering optimal value, leading to the adoption of the Construction Manager at Risk (CMAR) approach. CMAR integrates the expertise of both a construction manager (CM) and a traditional general contractor (GC). Under this model, the owner signs separate contracts with the CM and the designer. The CM assumes responsibility for the construction while managing trade contracts [24].

The CM is selected through a best-value process before the completion of construction documents and becomes a key member of the project team. During the design phase, the CM is compensated for services such as schedule oversight, cost control, constructability analysis, project management, technology guidance, and assistance with bidding and contract negotiations [25]. Figure 2.4 illustrates the CMAR delivery method, highlighting the contractual relationships and enhanced communication between the owner, designer, and CM.

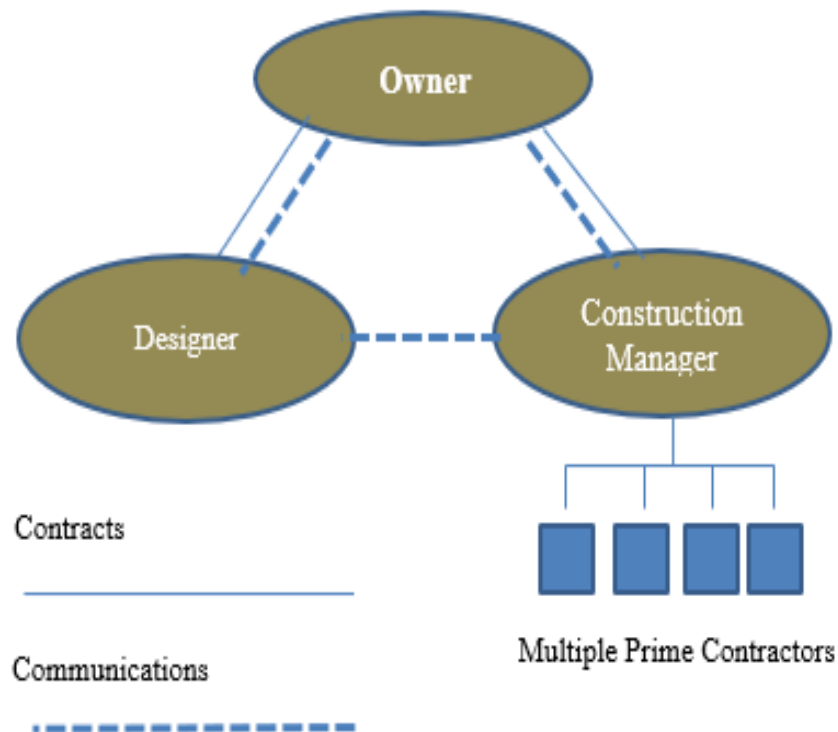


FIGURE 2.4: Construction Manager at Risk [25]

Construction Manager at Risk (CMAR) has proven to be an efficient delivery method, enabling earlier project completion compared to the Design-Bid-Build (DBB) approach. A study by [26] reported that CMAR can reduce schedule duration by 15% to 20%, leading to savings on general conditions, interest carrying costs, and allowing for early occupancy. Although starting construction before design completion may increase the Guaranteed Maximum Price (GMP) or contingency, these risks can be minimized through enhanced communication and early collaboration between the construction manager and the designer. CMAR is specifically designed to involve the construction manager in the preconstruction phase, mitigating risks and maximizing cost savings when they are most achievable.

2.2.4 Integrated Project Delivery (IPD)

Integrated Project Delivery (IPD) is a collaborative approach to construction project management that seeks to optimize efficiency, improve outcomes, and foster a shared sense of responsibility among all stakeholders involved. Unlike traditional project delivery methods, where each party operates largely within its own silo, IPD brings together owners, architects, engineers, contractors, and other key participants under a single contract. This unified agreement encourages transparency, open communication, and a focus on achieving collective goals, such as minimizing costs, enhancing quality, and delivering projects on time.

A core feature of IPD is its emphasis on early involvement of all stakeholders. By engaging key players from the outset, the team can collaboratively define project goals, address potential risks, and identify innovative solutions. This approach allows for better alignment of priorities, as decisions are made with input from all parties, leading to reduced waste and improved resource allocation. The use of modern tools like Building Information Modeling (BIM) is often integral to IPD, as it facilitates seamless coordination and real-time sharing of project data. IPD also promotes a shared risk and reward model. Instead of assigning blame for delays or cost overruns, all parties are incentivized to work together to resolve issues.

Success is measured by the overall performance of the project rather than individual contributions, fostering a culture of trust and mutual accountability. This collaborative spirit is further reinforced through contractual arrangements that tie compensation to achieving project milestones, encouraging every participant to strive for excellence.

By breaking down traditional barriers and emphasizing teamwork, Integrated Project Delivery has proven to be particularly effective in complex, high-stakes projects. It reduces inefficiencies, enhances innovation, and delivers greater value to owners while ensuring that all stakeholders are fully invested in the projects success. However, adopting IPD requires a cultural shift and a willingness to embrace new ways of working, which may pose challenges for organizations accustomed to conventional practices.

Project team integration involves bringing together various disciplines or organizations, each with its own goals, requirements, and cultures, to create a unified, cohesive, and mutually supportive team. In the construction industry, integration often refers to collaborative working methods, behaviors, and practices that foster an environment where knowledge can be openly shared among all stakeholders. In an integrated team setting, the traditional barriers between the design process and construction operations are either eliminated or minimized, leading to more efficient project delivery [25].

A growing approach to contracting in construction projects is Integrated Project Delivery (IPD). This method emphasizes collaboration, trust, respect, and teamwork among the various contracting organizations involved in the project. For IPD to be effective, it is crucial that all the organizations work together to form a strong, integrated team. This team should be focused on achieving the projects goals while supporting each others performance. In some cases, this requires a significant cultural shift in an industry where companies traditionally prioritize their own interests. To ensure the success of IPD, the team must stay aligned with the projects objectives, allowing all parties to maximize the benefits of this collaborative approach [26]. Figure 2.5 illustrates the integrated project team that

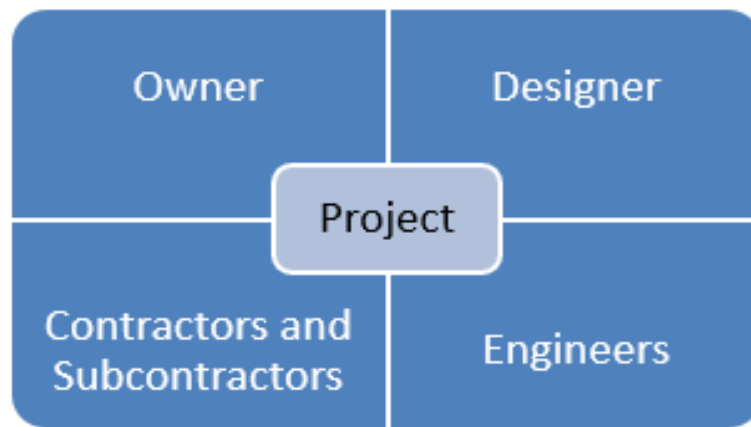


FIGURE 2.5: Typical Contractual Framework of IPD [26]

IPD aims to create. IPD predominantly seeks to abolish the silo effect created by other project delivery methods.

The key characteristics of IPD can be identified as (i) a multi-party agreement, (ii) early integration of key project participants, shared risks and rewards through an incentive pool, (iv) waiver of liability by key participants, and (v) focus on project goals above individual goals.

2.3 Main Variables

There are those elements which are considered as key performance indicators, these deliverables are aimed at achieving the overall goals of the project by finishing it as scheduled, managing different costs, assuring quality and satisfaction of the stakeholders. However, it is worth noting that each of these variables is intricately intertwined with the project delivery method (PDM) selected, hence may produce different results.

2.3.1 Cost Efficiency

Cost efficiency is the degree to which a project is able to make payments and manage the resources within the confines of the set budget. The risk of substantially exceeding expenditures is equally low owing to the effectiveness of PDMs in minimizing costs, waste, and additional expenses not anticipated. For example, the

collaborative approach embedded in Integrated Project Delivery (IPD) encourages cost officials to address and solve programmatic limitations early through risk and reward sharing [27]. In contrast, the Design- Bid-Build (DBB) approaches are usually excess in costs owing to the time wastage in resolving disagreements and plans that are not comprehensive in nature.

2.3.2 Time Performance

Time performance reflects the respect within the project timeline set and its milestones. Some construction projects have season delays that are caused due to unpleasant fragmentation of processes, communication barriers, and external environmental factors. As PDMs develop, new ones such as Design - Build (DB) integrate the two phases together and have a shorter time span [28]. For instance, the Construction Manager at Risk (CMAR) technique provides relevant scheduling and forecasting thereby minimizing uncertainties. Sequential time delays of the design-during-construction approach are often their proper management with project designs and implementations run separately.

2.3.3 Quality Outcomes

The deliverables have the quality and completeness that is also important for the success of construction. We can talk about quality outcomes as about measures that determine the specified functionalities of the project technical needed capabilities and the demands from the client. Quality issues are continuous with modern ways of PDM where IPD and CMAR are focused on integrating people throughout the projects to avoid conflicts at the last minute [29]. However, at times design - build methods may not be that successful due to time constraints at the costs of quality where DBB is widely known for that due to the fact that quality is embedded in design, to begin with.

2.3.4 Stakeholder Satisfaction

Stakeholder satisfaction is one of the most important, if not the greatest, indicators of project achievement in that it gives measures as to the extent the outcomes of

the project meet the expectations of the clients, Contractors and other key parties that were involved in the given project. Under such circumstances, the effective PDMs are capable to bringing about improvement in stakeholders satisfaction, as they are able to ensure transparency, collaboration and effective communication during all the stages of the project [29]. For instance, IPD models focus on shared vision and inclusive decision-making leads to better satisfaction. On the contrary, the fragmented part of perceived DBB incorporates a part of disputes which are then considered to have been caused by unmet expectations causative of poor stakeholder relationships. By defining and assessing these variables, stakeholders are able to choose the best appropriate PDM in relation to their construction project objectives and minimization of risks.

2.4 Factors Influencing the Performance of Construction Projects

This section aims to expand on the factors that determine the effectiveness of project delivery methods in construction, something that has been mentioned in this survey already and in previous studies. These factors not only determine the most favorable PMD but also determine how well the projects will be completed.

2.4.1 Choice of Project Delivery Methods

The choice of PDM is one of the most important factors that determines the outcome of the project for different project the PDM selected is different. According to [30], conventional methods such as Design-Bid-Build (DBB) are appropriate for projects with detailed designs while Integrated Project Delivery (IPD) is most appropriate for projects that are highly collaborative. This selection is often made with respect to the project characteristics like its level of complexity, the number of parties involved and the main objectives of the project.

2.4.2 Flexibility of Delivery Method

Performance improves as PDMs are adjusted to fit project conditions. fixed delivery methods often risk not solving such issues where they are supposed to be

addressed because of ambiguity while CMAR, a more flexible method, is better suited to the logic of design changes and growing scopes of the project [30].

2.4.3 Cost Performance

Cost performance is another parameter which ought to be analyzed in efforts towards gauging the success of PDM owing to its bearing on the budgetary considerations. As [30] suggest, collaborative methodologies such as IPD improve costs through optimization of resource allocation and risk sharing. On the other hand, the conventional approaches usually result in excessive expenditures because of disintegrated processes.

2.4.4 Schedule Performance

The timely completion of projects is paramount in guaranteeing the satisfaction of stakeholders. According to [31], PDMs which combine the design phase with construction, such as Design-Build (DB), tend to cut on the delay and are adhered to the schedule better. On the contrary, the reliance on sequential approaches like DBB tends to be associated with chronic delays on schedules owing to delays in design approval and selection of the contractors.

2.4.5 Quality Standards

The ability to meet the requisite construction quality standard is one of the key criteria for performance evaluation. [31] claim that in the case of PDMs designed around integration of different phases of a project, such as IPD, there was a better quality of the end product [32] that is achieved through setting out the project objectives in detail and coordinating them to the technical requirements Sequencing and Scheduling Tools for Construction Project Delivery Systems.

2.4.6 Client Satisfaction

Building client satisfaction relies on the coherency of the project outputs with the expectations of the clients. There is evidence that collaborative delivery methods

bring about improvement in level of satisfaction by fostering transparency and active client involvement across all the stages of the project [33].

2.4.7 Risk Management

Risk management is one of the major aspects which determines the performance of the PDMs. [34] note that early risk identification and its allocation, as in CMAR, dramatically decrease uncertainties. But traditional systems, interestingly, have difficulty in risk sharing which leads to conflicts and delays in projects.

2.4.8 Communication Efficiency

Effective and simple communication of all the stakeholders is a big guarantee for the success and completion of the project. [35] present evidence that PDMs which bolster the input of stakeholders on the project management decisions and for example the Integrated project delivery (IPD), help in improving communication and reducing misunderstandings. While mismatched expectations are sometimes the case - as chaos theory suggests in fragmented approaches.

2.4.9 Resource Allocation

Redeploying resources makes it necessary to be able to be efficient and save on costs when delivering a project. According to a study carried out by [36], PDMs which utilize Building Information Modeling (BIM) improve the efficiencies of the projects since such tools facilitate better resource planning and even help decrease wastage.

2.4.10 Team Collaboration

The degree of collaboration exhibited by project teams is also a factor in the success of the PDMs. According to [37], when integrated methods are applied, team working becomes a way of resolving issues in a project and this in turn leads to

better project performance. On the other hand, all traditional systems that have isolated processes in the workflow have a tendency of creating silos and hence inhibit the collaboration. These elements, taken from the literature, give a good insight into the relationships that exist between PDMs and construction project performance. Moreover, by including them in project planning and implementation, better results can be achieved and stakeholders satisfied.

2.5 Previous Work-related

This table synthesizes several investigations that have studied the determinants of construction project performance under different Project Delivery Methods. It provides insight into the important aspects and their treatment in earlier studies.

2.6 Tools and Methods to Address Factors

As noted by the Project Management Institute, effective management plan activities for construction include planning, inspection, an evaluation system, and control. These are closely related to the choosing and implementation of Project Delivery Methods (PDMS) that define performance measures. Several scholars have employed PDM as a factor in construction performance by research methods such as surveys, case studies, and comparative analysis to collect data from the experts or active players within the industry. Often, to evaluate such factors as Project Delivery Method Type or Cost Performance, a survey questionnaire allows for such assessments. Such factors are measured on an ordinal scale (e.g., 1-5), and statistical analysis of the collected data is done using SPSS software. To gauge the significance of each variable, a Relative Importance Index (RII) approach is used. This method averages the responses returned from the respondents, and the respondents were asked to rate the most important factor and the least important based on the rating scores.

These ratings and rankings can be very useful since they allow Project managers to focus on the most critical factors that are likely to contribute maximally to

TABLE 2.1: Literature Study

Sr. No.	Author	Year	Title	Country	Factor
1	[38]	2021	Analyzing the Impact of Project Delivery Methods on Construction Project Performance	Uganda	Choice of Project Delivery Methods, Cost Performance, Schedule Performance, Client Satisfaction, Risk Management, Team Collaboration
2	[39]	2020	The Influence of Project Delivery Methods on the Performance of Construction Projects	Egypt	Flexibility of Delivery Methods, Risk Management, Communication Efficiency, Resource Allocation
3	[40]	2019	Comparing the Effectiveness of Project Delivery Methods in the Construction Sector	USA	Cost Performance, Schedule Performance, Risk Management, Quality Standards
4	[41]	2018	An Overview of the Impact of Project Delivery Methods on Construction Performance	Iran	Client Satisfaction, Risk Management, Communication Efficiency, Team Collaboration
5	[42]	2017	The Role of Project Delivery Methods in Achieving	South Korea	Flexibility of Delivery Methods, Schedule Performance, Resource Allocation, Communication Efficiency
6	[43]	2016	The Role of Project Delivery Methods in Achieving High-Quality Outcomes in Construction Projects	Singapore	Quality Standards, Client Satisfaction, Team Collaboration, Communication Efficiency
7	[44]	2015	The Impact of Project Delivery Methods on Construction Project Risk Management	Jordan	Risk Management, Flexibility of Delivery Methods, Resource Allocation, Cost Performance
8	[45]	2014	Project Delivery Methods and Their Effects on Cost and Schedule Performance	Australia	Cost Performance, Schedule Performance, Resource Allocation, Client Satisfaction
9	[46]	2013	Analysis of Project Delivery Methods in the Construction Sector	UK	Team Collaboration, Communication Efficiency, Cost Performance, Schedule Performance
10	[47]	2013	Evaluation of Project Delivery Methods for Sustainable Construction	Canada	Risk Management, Schedule Performance, Quality Standards, Team Collaboration
11	[48]	2012	The Effect of Project Delivery Method on Team Collaboration in Construction Projects	Singapore	Team Collaboration, Client Satisfaction, Resource Allocation, Cost Performance
12	[49]	2011	The Role of Project Delivery Methods in Achieving Successful Construction Outcomes	China	Cost Performance, Risk Management, Schedule Performance, Quality Standards

the success of the project, thus enhancing the selection of PDMs and the project delivery system.

2.7 Gap Analysis

There is a wide acceptance within the construction industry that PDMs are successful enablers of the successful completion of a project. However, little has been researched on how various PDMs relate to project management efficiency and project nature in determining the performance of a construction project [50]. Past research has rather concentrated on the direct impacts of the PDM on time, cost, and quality, ignoring how the efficiency of the project management acts as a mediating factor between these delivery methods and the project outcomes. Specifically, why some PDMs are more effective than others and how appropriate project management activities such as resource use, involvement of stakeholders, and so on may enhance performance [51]. Changeable characteristics such as project nature, which includes technical complexities, scope, and regulatory requirements, have been considered to be a qualitative metric that influences the performance of a project, but studies have not adequately looked at how much nature influences the scope and level of performance projected from PDM. This is important considering that however well the delivery method detaching its constraints is designed, poor management of the project will still botch the project. On the other hand, appropriate management of projects can also help in overcoming the disadvantages posed by the PDMs, which are not optimal and hence give fruitful results to the projects. Consequently, there is an urgent requirement for construction professionals to grasp the interplay among PDMs, efficiency in project management, and the nature of a project in the drive for improved project performance [52].

2.8 Proposed Research Model

Fig 2.6, the research model elaborates the impact of project delivery methods on building projects performance with a moderate role of project nature & research mechanism. Every project starts with its various nature and type having a big impact of environmental and regulatory challenges. Selection of PDM is very critical

depending upon the nature and complexity of the project. It is more described in next steps which are interrelated, comprising of project management tools, begins with the coordination of resources and followed by risk management strategies, competency and dynamics of project team. At the same time the characteristics of PDM such as flexibility, schedule performance and quality standards govern this interrelated mechanism. The whole process is correlating and have great impact on each other. The complete process analyzing the performance of building projects in terms of PDM is comprehensively described.

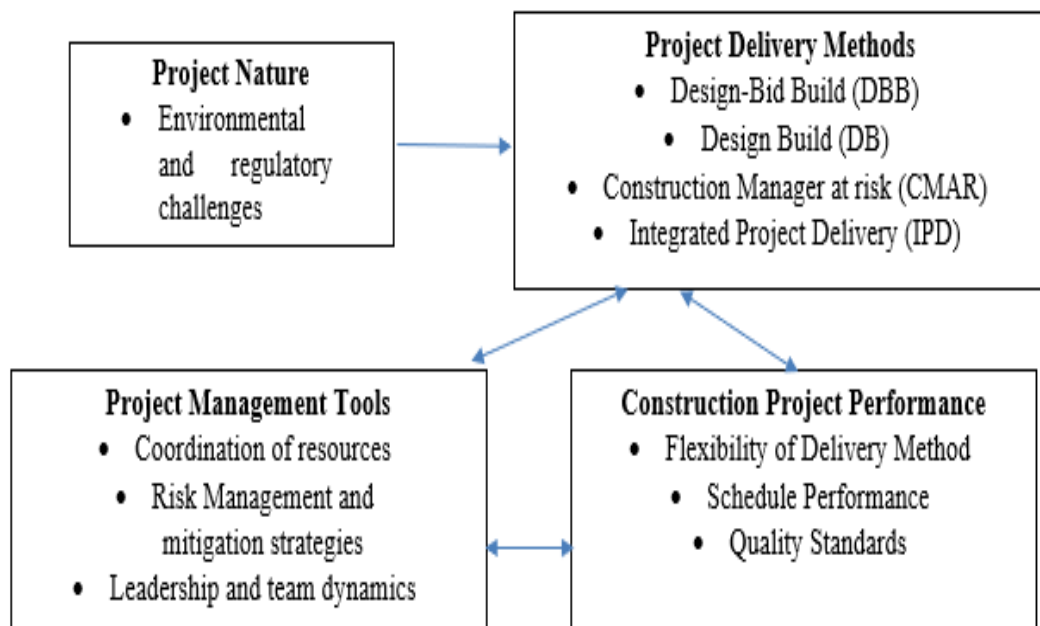


FIGURE 2.6: Research Model for Analyzing Project Performance w.r.t Delivery Methods [51,52]

2.9 Summary

Extensive literature review explores the factors which including multiple dependencies, technological challenges, varied stakeholder interest and legal constraints increase the complexity of building projects. The selection of appropriate PDM from well practicing methods depending upon the nature of project is very important because it significantly influence the success of building projects impacting the cost, schedule, quality and stakeholder satisfaction. regarding performance on the delivery of construction projects based on the methods of prosecution employed

above highlights the assumptions of the investigational unit regarding factors that affect project performance, such as cost, time, quality, client satisfaction, risk, and team interaction. The literature cited in this study explains that project success relies heavily on choosing the right delivery method, each offering distinct advantages and challenges in terms of cost, time, quality, and collaboration. SPSS approaches have been adopted to determine and rank the performance measures that have been designed to limit ambiguity and enhance decision-making in the construction sector. The review further showed that the employment of these techniques results in enhanced and more objective assessment of construction project delivery methods, which in the end improves the success rate and the efficiency of the execution of construction projects.

Chapter 3

Research Methodology

3.1 Background

This chapter defines the methodical strategy employed to tackle the research challenge and fulfill the study's objectives. Research methodology is an essential component of any study, offering a systematic framework that directs the complete process of data gathering, analysis, and interpretation. This chapter provides a detailed account of the research process, commencing with the selection of the suitable study design and the identification of the principal components affecting the phenomenon being studied. This chapter explains the method used to establish the sample size and outline the demographic traits of the participants. After that, it looks at the questionnaire development process, outlining how the survey tool was created to gather crucial information on the relevant factors. This chapter also describes the methods for gathering and analyzing data, ensuring that the approaches are suitable for solving the research challenge. The research technique underpins the study by connecting the research design with its aims and objectives, so ensuring that the findings are credible and significant. The methodology facilitates the researcher in describing, evaluating, and predicting the phenomena under investigation using a structured approach, while also guaranteeing transparency and reproducibility in the process. This research outlines methodologies that address the specific issues of the construction industry, emphasizing their ability

to yield significant insights regarding sustainability and stakeholder engagement factors.

3.2 Research Design

To understand how construction projects perform under various project delivery methods, this research adopts a comprehensive mixed-methods approach. The initial phase of the study consists of a qualitative investigation through an extensive literature review, aimed at identifying the core factors that influence project performance. This thorough examination of existing research helps establish a strong theoretical foundation for the study.

Following the qualitative phase, the research proceeds to a third phase, which is quantitative in nature and involves the development and administration of a structured questionnaire. The Delphi technique is employed during this process to refine the questionnaire and enhance its validity through expert consensus. The data collected from this instrument is then systematically prioritized and analyzed using the Statistical Package for the Social Sciences (SPSS), enabling the identification of patterns and correlations.

This sequential exploratory strategy is designed to provide both depth and breadth in understanding the relationship between project delivery methods and project performance. By combining qualitative and quantitative insights, the study aims to generate practical recommendations for improving project outcomes and supporting decision-making processes in the construction industry.

3.3 Preliminary Investigation

The initial phase of this study aimed at establishing the link between the methods used in the delivery of a project and the performance of construction projects. In particular, A systematic literature review was carried out with an understanding of factors that affect the performance of projects across different delivery systems such as Design-Bid-Build (DBB), Design-Build (DB), and Construction Manager

at Risk (CMAR). Industry reports and studies obtained from various regions are explicated to illustrate the background of the study. Informal interviews were also undertaken to seek the opinions of experts on the relevance of these factors in construction practice today. This initial investigation set the stage for the conceptualization of the research purpose and the research methods to be employed in the study.

3.4 Research Methodology: Analyzing Performance of Building Projects through Project Delivery Methods

In this methodology, the relationship between the project delivery methods and the performance of building projects is established in a certain way. The Literature Review is the first research activity and it aims to find out what is known and what has been theorized about the selected topic. Following this, expert consultations and a structured questionnaire based on the Delphi technique are used for data collection. The gathered data are then analyzed quantitatively through the SPSS, which is used to rank factors that are determinants of project success. Afterwards, the results are discussed and a Framework is proposed with the aim of changing the way industry has been working in the future.

3.5 Questionnaire Design

Two to three rounds of Delphi technique are performed with the help of experienced professionals from the construction industry to come up a questionnaire. This team with the help of the professionals deleted and validated the factors identified through the literature review and thus ensured that the factors are accurate and relevant in the evaluation of how project delivery techniques affected the performance of construction projects. A Delphi technique is employed first to come up with the evaluation model specifically tailored towards assessing building

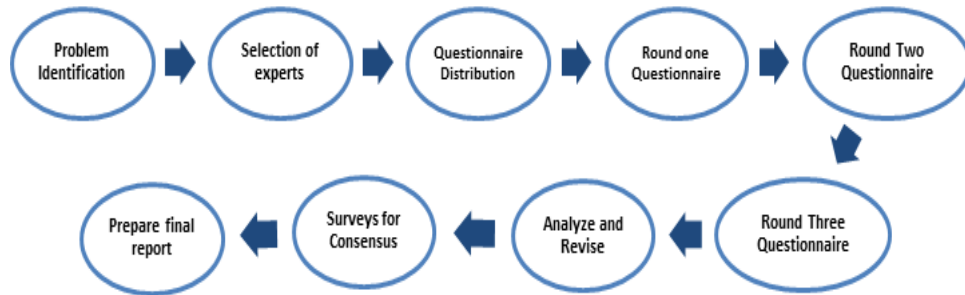


FIGURE 3.1: Delphi Process [55]

projects based on the PM delivery techniques employed in the PMC. As with most approaches Delphi uses a multi stage process whereby interactions with experts in the area of interest are done in successive rounds. [55] and other studies reviewed identified the key areas which influence the outcome of building projects as the delivery approaches used in the respective countries such as Middle East and non-Western nations and traditional approaches like Design-bid-build. Factors identified by [55] and recently [56] in their studies include among others cost, time, quality, stakeholder management and success of a project.

These differences were validated and refined using the Delphi technique. This technique is known for its ability to reach a consensus through the use of a group of experts, and according to [56] and [13] it is pertinent as it allows the selection of the most pertinent factors through well-structured feedback from experts in the area over several rounds. Further, a panel of experts in building project management and project delivery methods was constructed. The experts were given an option to thoroughly consider factors reviewed in the first round and confirmed their relevance in building project performance in terms of literacy and application in that context. Factors which resulted in such questions were modified or deleted and new questions corresponding to the industry were formulated [13]. The questionnaires were recast and rounds were continued and proposed that the experts re-evaluate the elements from the questionnaires on each round using the modified version of the documents. This procedure continued until every expert acknowledged the importance of all elements and a final questionnaire was agreed

that incorporated the most important elements in their opinion regarding project performance [56]. The validated version of the survey instrument and respondents answers, obtained through the Delphi techniques, provided a robust framework for considering the influence of various systems of construction organization on project success within the recommended guidelines and limits of industry rational [57].

3.5.1 Development of Factors

We considered a complete approach including expert opinions and exhaustive literature review as the means for selecting the factors for our research. At first, according to the previous studies devoted to building project performance and building project delivery systems potential factors were identified. After this, we communicated with a number of construction professionals by means of emailing and sending printed copies of the study in order to facilitate the formation of the refined factors adopted. Respondents were asked to both assess the significance and the relevance of every factor of the building projects that he or she practices or studies.

As a consequence, this expert feedback enabled us to decide which factors would be the most essential in relation to project delivery as well as project performance. The experts were picked as they have worked in the construction industry before and they will allow the factors to be realistic and current. Their feedback was vital in making sure that this final set of factors was general enough for the questionnaire but at the same time still targeted the main issues of the industry. This process of selecting the respondents was also very important in order to have a reasonable degree of confidence about the reliability of this information.

3.5.2 Impact scale (Likert)

The performance of construction projects in terms of the project delivery methods was assessed using a Likert scale. The matching criteria listed below were used to evaluate the project performance factors.

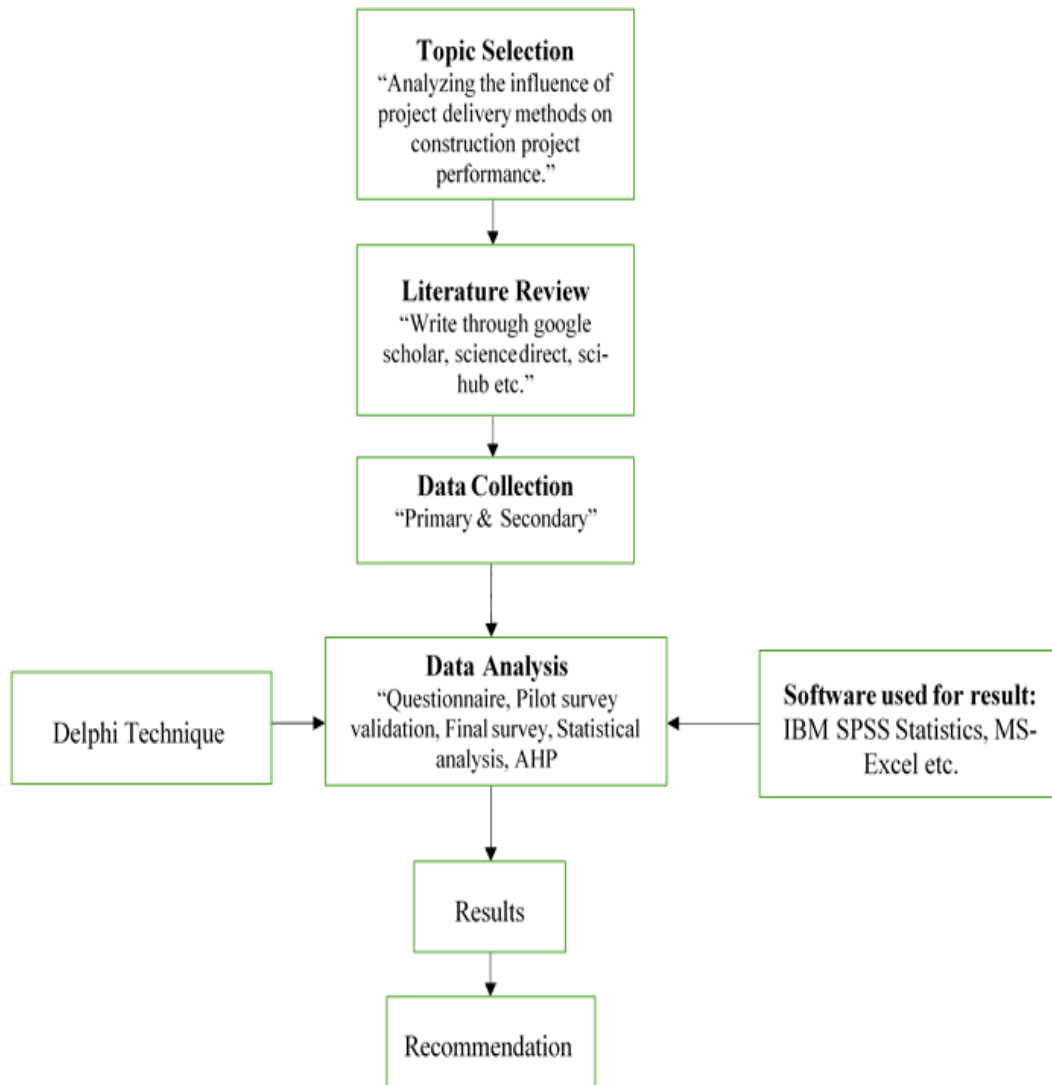


FIGURE 3.2: Flow chart of Research Methodology

TABLE 3.1: Impact scale (Likert scale)

Descriptive Range	Range
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

3.5.3 Data Acquisition

This study utilized data collected through a series of methods, beginning with research of literature to identify the main parameters affecting the success of construction projects delivery. After identifying these factors, a questionnaire was created with the help of expert panel using Delphi method in two to three rounds.

The final version of the questionnaire was handed over to feedback on the relevance of the identified factors from farmers in the construction industry. Thereafter, data were gathered through the five-point Likert scale which in turn made it possible to objectively assess the significance of each factor in determining the success of building projects executed through various project delivery systems.

3.5.3.1 Step 1-Problem Identification

This study began with a preliminary literature review to identify a relevant and suitable research topic. The primary criterion for selection was to address a pressing issue within Pakistan's construction industry.

3.5.3.2 Step 2-Literature Review

The initial phase of the research process entails performing a comprehensive literature review. This phase is essential as it establishes a fundamental comprehension of the research issue and situates the study within the current body of knowledge. The review not only informs the formulation of the issue statement but also assists in delineating the research objectives by emphasizing critical themes and deficiencies in existing research.

3.5.3.3 Step 3-Defining the Problem

Based on a comprehensive literature review, key issues in waste management in Pakistan were identified, leading to the formulation of a construction industry-specific problem.

3.5.3.4 Step 4-Aim and Objectives

Following the identification of the problem, the study's aim and objectives were established to tackle the issue of enhancing the performance of Pakistan's construction industry.

3.5.3.5 Step 5-Design of Data Collection Tool

This investigation employed a quantitative methodology for data gathering to fulfill its aims. A structured questionnaire was created as the main instrument for data collection. The questionnaire was meticulously crafted to investigate the correlation between stakeholder engagement and the sustainability of building projects. The study concentrated on evaluating the effects of stakeholder disengagement, pinpointing significant stakeholder issues, and examining risks associated with stakeholder participation. The collected data formed the basis for recommending policies to enhance stakeholder engagement and promote sustainable construction practices.

3.5.3.6 Step 6-Data Collection

The data collection process involved administering a survey that utilized a structured questionnaire. The questionnaire was transformed into a digital format through an online data collection tool, resulting in the creation of a shareable link for streamlined distribution. The information was disseminated to participants through email and messaging platforms to guarantee wide accessibility. The questionnaire was first distributed to a broader audience, and responses were collected. Upon thorough examination of the gathered data for both completeness and accuracy, a definitive set of valid responses was chosen for subsequent analysis.

3.5.3.7 Step 7-Data Analysis

The data analysis focused on categorizing and ranking the investigated parameters. The collected data was converted into SPSS format for processing. SPSS V25 and Microsoft Excel were utilized for the analysis.

3.5.3.8 Step 8-Conduct of Survey

The questionnaire is distributed among a wide range of stakeholders involved in the construction industry, including clients, developers, contractors, consultants, and other relevant professionals. The survey, conducted via Google Forms, aimed to gather insights into the role of stakeholder engagement in sustainable building

construction management. Responses were collected from registered participants across Rawalpindi and Islamabad, as illustrated in the attached graph 3.2, which shows the geographical distribution of the survey respondents. This ensures that the feedback reflects a diverse range of perspectives from various stakeholders within the construction sector.

3.6 Sample Size and Questionnaire Development

The sample size represents a subset of individuals (respondents) selected from a larger population to serve as its representative. In this study, the sample size was determined using the formula proposed by [58], as presented in Equation 3.1. A widely used approach for estimating an appropriate sample size in survey research is Yamane's formula (1967), which calculates the required sample size based on the total population and the desired margin of error. This method typically applies a 95% confidence level. The formula for Yamane's sample size calculation is:

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Where:

n = sample size, N = population size, e = margin of error

$$n = \frac{185}{1 + 185(0.05^2)} \approx 126 \quad (3.1)$$

Based on the above formula, the required sample size for this study is 126. Since the number of collected samples exceeds this requirement, the sample size is deemed sufficient for analysis.

3.7 Method of Data Analysis

3.7.1 Reliability Test

A reliability test was conducted to evaluate the consistency of the collected data using Cronbach's alpha (α). The value of Cronbach's alpha was calculated through

SPSS and assessed based on specific criteria: below 0.5 is unacceptable, 0.5-0.6 is poor, 0.6-0.7 is questionable, above 0.7 is acceptable, and 0.8-0.9 is considered good to excellent. These classifications, as referenced from [43], are presented in Table 3.2.

TABLE 3.2: Ranging Scale of Cronbachs Alpha, [44].

Internal Consistency	Cronbach's Alpha
Excellent	Alpha \geq 0.9
Good	$0.8 \leq$ Alpha $<$ 0.9
Acceptable	$0.7 \leq$ Alpha $<$ 0.8
Questionable	$0.6 \leq$ Alpha $<$ 0.7
Poor	$0.5 \leq$ Alpha $<$ 0.6
Unacceptable	0.5 Alpha $<$ 0.5

3.7.2 Normality Test

Shapiro-W-test Wilks (1965) is a well-established and reliable technique for determining normality. The Shapiro-Wilk test, often known as the normality test, is used to determine whether or not the data obtained is normal. If data are normally distributed (parametric data), then the significant level should really be larger than 0.05, but a value less than 0.05 indicates that the data range is not normal (nonparametric data).

3.7.3 Parametric and Non-parametric Evaluation

In statistical analysis, the choice between parametric and nonparametric tests is made when the results do not confirm the test hypothesis. The parametric test is valid for a stable, regularly distribution pattern with precisely defined spreads for each group, as well as for linear data. However non-parametric tests are performed. when data is examined on ordinal and ordered scales, doesnt really follow a specific distribution, and exhibits non - linear behavior [59]. Non-parametric tests reveal that the data are not distributed normally, whereas parametric tests demonstrate that the data are distributed normally. [60] demonstrated that a

non-parametric test is utilized when data do not have a normal distribution. The normality hypothesis is rejected if p-value is less than or equal to 0.05. The normality assessment hypothesis is as follows: H0: The data follows a normal distribution if p-value greater than alpha level. H1: The data does not follow a normal distribution if p-value less than alpha level.

3.7.4 Kruskal Wallis Analysis

The Kruskal-Wallis H test is conducted using IBM SPSS Statistics as a non-parametric method to assess differences in median values among three or more independent groups when the assumption of normality is not met. This test is applied following the normality assessment (Shapiro-Wilk or Kolmogorov-Smirnov) to determine whether statistically significant variations exist across the groups. The test is based on ranking the data and computing the Kruskal-Wallis H statistic, which is evaluated against the chi-square distribution to determine significance. The results include the H-statistic, degrees of freedom, and the p-value. A p-value below 0.05 indicates a statistically significant difference, leading to the rejection of the null hypothesis. If significant differences are detected, post-hoc analysis (such as Dunns test with Bonferroni correction) is performed to identify the specific groups exhibiting variations. Utilizing SPSS for the Kruskal-Wallis test ensures an accurate and reliable statistical evaluation, providing meaningful insights into group differences without the constraints of normality assumptions.

3.7.5 Relative Importance Index

This study methodology consisted of identifying and evaluating the intensity level of results associated with accidents and hazards, harmful behaviors, unsafe settings, management systems and social groups, and natural factors. The value of each component was calculated by averaging the data set values supplied by respondents. Therefore, the intensity level selected by respondents was used to compute the relative significance index for each piece. The 1-to-5 ranking scale was converted into a relative relevance index for each component in order to quantify

the ranks of all the elements. RII is determined by the equation (2).

$$\text{RII} = \frac{W}{A \cdot N} \quad (2)$$

Where:

W = Weightage given to each factor by respondents ranges from 1 to 5 using Likert scale

A = Highest value for factors (which is 5 on the Likert scale)

N = Total number of respondents.

3.8 Summary

The methodology chapter offers an organized framework for evaluating the factors that affect the performance of building projects by integrating various expert consensus techniques, multi-criteria decision-making methods, and the use of statistical tools. A combination of both the questionnaire and interviews, which are part of the Delphi method, serves to elicit and integrate the expert views in a better and more rounded manners concerning the factors and criteria that are critical in the analysis. This technique guarantees that all the views are systematically incorporated into the evaluation process. Pilot testing facilitates orderliness and transparency in the decision-making process. Data is collected through organizational self-designed survey questionnaires, which are further analyzed with the use of IBM SPSS statistics to achieve effectiveness and trust. The purpose of the reliability test to test the internal reliability of the matrices data correlating responses received. In order to examine the data distribution Guba1981 the Shapiro-Wilk test is used, which identifies whether the dataset follows normal distribution or its assumptions. The Kruskal-Wallis test is the nonparametric equivalent of the one-way analysis of variance, which is employed to test for inter-group differences in an experiment involving three or more groups where there is a dependency between factors. This approach includes the account of the opinions of experts, some decision-making principals, and necessary calculations to make an all-inclusive assessment of the success criteria of a building project. The assimilation of these

instruments permits optimal selection and ranking of those parameters, which play a distinct role in the outcome of the project under review.

Chapter 4

Results and Analysis

4.1 General

This chapter delineates the findings and analysis of the study, emphasizing the data acquired using structured questionnaire surveys. The survey's major objective was to assess and rate different Project Delivery Methods (PDMs) according to their efficacy in fulfilling clients' goals. The examination also investigates the owner's engagement in contracting with a sole business accountable for both the design and construction of the project. The project is supervised exclusively by either the architect or the contractor from inception to completion, contingent upon the contractual arrangement. The results and comprehensive analysis are presented in the following parts.

This chapter outlines the findings of the study, which were derived from a questionnaire survey designed to meet the study's objectives. The survey included Likert-type questions, allowing respondents to rate their level of agreement with various statements on a scale ranging from "strongly disagree" to "strongly agree." This format was chosen to capture more precise data, offering a clear measure of respondents' attitudes and opinions. Once the data was collected, responses were coded and analyzed using SPSS software, a tool commonly used in research for statistical analysis. This approach allowed for a structured and systematic analysis of the responses, ensuring that the findings were both reliable and accurate. To present the results effectively, tables and figures are used throughout the chapter.

These visual aids help to highlight key patterns and trends in the data, making it easier to interpret and understand the findings. The chapter also includes background information on the respondents, such as demographic details, which provide important context for interpreting the data. These details help explain how factors like age, gender, and education might influence respondents' answers. The findings are then discussed in relation to the study's research objectives and questions. Each objective is addressed in detail, with the results analyzed and linked to the broader theoretical framework and existing literature. Where relevant, comparisons with similar studies are made to offer additional insight into the significance of the findings. Overall, this chapter provides a comprehensive overview of the data collected through the questionnaire survey, presenting the results in a clear and organized manner. This analysis will form the basis for further discussion and conclusions in later chapters of the study.

4.2 Development of Questionnaire and Finalization

4.2.1 Coding of the Questionnaire

The coding of the questionnaire was done to systematically categorize and organize the questions for efficient analysis, as shown in appendix. Each question was assigned a unique alphanumeric code to represent its specific theme or focus area. For example, questions related to Project Delivery Methods was coded under the prefix A & PDM (e.g., A for the main question and PDMA, PDMb, etc., for the sub-questions). Questions regarding the Design Build Method were categorized under the code DB, with sub-codes like DB-01 DB approach streamlines the construction process. Similarly, questions addressing Design-Bid-Build were grouped under the DBB code, such as DBB-01 for the DBB method effects the delivery time compared to other methods and DBB-06 for the DBB method is associated with maximum quality monitoring during the project life cycle. Similarly, questions addressing Construction Manager at Risk as CMAR, with sub-codes like CMAR-01 CMAR

method allocates the risks among stakeholders and CMAR-02 for CMAR method promotes early involvement of contractors in the project lifecycle. More over questions addressing Integrated Project Delivery as IPD with sub-codes like IPD-01 for IPD enhances the participation among project stakeholders, etc. This coding system allows for easy identification and referencing of each question within its thematic category, facilitating the organization and analysis of the responses in relation to key themes such as project delivery methods and building performance in building projects.

4.2.2 Analysis of Pilot Survey

Before the main survey was conducted, a pilot survey was carried out to test the effectiveness of the questionnaire and refine the research methodology. The primary goal of this pilot phase was to identify any potential issues with the questionnaire design, ensuring that the questions were clear, relevant, and likely to provide the desired information. Additionally, the pilot survey served as an opportunity to evaluate the overall research approach and make any necessary adjustments before administering the survey to the full sample. A selected group of individuals, representing a diverse cross-section of the target population, participated in the pilot survey. This diverse group was chosen to ensure that the questionnaire would be effective across various demographic segments, such as experience and educational background. By involving participants with different characteristics, the researcher was able to test how the questions would be understood and interpreted by people from various walks of life. The details of the participants in the pilot survey are provided in Table 4.1, 4.2, 4.3 4.4 & 4.5 which includes key demographic information about the sample.

The pilot survey used a smaller sample size compared to the main survey, which allowed for more focused feedback collection. This smaller group made it easier to engage with participants and gather detailed input on their experiences with the questionnaire. Participants were asked to provide feedback on various aspects of the survey, including the clarity of the questions, the length of the questionnaire, and whether any questions were confusing or difficult to answer.

TABLE 4.1: Details of Respondents Organization Type on Pilot Survey

S. No.	Response	No's	Percentage (%)
1	Organization Type		
a	Client	4	29%
b	Consultant	2	14%
c	Contractor	4	36%
d	Education and Research	3	21%
	Total	13	100%

TABLE 4.2: Details of Respondents Designation on Pilot Survey

S. No	Response	No's	Percentage (%)
2	Designation		
a	Assistant Professor	2	15%
b	Contracts Manager	1	8%
c	General Manager	1	8%
d	Owner/CEO	1	8%
e	Project Director	2	15%
f	Project Manager	5	46%
	Total	13	100%

TABLE 4.3: Details of Respondents Highest Education Level on Pilot Survey

S. No	Response	No's	Percentage (%)
3	Highest Education Level		
a	B.Sc. Civil Engineering	4	29%
b	M.S. Civil Engineering	6	50%
c	Ph.D.	3	21%
	Total	13	100%

TABLE 4.4: Details of Respondents Total Years of Experience on Pilot Survey

S. No	Response	No's	Percentage (%)
4	Total Years of Experience		
a	11-15 years	2	16%
b	16-20 years	2	15%
c	20-25 years	5	38%
d	> 26 years	3	31%
	Total	13	100%

TABLE 4.5: Details of Respondents Experience in Building Construction on Pilot Survey

S. No	Response	No's	Percentage (%)
5	Years of Experience in Building Construction		
a	6-10 years	2	15%
b	11-15 years	3	23%
c	16-20 years	1	8%
d	20-25 years	5	38%
e	> 26 years	2	15%
	Total	13	100%

In addition to this, the researchers were able to observe how long it took participants to complete the survey and identify any logistical challenges that could arise when conducting the main survey. The feedback from the pilot survey was invaluable in refining the questionnaire. Any questions that were unclear or ambiguous were reworded for clarity, ensuring that they would be better understood by the larger group of respondents in the main survey. Moreover, the pilot phase helped identify any technical or operational issues related to survey administration, such as issues with online survey tools or difficulties with data collection. By addressing these issues early on, the research team was able to ensure that the main survey would run smoothly. Overall, the pilot survey was an essential step in the research process. It allowed the research team to test the questionnaire and research approach, making necessary modifications before the main survey was distributed to the full sample. The insights gained from the pilot survey helped improve the reliability and validity of the data collected in the main survey, contributing to

a more accurate and effective study. Most of the experts suggested to remove total years of experience in survey and include only years of experience in building projects so it has been removed from questionnaire for main survey.

4.2.3 Demographic Analysis of Actual Survey

The details of the respondents provided are based on the final questionnaire survey conducted to examine the project delivery methods influence on building projects performance. A total of 192 responses were collected which were analyzed to gain insights into the involvement of various PDMs in building building projects. The respondents were drawn from diverse positions within the construction industry to ensure a comprehensive representation of the sector.

Among the 192 valid responses, 29 respondents were Owners/CEOs, offering strategic-level insights into PDM decision-making and organizational priorities. Additionally, 8 Project Directors and 59 Project Managers provided their expertise on project planning and execution, shedding light on the management processes that drive PDMs in building projects. 26 Resident Engineers and 15 Construction Managers contributed practical insights based on their experience in overseeing daily operations on construction sites, addressing challenges related to resource management, energy efficiency, and waste reduction. 15 Contract Managers shared their perspectives on the legal and financial aspects of PDM, while 40 Site Engineers provided input from an operational standpoint, focusing on the technical implementation of building performance.

The distribution of respondents by designation is shown in Figure 4.1 below, reflecting the broad spectrum of roles involved in building projects. This diversity underscores the critical need for collaboration across various sectors, with each role playing a vital part in effectively integrating project delivery methods into construction practices. The varied representation of stakeholders emphasizes that successful PDM implementation relies on contributions from all sectors involved in the project. Furthermore, this diverse input is essential for addressing the complex challenges associated with performance of building projects and ensuring a holistic approach to project success.

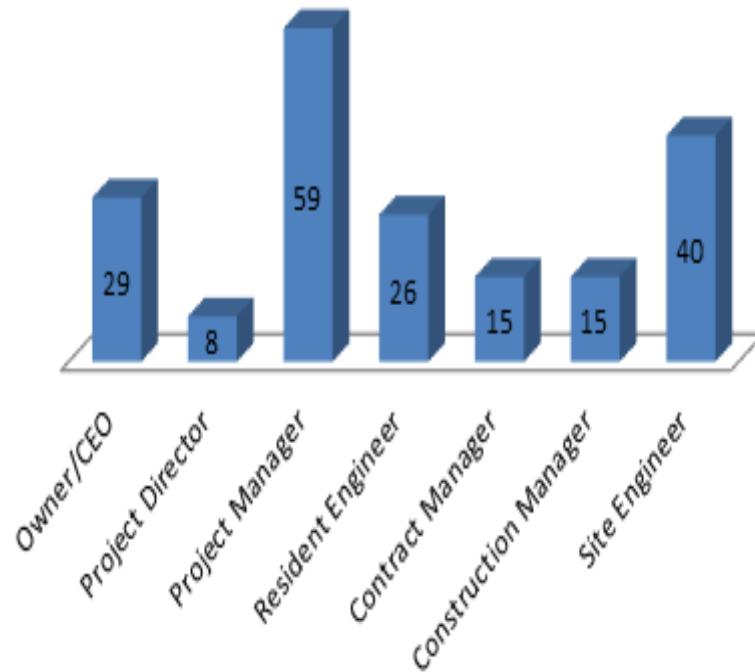


FIGURE 4.1: Designations of Respondents

The educational background of the survey respondents highlights a diverse range of academic qualifications, as illustrated in the figure 4.2. Among the 192 valid responses, 6 respondents held a Ph.D., showcasing a high level of expertise and research-based knowledge in the field. A significant portion of the respondents, 81 individuals, held an M.Sc. in Civil Engineering, indicating a strong foundation in advanced civil engineering concepts and practices. Additionally, 100 respondents held a B.Sc. in Civil Engineering, reflecting a broad base of professional experience and technical knowledge in the field. Finally, 5 respondents had completed an Associate Diploma in Civil Engineering, demonstrating a practical, hands-on approach to the industry. This varied educational background enriches the survey results by incorporating insights from both academic and practical perspectives, contributing to a well-rounded understanding of building construction.

The professional background of the survey respondents reflects a diverse range of roles within the construction industry, as shown in the figure 4.3. Among the 192 valid responses, 46 respondents were Clients, providing insights from a strategic and decision-making perspective on building projects. A larger portion, 100 respondents, were Contractors, contributing valuable practical knowledge regarding

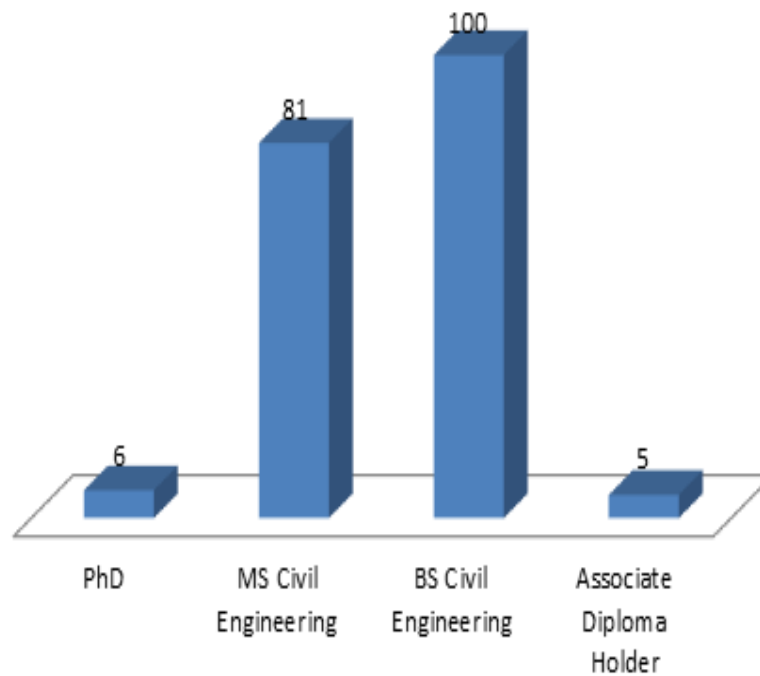


FIGURE 4.2: Education of Respondents

the execution and management of building projects on the ground. Additionally, 46 respondents were Consultants, offering expertise in design, planning, and project management, with a focus on project delivery methods.

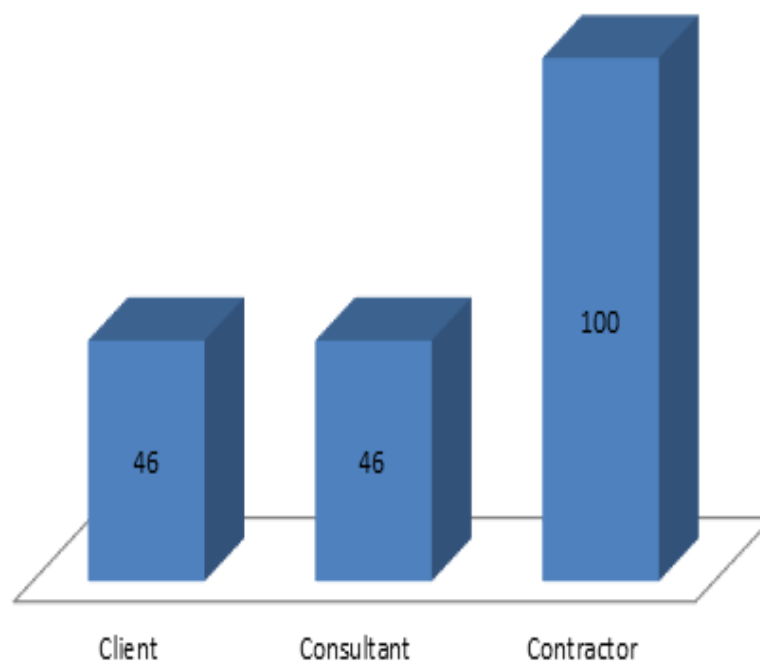


FIGURE 4.3: Respondents Organization Type

The survey respondents varied in terms of their years of experience in the building construction industry, as shown in the figure 4.4 below.

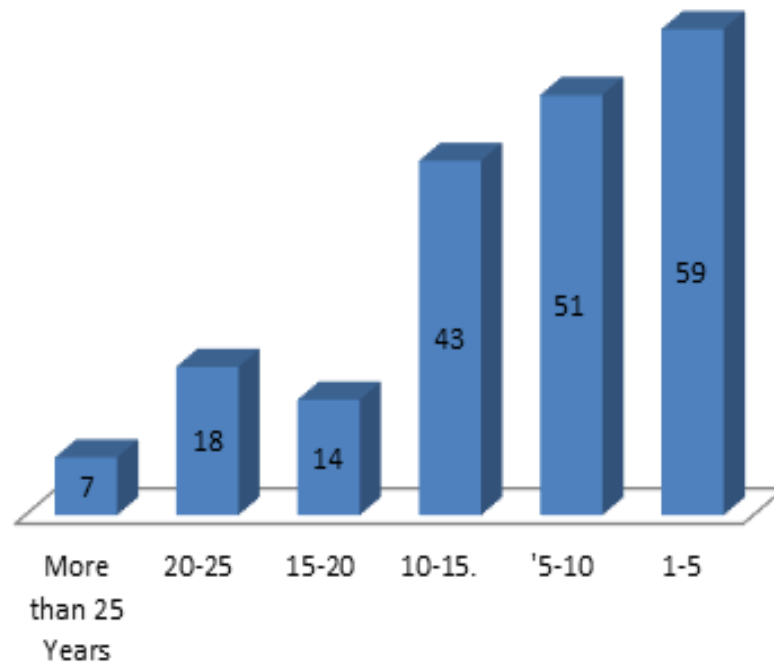


FIGURE 4.4: Years of Experience in Building Projects of Respondents

59 respondents had 1-5 years of experience, while 51 had 5-10 years, reflecting a solid foundation in the field. 43 respondents had 10-15 years of experience, and 14 had 15-20 years, showcasing significant expertise. Additionally, 18 respondents had 20-25 years of experience, with 07 respondents boasting more than 25 years, offering a wealth of knowledge and long-term industry insights. This diverse experience range provides a comprehensive view of the industry's evolving dynamics.

4.3 Reliability Test

A reliability test is an essential phase in the process of data analysis, as it evaluates the internal consistency of the data, confirming that the measurement tool or instrument yields stable and consistent results. The concept of internal consistency pertains to how well various items or questions within a test or survey assess the same fundamental construct. A commonly employed approach to assess internal consistency is Cronbach's Alpha, a statistical metric that measures the reliability

of a collection of items or questions. A high Cronbach's Alpha value signifies robust internal consistency, suggesting that the items are closely interconnected and consistently assess the same construct. On the other hand, a low value indicates a lack of consistency, suggesting that the items might not be accurately measuring the intended construct.

TABLE 4.6: Case Processing Acceptance

Case Processing Summary			
		N	%
Cases	Valid	188	97.9
	Excluded	4	2.1
	Total	192	100

The evaluation of reliability through Cronbach's Alpha is generally informed by recognized standards or thresholds, aiding in the interpretation of the findings. For example, Table 4.7 outlines criteria for assessing reliability in relation to the Cronbach's Alpha value. A value exceeding 0.70 is typically regarded as acceptable, signifying strong internal consistency, whereas values ranging from 0.60 to 0.70 might be viewed as marginal. Values falling below 0.60 are frequently considered inadequate, indicating that the measurement instrument might require modification or enhancement. These guidelines assist in assessing the reliability of data to decide if further analysis can be conducted or if modifications to the instrument are required. In the context of the investigation, Table 4.9 displays the outcomes of the reliability assessment conducted on the data. This table probably presents the Cronbach's Alpha values for various constructs or scales utilized in the study, offering a comprehensive overview of the reliability of each element. For instance, a Cronbach's Alpha value of 0.85 for a specific scale signifies excellent internal consistency, suggesting that the items within that scale are highly reliable and consistent in assessing the intended construct. Conversely, a value of 0.55 from an alternative scale indicates that the items might not be accurately capturing the intended construct, necessitating additional refinement of the scale.

In conclusion, conducting reliability testing with Cronbach's Alpha is a crucial step in guaranteeing the quality and consistency of data in studies. By evaluating

internal consistency, one can ascertain the reliability of measurement tools and the appropriateness of the collected data for subsequent analysis. The guidelines outlined in Table 4.7 and the findings shown in Table 4.9 present a systematic method for assessing reliability, aiding in making well-informed choices regarding data. Ultimately, a rigorous reliability test guarantees that the study's findings are credible, valid, and significant, enhancing the overall strength of the investigation.

TABLE 4.7: Reliability Test

Cronbach's Alpha	N of Items
0.97	39

TABLE 4.8: Description of Reliability Test [61]

Description	Cronbach's Alpha
Alpha <0.5	Data is unacceptable
$0.5 \leq \text{Alpha} \leq 0.6$	Data is Poor
$0.6 \leq \text{Alpha} \leq 0.7$	Data is questionable
$0.7 \leq \text{Alpha} \leq 0.8$	Data is acceptable
$0.8 \leq \text{Alpha} \leq 0.9$	Data is good
$0.9 < \text{Alpha}$	Data is Excellent

From table 4.9, The reliability examination of several Project Delivery Methods (PDMs) using Cronbach's Alpha values demonstrates a substantial degree of data consistency. The Integrated Project Delivery (IPD) technique, according to

TABLE 4.9: Result of Reliability Test

S. No.	Description	N of Items	Cronbach's Alpha
1	Ranking Project Delivery Methods (PDMs) Based on Client Objective Support	4	0.791
2	Design-Build (DB) Project Delivery Method	8	0.936
3	Design-Bid-Build (DBB)	8	0.899
4	Construction Manager at Risk (CMAR)	9	0.904
5	Integrated Project Delivery (IPD)	9	0.945

the dependability categorization, possesses the highest reliability score of 0.945, categorizing it as "Excellent." Design-Build (DB) (0.936), Construction Manager at Risk (CMAR) (0.904), and Design-Bid-Build (DBB) (0.899) all reside within the "Good" to "Excellent" spectrum, indicating robust internal consistency. The ranking of PDMs according to client objective support has a dependability score of 0.791, classified as "Acceptable." The results indicate that the data gathered for assessing various PDMs is very dependable and appropriate for analysis.

4.4 Normality Test

The concept of normality in statistics pertains to how closely a data distribution aligns with a normal, or Gaussian, distribution. A normal distribution features a symmetrical, bell-shaped curve, with the majority of data points concentrated around the mean, while fewer values appear as one moves away from the mean in either direction. This pattern is frequently characterized as "bell-shaped" due to its even, symmetrical form. The assumption of normality is crucial in various

parametric statistical tests, including t-tests, ANOVA, and linear regression, since these techniques depend on the data exhibiting a normal distribution to yield precise and dependable outcomes. When data follows a normal distribution, it enables the making of valid inferences and predictions through statistical analyses.

To assess if a dataset adheres to a normal distribution, specific tests are employed to evaluate its normality. The Shapiro-Wilk test and the Kolmogorov-Smirnov test are two tests that are frequently utilized. The tests assess the alignment of the observed data distribution with an ideal normal distribution, calculating a p-value to determine the probability that the data follows a normal distribution. A p-value exceeding 0.05 indicates that the data does not significantly differ from normality, implying that it can be regarded as normally distributed. If the p-value is less than 0.05, it suggests a significant deviation from normality, indicating that the data does not conform to a normal distribution.

When data does not conform to the assumption of normality, it can significantly impact the validity of parametric statistical tests. Parametric tests depend on the assumption of normality to maintain the precision of their outcomes, and breaching this assumption may result in erroneous conclusions. In such cases, it is common to utilize non-parametric tests, which do not necessitate the assumption of normal distribution for the data. Non-parametric tests, including the Mann-Whitney U test and the Kruskal-Wallis test, offer greater flexibility and robustness for analyzing data that does not conform to normality, thus serving as a suitable alternative when the assumptions of normality are not satisfied.

In conclusion, normality serves as a fundamental principle in statistics, illustrating the extent to which a dataset aligns with a normal distribution. Many parametric statistical tests rely on the assumption of normality, which is crucial for ensuring accurate results. Tests such as the Shapiro-Wilk and Kolmogorov-Smirnov tests are essential for assessing whether the data satisfies this assumption. When the data shows significant deviations from normality, non-parametric tests provide a dependable option for analysis. Grasping and verifying normality is an essential phase in affirming the validity and reliability of statistical analyses.

TABLE 4.10: Result of Normality Test

Tests of Normality								
S.No	Independent Factors	Dependent Factors	Kolmogorov-Smirnova			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
1	Design Build (DB) Project Delivery Methods	Strongly Disagree	0.277	6	0.168	0.773	6	0.033
		Disagree	0.23	21	0.005	0.841	21	0.003
		Neutral	0.21	36	0	0.901	36	0.004
		Agree	0.278	75	0	0.842	75	0
		Strongly agree	0.283	21	0	0.764	21	0
2	Design-Bid-Build (DBB)	Strongly Disagree	0.277	6	0.168	0.773	6	0.033
		Disagree	0.286	21	0	0.852	21	0.005
		Neutral	0.186	36	0.003	0.914	36	0.009
		Agree	0.23	75	0	0.877	75	0
		Strongly agree	0.249	21	0.001	0.846	21	0.004
3	Construction Manager at Risk (CMAR)	Strongly Disagree	0.223	6	.200*	0.908	6	0.421
		Disagree	0.22	21	0.009	0.889	21	0.021
		Neutral	0.236	36	0	0.876	36	0.001
		Agree	0.309	75	0	0.85	75	0
		Strongly agree	0.235	21	0.004	0.841	21	0.003
4	Integrated Project Delivery (IPD)	Strongly Disagree	0.277	6	0.168	0.8	6	0.059
		Disagree	0.3	21	0	0.864	21	0.007
		Neutral	0.217	36	0	0.881	36	0.001
		Agree	0.323	75	0	0.76	75	0
		Strongly agree	0.285	21	0	0.714	21	0

The Shapiro-Wilk test evaluates data normality, with a p-value beyond 0.05 indicating normalcy, whereas a p-value below 0.05 signifies a departure from normality. All significance (Sig.) values in this table for the categories are below 0.05, indicating that none of the distributions adhere to a normal pattern. The lowest normalcy value is recorded for "Strongly Disagree" (0.627, $p < 0.001$), signifying the most pronounced deviation from normality, whilst "Neutral" has the highest statistic (0.901, $p = 0.009$), yet still does not conform to normality. As all p-values are below 0.05, the data fails to satisfy the assumption of normality. This indicates that non-parametric statistical tests ought to be utilized rather than parametric tests, given that the data does not conform to a normal distribution. The divergence from normalcy indicates variability in answers, necessitating rigorous statistical methods to guarantee precise analysis. This the result of Design-Build (DB) Project Delivery Method and its dependents factors. The results from the normality tests, which include the Kolmogorov-Smirnov and Shapiro-Wilk tests, show that most of the data distributions significantly differ from normality. The Shapiro-Wilk test is really important when dealing with small sample sizes, and the significance values (Sig.) are usually below 0.05, which indicates that the data isn't normally distributed among the various Project Delivery Methods (PDMs). The Construction Manager at Risk (CMAR) method for the "Strongly Disagree" category has a p-value of 0.421, which suggests a possible normal distribution. However, all the other p-values for the dependent factors across different PDMs are below 0.05, which confirms non-normality. Based on these results, it seems that parametric tests, which assume normality, might not be the best choice for further analysis. Instead, we should think about using non-parametric tests like the Kruskal-Wallis or Mann-Whitney U tests for comparing groups. Noticing some big differences from what we expect in normal data means we might want to look into data transformations, like log transformation, to help make things more normal, based on what we're trying to achieve in our research.

4.5 Non-parametric Test

To ensure the validity of the statistical analysis, a normality test was first conducted using skewness and kurtosis. The results indicated that the dataset did

not follow a normal distribution, necessitating the use of a non-parametric alternative for further analysis. Given this, the Kruskal-Wallis test was employed to compare distributions across different respondents group. The results of the Kruskal-Wallis test revealed that for all variables, the p-value was 0.486, which is greater than the significance level of 0.05. This indicates that there are no statistically significant differences in the distribution of the tested variables across the group. Consequently, the null hypothesis was retained for all cases, confirming that the distribution of each variable remains consistent across the different categories. These findings reinforce the conclusion that the dataset does not exhibit significant group-based variations. The use of the Kruskal-Wallis test, following the confirmation of non-normality, provides robust evidence supporting the uniformity of distributions. This ensures that any further analytical procedures can be conducted with the confidence that the dataset is statistically consistent across respondent's group.

4.6 Validity Test

Validity testing is an essential process employed to assess if a measurement instrument, tool, or procedure accurately and effectively measures its intended target. This guarantees that the outcomes derived from studies, assessments, or evaluations are dependable, accurate, and significant. Testing for validity is crucial for ensuring the credibility and reliability of any measurement tool, as it verifies that the instrument is suitable for its intended use and generates results that are relevant to real-world situations. Validity encompasses multiple dimensions and is not merely a singular idea. It can be evaluated through different forms, each designed to fulfill a specific role in assessing the effectiveness of a test or measurement instrument. The prevalent categories of validity encompass content validity, construct validity, criterion validity, face validity, as well as convergent and discriminant validity. The assessment of content validity involves evaluating whether the measurement tool sufficiently encompasses all facets of the construct it aims to measure, thereby guaranteeing that the test is thorough and reflective of the domain in question. Construct validity assesses the extent to which

TABLE 4.11: Non-Parametric Kruskal Wallis Test

S. No.	Variable	Test Used	p-value	Decision
1	A	Kruskal-Wallis	0.486	Retain null hypothesis
2	PDMa	Kruskal-Wallis	0.486	Retain null hypothesis
3	PDMb	Kruskal-Wallis	0.486	Retain null hypothesis
4	PDMc	Kruskal-Wallis	0.486	Retain null hypothesis
5	PDMd	Kruskal-Wallis	0.486	Retain null hypothesis
6-13	DB01 - DB08	Kruskal-Wallis	0.486	Retain null hypothesis
14-21	DBB01 - DBB08	Kruskal-Wallis	0.486	Retain null hypothesis
22-30	CMAR01 - CMAR09	Kruskal-Wallis	0.486	Retain null hypothesis
31-39	IPD01 - IPD09	Kruskal-Wallis	0.486	Retain null hypothesis
40	Total	Kruskal-Wallis	0.486	Retain null hypothesis

a test effectively measures the theoretical construct or trait it aims to evaluate, confirming its coherence with the foundational theory. Criterion validity investigates the connection between test results and an external criterion or outcome, categorized into concurrent validity (the correlation with a criterion assessed at the same time) and predictive validity (the ability to forecast future outcomes or behaviors). Face validity pertains to how much a test seems to measure what it is intended to measure upon initial examination, aiding in the perception of the test's relevance and appropriateness by its users. Convergent and discriminant validity confirm that the test aligns with other assessments of the same construct (convergent validity) while remaining uncorrelated with assessments of different constructs (discriminant validity), thereby affirming the test's distinctiveness and precision.

The significance of validity testing is paramount. It ensures accuracy by confirming that the measurement instrument yields precise outcomes devoid of systematic errors or biases. This increases the reliability of research outcomes, rendering them more dependable and recognized within the scientific community. Validity testing enhances decision-making by offering dependable data that can inform choices across various domains, including education, psychology, healthcare, and business. This enhancement also contributes to the broader applicability of the findings, allowing them to be relevant in practical contexts outside of the particular study or evaluation. Furthermore, validity testing safeguards against the misinterpretation of results, guaranteeing that the conclusions reached are both meaningful and pertinent. Instances of validity testing in practice encompass academic assessments, where a mathematics exam is designed to accurately gauge a student's mathematical abilities instead of their reading comprehension skills, and psychological evaluations, where a depression scale aims to assess symptoms of depression rather than anxiety or stress. In employee selection tests, a job aptitude test must effectively predict job performance and correlate with relevant job-related skills. Similarly, in market research surveys, a customer satisfaction survey should precisely measure customer experiences and opinions, avoiding unrelated factors such as brand loyalty or pricing.

In summary, validity testing serves as a fundamental element of inquiry and evaluation, guaranteeing that measurement instruments are precise, dependable, and significant. By assessing various types of validity like content, construct, and criterion validity professionals can ensure that their tools accurately measure the intended constructs and yield results that are relevant to real-world situations. The absence of validity testing would greatly undermine the credibility and utility of research findings and assessments. Consequently, testing for validity is a crucial phase in the creation and utilization of any measurement instrument.

The results demonstrate robust validity, with a correlation value of 0.01 in a two-tailed test, indicating a negligible probability of mistake. Furthermore, the values from C21 to C59 exceed 0.05, indicating that the data does not considerably deviate from the anticipated values and remains within an acceptable range. The

mean value of 0.07 further substantiates the consistency and reliability of the data, hence confirming their validity.

Furthermore, the p-value is below 0.05, indicating that the results are statistically significant. This indicates that the test satisfies validity standards from several perspectives, guaranteeing that the findings accurately represent the intended measures. These statistical indications indicate that the assessment is both valid and dependable.

4.7 Relative Importance Index

The Relative Importance Index (RII) serves as a statistical instrument for assessing the significance or priority of different elements, criteria, or variables within a dataset. This method is frequently utilized in studies, surveys, and decision-making frameworks to prioritize the importance of various elements according to feedback from participants or through data evaluation. The RII holds significant importance in areas like project management, construction, education, and social sciences, where the prioritization of factors is crucial for informed and effective decision-making. By quantifying the relative importance of each element, the RII assists in identifying which factors warrant the most attention or resources for analysis and evaluation.

The significance of the Relative Importance Index is rooted in its capacity to offer a clear and organized method for prioritization. In intricate projects or investigations, numerous factors or criteria frequently require consideration, and not all hold equal significance. The RII provides a systematic approach to rank these factors according to their assessed or computed significance, guaranteeing that decisions are informed by data and centered on the most essential elements. In project management, the RII serves as a tool to prioritize risks, resources, or project objectives, allowing for efficient resource allocation and addressing the most critical challenges initially. In the realm of education, the RII serves as a valuable tool for pinpointing the key factors that impact student performance and the effectiveness of the curriculum.

Furthermore, the RII improves transparency and objectivity in the processes of decision-making. Utilizing quantitative data and statistical analysis helps to reduce biases and subjective judgments that frequently obscure decision-making. The RII serves as a dependable instrument for stakeholders seeking to substantiate their decisions or strategies with empirical evidence. In building projects, the RII serves as a tool to prioritize safety measures and quality standards, ensuring that the most critical issues are addressed to prevent accidents or delays. In social sciences, it assists decision-makers in pinpointing the most urgent societal challenges that necessitate action. Overall, the RII serves as a robust instrument that facilitates effective prioritization, resource allocation, and evidence-driven decision-making across diverse domains.

TABLE 4.12: Result of Relative Importance Index (RII) for Design Build (DB)

S.No	Factors	Level of Effectiveness					N	RII	Rank
		1	2	3	4	5			
1	Single-firm project	20	16	40	75	40	191	0.704	1
2	Reduces team conflict	14	16	30	68	63	191	0.689	3
3	Improves cost control	12	22	46	66	45	191	0.65	6
4	Controls project timeline	12	18	39	76	46	191	0.666	5
5	Ensures quality standards	12	24	56	60	39	191	0.631	7
6	Identifies potential risks	14	20	52	67	35	188	0.622	8
7	Enhances stakeholder communication	9	18	38	79	47	191	0.676	4
8	Clients are satisfied	11	20	49	80	30	190	0.699	2

The Relative Importance Index (RII) is an essential statistic utilized to evaluate the efficacy of several components in the Design-Build (DB) methodology based on survey feedback. The foremost factor, Single-firm project (RII = 0.704, Rank 1), underscores the significance of unifying project design and construction inside a single organization. Clients express satisfaction (RII = 0.699, Rank 2), suggesting that DB initiatives typically fulfill client expectations. Reduces team conflict (RII = 0.689, Rank 3) and enhances stakeholder communication (RII = 0.676, Rank 4) indicate that DB effectively mitigates conflicts and fosters collaboration. The control of project timelines (RII = 0.666, Rank 5) and the enhancement of cost control (RII = 0.650, Rank 6) indicate that although Design-Build (DB) facilitates adherence to schedules and budgets, these factors are subordinate to communication and dispute resolution. The quality standards (RII = 0.631, Rank 7) indicate that quality compliance is appreciated but not prioritized, but the identification of potential hazards (RII = 0.622, Rank 8) ranks lowest, suggesting that risk management is a less major advantage of the DB strategy. These rankings offer insights into the benefits and weaknesses of the DB technique in project management.

The Relative Importance Index (RII) is a crucial metric employed to evaluate the efficacy of several components in the Design-Bid-Build (DBB) technique, derived from survey responses, offering insights into its benefits and drawbacks. The foremost factor, traditional project delivery (RII = 0.728, Rank 1), underscores the prevalent acknowledgment of DBB as a conventional approach, succeeded by client expectation fulfillment (RII = 0.699, Rank 2) and appropriate risk distribution (RII = 0.676, Rank 3), emphasizing its advantages in quality assurance and accountability. Collaboration among stakeholders (RII = 0.651, Rank 4) is esteemed yet poses challenges, whereas cost overruns (RII = 0.640, Rank 5) signify concerns with budget management. Schedule flexibility (R.II = 0.631, Rank 6) and quality monitoring (RII = 0.622, Rank 7) are recognized advantages, albeit secondary, while design quality improvement (RII = 0.595, Rank 8) is ranked lowest, indicating potential issues with design efficiency. Elevated RII values signify enhanced perceived efficacy, whilst diminished values underscore difficulties, with DBB succeeding in risk distribution and customer contentment but encountering

TABLE 4.13: Result of Relative Importance Index (RII) for Design Bid Build (DBB)

S.No	Factors	Level of Effectiveness					N	RII	Rank
		1	2	3	4	5			
1	Traditional project delivery	23	16	33	54	65	191	0.728	1
2	Improves design quality	14	56	30	46	45	191	0.595	8
3	Causes cost overruns	15	29	44	48	55	191	0.64	5
4	Impacts stakeholder collaboration	12	20	45	73	41	191	0.651	4
5	Allows schedule flexibility	12	24	56	60	39	191	0.631	6
6	Ensures quality monitoring	14	20	52	67	35	188	0.622	7
7	Allocates risks properly	9	18	38	79	47	191	0.676	3
8	Meets client expectations	11	20	49	80	30	190	0.699	2

hurdles related to costs and teamwork. The results validate DBB as a prevalent project delivery technique; however, subsequent research should concentrate on optimizing design efficiency and cost management to augment its overall efficacy.

Table 4.10 displays the Relative Importance Index (RII) of different parameters affecting the Construction Manager at Risk (CMAR) methodology. The RII values denote the importance of each component in guaranteeing project success. Early contractor involvement is crucial, highlighting the benefit of incorporating construction skills throughout the design phase. Cost control and quality enhancement are significant strengths of CMAR, illustrating its efficacy in budget management and project outcome improvement. Furthermore, risk management

and uncertainty mitigation aid in alleviating unexpected obstacles. Nonetheless, prospective delays persist as a concern, underscoring the necessity for improved scheduling procedures. The results indicate that CMAR promotes collaboration and client involvement, establishing it as a dependable project delivery approach.

TABLE 4.14: Result of Relative Importance Index (RII) for Construction Manager at Risk (CMAR)

S.No	Factors	Level of Effectiveness					N	RII	Rank
		1	2	3	4	5			
1	CMAR method allocates the risks among stakeholders.	13	54	28	44	43	190	0.49	9
2	Early involvement: Engages contractors early.	28	14	29	55	65	191	0.72	1
3	Cost control: Manages project expenses.	14	56	30	46	45	191	0.595	8
4	Quality improvement: Enhances project quality.	15	29	44	48	55	191	0.64	5
5	Uncertainty reduction: Minimizes project risks.	12	20	45	73	41	191	0.651	4
6	Potential delays: Causes possible delays.	12	24	56	60	39	191	0.631	6
7	Risk management: Handles unforeseen risks.	14	20	52	67	35	188	0.622	7
8	Team collaboration: Builds project trust.	9	18	38	79	47	191	0.676	3
9	Client involvement: Engages clients continuously	11	20	49	80	30	190	0.699	2

The Relative Importance Index (RII) is a crucial indicator utilized to evaluate the efficacy of several elements affecting the Construction Manager at Risk (CMAR) technique, offering insights into its benefits and obstacles in project execution.

The foremost element, early contractor engagement (RII = 0.720, Rank 1), underscores CMAR's capacity to improve constructability input and project efficiency from the beginning. Client involvement (RII = 0.699, Rank 2) guarantees ongoing engagement, resulting in enhanced decision-making and alignment with project objectives, whereas team cooperation (RII = 0.676, Rank 3) cultivates trust and coordination among stakeholders. CMAR reduces project uncertainties (RII = 0.651, Rank 4) and promotes quality enhancement (RII = 0.640, Rank 5), rendering it an advantageous project delivery approach. Nonetheless, obstacles such as possible delays (RII = 0.631, Rank 6) and risk management (RII = 0.622, Rank 7) suggest that unexpected risks may affect project timelines. Furthermore, cost control (RII = 0.595, Rank 8) is ranked the lowest, indicating that budget management is a less robust facet of CMAR relative to its other advantages. The Relative Importance Index (RII) is essential for identifying the key aspects influencing CMAR's effectiveness, highlighting early engagement, client involvement, and team collaboration as its primary strengths, while indicating that cost control and risk management necessitate enhancement. CMAR is a respected project delivery approach that provides organized risk distribution and quality assurance; nonetheless, issues such as cost overruns, schedule delays, and risk management require attention to improve its efficiency. Future research ought to concentrate on enhancing cost management measures and proactive risk mitigation to optimize the advantages of CMAR in building projects. The research indicates that the primary advantage of IPD is its capacity to minimize disagreements, evidenced by the greatest Relative Importance Index (RII) of 0.729, signifying robust endorsement of its efficacy in enhancing project results. Client recommendations (R.II: 0.699) and alignment of project objectives (RII: 0.676) are closely ranked, indicating that client happiness and goal alignment are essential concerns for responders. The influence of IPD on scheduling (RII: 0.651) and risk management (R.II: 0.640) is esteemed, albeit with low endorsement. Quality satisfaction (RII: 0.631) and cost reduction (RII: 0.622) are ranked lower, indicating mixed opinions, but enhancing overall project efficiency (R.II: 0.595) is perceived as the least significant. Factors pertaining to dispute mitigation, client contentment, and objective congruence are prioritized, whilst enhancements in efficiency and cost savings are considered

TABLE 4.15: Result of Relative Importance Index (RII) for Integrated Project Delivery (IPD)

S.No	Factors	Level of Effectiveness					N	RII	Rank
		1	2	3	4	5			
1	IPD enhances the participation among project stakeholders.	18	58	25	46	44	191	0.6	9
2	IPD reduces disputes.	26	14	29	55	67	191	0.729	1
3	IPD improves efficiency.	14	56	30	46	45	191	0.595	8
4	IPD addresses risks.	15	29	44	48	55	191	0.64	5
5	IPD improves scheduling.	12	20	45	73	41	191	0.651	4
6	IPD satisfies quality.	12	24	56	60	39	191	0.631	6
7	IPD reduces costs.	14	20	52	67	35	188	0.622	7
8	IPD aligns goals.	9	18	38	79	47	191	0.676	3
9	Clients recommend IPD.	11	20	49	80	30	190	0.699	2

secondary.

4.8 Discussion

The findings of this study reveal that the performance of building projects is significantly influenced by the choice of Project Delivery Method (PDM). While Design-Bid-Build (DBB) remains the most commonly used due to its traditional familiarity, Design-Build (DB) and Construction Manager at Risk (CMAR) are increasingly preferred for their ability to enhance cost control, reduce conflicts, and improve coordination. Integrated Project Delivery (IPD), though less widely adopted, showed great potential for achieving alignment among stakeholders and minimizing disputes. Each method demonstrated specific strengths: DB enhanced

client satisfaction and communication; DBB excelled in risk distribution; CMAR ensured quality through early contractor involvement; and IPD fostered collaboration and project goal alignment. These insights underscore the importance of matching the delivery method to the nature and complexity of a project to achieve optimal results.

The study also highlights the need for client education on PDM selection to enable informed decision-making. Effective project delivery requires not only choosing the right method but also integrating advanced tools such as Building Information Modeling (BIM), Lean Construction, and digital scheduling systems to support risk management and timely execution. The results suggest that project-specific goals such as tight timelines, budget constraints, or high collaboration requirements should guide the selection of delivery methods. While the quantitative approach of this research provided clear comparative outcomes, future studies could expand by incorporating qualitative insights through interviews or case studies, and further explore how emerging technologies influence the effectiveness of modern project delivery methods.

4.9 Summary

This chapter outlines the most significant outcomes of the study by evaluating the information that was gathered. While conducting the pilot survey, the dataset covers the several aspects such as Designation, Education, Total years of experience in construction industry, typical experience in building projects, Type of organization, and PDM experience. Also, four PDM factors were considered, Design-Bid (DB), Design-Bid-Build (DBB), Construction Manager at Risk (CMAR), and Integrated Project Delivery Method (IPD). Reliability analysis showed good results indicating that the data gathered for assessing various PDMs is very dependable and appropriate for analysis. The dataset underwent a normality test, all p-values were below 0.05, the data failed to satisfy the assumptions of normality. This indicated that non-parametric statistical test ought to be utilized rather than parametric tests. Using the gathered data statistics Kruskal-Wallis test was performed, which resulted no significant difference in p-value of any single group retaining the

Null Hypothesis. Insight into the factors being analyzed were provided through the calculation of the Relative Importance Index (RII) as well. These outcomes serve as evidence to bring out further examination and draw conclusions in the next chapter, validating the primary question and helping to understand the research issues.

Chapter 5

Conclusions and Recommendations

5.1 General

This chapter offers a thorough conclusion and recommendations derived from the results and analysis detailed in Chapter 4. The study sought to assess the efficacy of different Project Delivery Methods (PDMs) in meeting client objectives and to evaluate the degree of client involvement in projects managed by a single business responsible for both design and construction. The survey data, reliability testing, normalcy tests, and validity tests have yielded significant insights into the strengths and drawbacks of various PDMs. This chapter encapsulates the principal findings, formulates conclusions, presents recommendations, provides future research directions and also implementation of the research for enhancing project delivery methodologies within the construction sector.

5.2 Conclusions

- This study sought to evaluate the efficacy of several Project Delivery Methods (PDMs) in achieving customer objectives, utilizing data gathered from industry professionals via structured surveys. The investigation concentrated on various elements, including professionals' experiences with PDMs, their

educational credentials, organizational positions, and the significance of informing clients about PDMs.

- The selection of project delivery method should be based on the specific needs of the project, considering factors such as budget, timeline, complexity, and the desired level of stakeholder collaboration
- The Relative Importance Index (RII) is a valuable tool for understanding the strengths and weakness of each project delivery method. The results highlights the followings.
- DB with $\text{RII} = 0.704$ (Rank 1) signifies by unifying the project design and construction inside a single firm.
- Design-Bid-Build (DBB) remains the most widely used method, as conventional approach by scoring $\text{RII} = 0.728$ (Rank 1).
- The study reveals that CMAR with $\text{RII} = 0.720$, (Rank 1) underscores its capacity to improve constructability input and project efficiency from the beginning.
- The primary advantage of IPD is its capacity to minimize disagreement, evidenced by $\text{RII} = 0.729$ (Rank 1) resulting in the project efficiency enhancing.

5.3 Recommendations

In light of the findings, the subsequent recommendations are put out to improve the efficiency and efficacy of PDMs in the construction sector:

5.3.1 Complex and Fast-Track Projects

For complex and Fast-Track projects, use Design Build (DB) or Integrated Project Delivery (IPD) to leverage Integrated teams and flexibility for quicker delivery.

5.3.2 Projects with High Stakeholder Involvement

For projects with high stakeholder involvement, prefer Integrated Project Delivery (IPD) to faster collaboration, minimize conflicts, and ensure alignment.

5.3.3 Simple and Low-Risk Projects

For simple and low-risk projects, Design-Bid-Build (DBB) is ideal as it offers clear scope, predictable processes, and well-established roles.

5.4 Future Research Direction

Further research is necessary to explore the impact of different PDMs factors on project performance, cost and schedule. Additionally, examining the long-term effects of various PDMs on stakeholder relationships and organizational culture could provide valuable insights.

Further research is needed to explore the impact of emerging technologies, such as artificial intelligence (AI) and Block Chain (BC), on project delivery methods and to develop best practices for implementing collaborative approaches in complex projects.

5.5 Research Implementation

The results of this study can be implemented at multiple levels within the construction industry to enhance project delivery outcomes:

5.5.1 Strategic Planning Level:

Clients, consultants, and decision-makers can use the study's findings during the project planning and procurement stages to select the most appropriate project delivery method (PDM) based on project-specific factors such as budget, schedule urgency, complexity, and stakeholder involvement. For example, DB or CMAR can be selected for projects with tight budgets or timeframes, while IPD is suitable for highly collaborative and technically complex projects.

5.5.2 Organizational and Policy Level:

Construction firms and public sector agencies can integrate the Relative Importance Index (RII) approach into their internal guidelines and standard operating

procedures to objectively assess the trade-offs between traditional methods (like DBB) and collaborative approaches (like IPD and CMAR). This can inform updates to procurement policies and contractual frameworks.

5.5.3 Project Execution Level:

On-site project managers and engineers can apply the insights by aligning project team roles, responsibilities, and communication strategies with the chosen PDM. For instance, early contractor involvement in CMAR projects can be implemented to improve constructability reviews and reduce cost variations.

5.5.4 Educational and Training Level:

Universities, training institutions, and professional bodies can incorporate these findings into curriculum and continuing education programs. Teaching the strengths and limitations of each PDM supported by real-world data can improve the capability of future construction professionals to make informed decisions.

By implementing these insights across planning, execution, and organizational levels, the construction industry can improve efficiency, stakeholder satisfaction, and overall project success.

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Appendix-A

Issue No: _____



CAPITAL UNIVERSITY OF SCIENCE
AND TECHNOLOGY, ISLAMABAD

Department of Civil Engineering

Dear Sir,

I am Rana Muhammad Attique Ur Rehman, MS Research Scholar in the Department of Civil Engineering at Capital University of Science & Technology (CUST), Islamabad. I am conducting research on "Analyzing Performance of Building Projects in Terms Of Project Delivery Methods." Your valuable input is crucial for this study. I kindly request you to complete the attached questionnaire. The survey is designed to be engaging and insightful, and your response will provide meaningful contributions for this research. Please rest assured that all your responses will be kept strictly confidential and will only be used for academic purposes, without referring. Thank you in advance for your time and support in contributing to this important research.

Sincerely,

Rana Muhammad Attique Ur Rehman
Department of Civil Engineering

Analysing Performance Of Building Projects In Terms Of Project Delivery Methods

SECTION- I

Demographics

Personal Information

1	Name: _____	Organization Name: _____	Organization Type: _____	Contact Details: _____
2	Designation			
	<input type="checkbox"/> Owner/CEO			
	<input type="checkbox"/> Project Manager			
	<input type="checkbox"/> Residential Engineer			
	<input type="checkbox"/> Site Engineer			
	<input type="checkbox"/> Others (Pl Specify) _____			
3	Education			
	<input type="checkbox"/> Ph.D			
	<input type="checkbox"/> M.S Civil Engineering			
	<input type="checkbox"/> B.Sc. Civil Engineering			
	<input type="checkbox"/> Associate Diploma Holder			
	<input type="checkbox"/> Others (Pl Specify) _____			
4	Experience in Building Projects:			
	<input type="checkbox"/> 1-5			
	<input type="checkbox"/> 6-10			
	<input type="checkbox"/> 11-15			
	<input type="checkbox"/> 16-20			
	<input type="checkbox"/> 20-25			
	<input type="checkbox"/> More than 25 years			
5	Type of firm / Organisation:			
	<input type="checkbox"/> Client			
	<input type="checkbox"/> Consultants			
	<input type="checkbox"/> Contractor			
	<input type="checkbox"/> Other			
6	Please mark your experience in on follwing types of Project Delivery Methods (PDM,s) (Select all that Apply)			
	<input type="checkbox"/> Design-Build (DB)			
	<input type="checkbox"/> Design-Bid-Build (DBB)			
	<input type="checkbox"/> Construction Manager at Risk (CMAR)			
	<input type="checkbox"/> Integrated Project Delivery (IPD)			

SECTION- II

According to your Knowledge, Select the best option using the following scale
Strongly Disagree=1 Disagree=2 Neutral=3 Agree=4 & Strongly Agree=5

S.No	Questions	Response					
		Code	1	2	3	4	5
A.	There is need to educate the client about PDM's.	A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B.	Please rank the PDM which support client's objectives in a better way.	B					
a.	Design -Build (DB).		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	Design-Bid-Build (DBD).		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	Construction Manager at Risk (CMAR)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	Integrated Project Delivery (IPD)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e.	Other (Pl Specify):		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>Design-Build (DB)</u>							
1	DB Involves in owner contracting with a single firm for a project design and construction. The entire project is led by either the architect or the contractor depending on who the contract is with from start to finish.						
a	DB approach streamlines the construction process.	DB-01	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	DB method reduce conflict between design and construction team.	DB-02	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	DB approach contributes to better cost control.	DB-03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	DB method helps to control the project timeline.	DB-04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	DB method complies with quality standards.	DB-05	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	DB method identifies potential risks.	DB-06	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	How well the DB method promote communication between stakeholders ?	DB-07	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Clients are satisfied with the outcomes delivered by the DB method.	DB-08	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>Design-Bid-Build (DBB)</u>							
2	DBB also called tradional project delivery, involves a design team and general contractor working directly for the owner under separate contracts. The design team works with the owner to develop the contract documents drawings, specification and other exhibits only.						
a	DBB method effects the delivery time compared to other methods.	DBB-01	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	Sequential nature of DBB leads to improve design quality.	DBB-02	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	DBB approches result in cost overruns.	DBB-03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	DBB method impacts collaboration between stakeholders.	DBB-04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	DBB method allows flexibility in accommodating changes to the project schedule.	DBB-05	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	DBB method is associated with maximum quality monitoring during the project life cycle.	DBB-06	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	Evaluate that DBB method ensures proper allocation of risks.	DBB-07	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	DBB method meet or exceed client expectations in terms of quality.	DBB-08	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3	<u>Construction Manager at Risk (CMAR)</u>							
	CMAR, a construction manager acts is the owner's representative during both the design and construction phases. However the CMAR accepts the risk for meeting the project deadline and owner's cost requirements, which are usually expressed as a guaranteed maximum price (GMP).							
	a	CMAR method allocates the risks among stakeholders.	CMAR-01	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b	CMAR method promotes early involvement of contractors in the project lifecycle.	CMAR-02	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c	CMAR impacts overall project cost control.	CMAR-03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	d	CMAR improves project quality.	CMAR-04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	e	CMAR decreases uncertainties of project.	CMAR-05	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	f	CMAR have much potential to cause the delays.	CMAR-06	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	g	CMAR handles unforeseen risks during construction.	CMAR-07	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	h	CMAR enhances the trust and collaboration between teams.	CMAR-08	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Evaluate that CMAR ensures client's involvement throughout the project lifecycle.	CMAR-09	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4	<u>Integrated Project Delivery (IPD)</u>							
	IPD is a relatively recent addition to the suite of project delivery methods. In these projects, all the project team members are contractually connected with only one contract. All team members are selected before design begins, and they each play a role in the whole process, from design to construction.							
	a	IPD enhances the participation among project stakeholders.	IPD-01	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b	IPD reduces the likelihood of disputes during the project lifecycle.	IPD-02	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c	IPD improves efficiency in cost and time management.	IPD-03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	d	IPD address project risks effectively.	IPD-04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	e	IPD improves project scheduling efficiency.	IPD-05	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	f	IPD satisfies the quality of delivered outcomes.	IPD-06	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	g	IPD reduces the risk-related cost impact.	IPD-07	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	h	Measure the impact of IPD on aligning with project goals.	IPD-08	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Clinents usually recommends IPD for future projects.	IPD-09	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Any Comments please:								
Thank You for your Valuable Time								