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Critical Coordination Factors Affecting Design and Build Projects

A Comprehensive Review of the Literature

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Abstract – The design and build projects (DB) have increased in numbers in the last few decades. DB method is becoming more popular than the traditional method in Malaysia, especially in national projects.However, design-build projects may suffer from a significant number of problems, such as conflicts between the project parties (designers, contractors, and owners), resulting in poor performance and poor quality. One common cause of project failure of conventional projects is poor coordination and communication process. It has been found that no such study has been found to identify the coordination factors that might affect the project's success. To fill this gap, this research aims to establish a framework of coordination factors affecting DB projects' performance in Malaysia. This study uses a mixed methodology approach to identify critical coordination factors by a comprehensive review of the literature. The identified factors were categorized, ranked, and prioritized according to their influence on project performance using a quantitative approach. It is found that scheduling and planning, human resource coordination, documentation & records coordination, contract implementation coordination, value engineering and quality assurance, technical coordination, design coordination, management coordination, and external coordination are the significant factors of coordination that may affect the performance of construction projects. This study provides empirical evidence by correlating the identified coordination factors with DB project performance. Identification of coordination factors will help in enhancing and improving the performance of design and build projects.

Keywords: *construction, coordination factors, critical coordination, design and build, project performance.*

I. INTRODUCTION

The construction industry has recently faced a surge in large-scale projects that involve complex construction processes (Luo et al., 2017). The construction industry plays a crucial role in the economy of any country, as it contributes to around 6-10% of the GDP of developed countries and 3-6% to the GDP of developing countries (Ajayi & Oyedele, 2018b; Yap et al., 2019). Despite the rapid growth, this

sector still suffers from serious issues such as delays, additional costs, poor quality and construction waste(Memon et al., 2014; Zidane & Andersen, 2018)

The emergence of design and build (DB) projects has become a replacement for traditional projects, which have become prevalent, particularly in the public sector (Lee et al., 2020; Saaidin et al., 2016). In the DB method, work must be performed through an effective cooperative process among project parties (Barrane et al., 2021). The DB method provides certain benefits to projects because it involves a single entity responsible for both the design and construction aspects (Said, 2021; Zulch & Kitshoff, 2021). Studies suggest that the coordination among stakeholders, including clients, contractors, and consultants, has a major impact on the success of DB projects in public projects (Lee et al., 2021). Therefore, less information on the DB project method caused poor performance of projects (Lee et al., 2021). Additionally, operational coordination is also the main criterion determining the success of DB public projects.

Previous research focused on issues of DB projects such as terms and requirements for selecting the contractor (Abbas et al., 2016; Ding et al., 2018). However, there is a dearth of research focusing on the coordination issues between the design team and the construction team which usually happen in DB projects (Ajayi & Oyedele, 2018a; Chang et al., 2010). Consequently, construction project complexity requires genuine coordination between the project team in the early stage of the project. Not much research has been carried out concerning pre-construction planning, which is the incorporation between designer and contractor in the early stage to facilitate construction (Abbas et al., 2016; Yap et al., 2018). According to Al Nahyan et al. (2019), additional strategies should be employed, such as planning, monitoring, coordinating, controlling, communication, and decision-making, to attain project success. Nonetheless, there is a research gap in pinpointing the coordination factors that influence the performance of DB projects.

Coordination factors in DB projects are not the only factors that affect the performance, but they are vital components of the communication and coordination process which may have a significant effect on DB project performance. Identification of the criticality of coordination factors affecting the DB project performance will fulfil a gap in the literature.

The study aims to develop a framework for identifying critical coordination factors that affect the performance of design-build (DB) construction projects. Therefore, the research objectives of this study are to identify the importance and significance of coordination factors and to explore the critical coordination factors for DB projects.

The finding of this study provides support to create a harmonious working environment and better communication and integration between project actors with a well-developed relationship among key parties. Consequently, the performance of projects will improve. There are few studies and research conducted in identifying coordination factors influencing the performance of construction projects. However, this study focuses on the DB types of projects due to the necessity of coordination processes in these types of projects. Hence, the finding of this research will provide useful insights for academicians and practitioners to understand the DB coordination framework.

This study stands out as it offers both theoretical and practical implications while presenting a coordination framework for DB projects. The framework identifying coordination factors is expected to assist in resolving coordination problems and enhance DB project performance.

II. METHODS

In this SLR Kitchenham technique has been followed and introduced by Kaiwartya et al. (2016). Further to conduct the SLR on coordination factors six phases have been conducted to develop this study. These phases include 1) defining research questions, 2) formulating a search strategy, 3) Selection of studies, 4) Quality assessment, 5) Data mining, and 6) Integration of data.

The articles reviewed in this paper were identified through a comprehensive literature search process. This process involved conducting keyword searches across various literature sources, followed by a thorough screening of identified studies to select only the most relevant ones. The selected studies were then integrated into the paper's findings and synthesized to present a comprehensive overview of the topic under review. In summary, the process included four main steps: keyword search, literature sources, selection of relevant studies, and integration of data.

The search of the literature was strictly limited to the coordination factors in construction projects and coordination factors in BD projects. Moreover, different project stages are included along with the main search keywords. Hence, the term "Coordination Factors in Construction Projects is considered as the main search term and then the underlying steps we followed:

1. Different synonyms of search terms were used.
2. Different spellings of search terms were also used.
3. The important keywords from the most relevant articles were used to enhance the search.
4. Additionally, some operators like "AND & OR" are utilized to enhance the literature search.

The literature was searched on prestigious literature databases including Science Direct, Web of Science, Scopus, IEEE, and ACM. Furthermore, the advanced search option of selected databases is used to find relevant literature.

The literature search for relevant studies included 71 research papers where 25 papers were from ScienceDirect, 19 from ACM Digital Library, 11 from IEEE Xplore, and 16 papers were accessed from Web of Science. It is important to mention that the 71 research papers that were selected at the initial stage were unduplicated papers. Further, we filter out irrelevant studies in two phases.

1) Phase 1

In this phase criteria to include and exclude the selected papers have been developed. This is significant to include only relevant studies which have useful information on the subject matter.

Induction criteria: We have included studies that have significant information on the coordination factor in the construction industry and coordination factors in DB projects. The research papers containing similar concepts like crucial factors in DB projects and critical factors in DB projects were also included.

Excluding Criteria: The irrelevant research studies were excluded. For instance, some irrelevant studies were selected due to the use of relevant terms like "critical factors" or "important factors" were used to search literature.

2) Phase 2

In this phase, quality assessment criteria were applied to the selected papers from phase 1. The paper that has successfully passed phase 2, was selected for further discussion.

Quality Assessment Criteria: The accuracy of literature is a vital subject while conducting SLR. Hence, this phase ensured the accuracy of the literature to maintain the quality of the results of this study. The quality assessment criteria (QACs) that have been followed are listed below:

QAC1: The selected study is significant on the subject matter.

QAC2: The study is particularly relevant to construction industry projects.

QAC3: The study has shed light on the significance of coordination factors in the construction industry.

QAC4: The study has related to the identification of coordination factors in construction projects.

QAC5: The selected study is rigorous.

Further, three anchor assessment criteria were utilized to score the selected studies on QAC. The three-point score consists of 0, 0.5, and 1. Where "0" corresponds to NO, 0.5 corresponds to Partly and "1" corresponds to "Yes". However, only those studies that scored >=0.50 were included in this study. Table 1 below explains the QAC record.

Table 1. Quality Scores

Study ID	QAC1	QAC2	QAC3	QAC4	QAC5	SCORE
CF1	1	1	1	1	1	100%
CF2	1	1	0	1	1	80%
CF3	1	1	1	1	1	100%
CF4	1	1	1	1	1	100%
CF5	1	1	0	0	1	60%
CF6	1	1	0.5	1	1	90%
CF7	1	1	0	1	1	80%

Table 1. Continued

Study ID	QAC1	QAC2	QAC3	QAC4	QAC5	SCORE
CF8	1	1	0	0.5	1	70%
CF9	1	1	0.5	1	0.50	80%
CF10	1	1	1	0.5	0.50	80%
CF11	1	1	1	1	1	100%
CF12	1	1	0.5	1	1	90%
CF13	1	1	0	1	1	80%
CF14	1	1	0.5	1	0.50	80%
CF15	1	0.5	1	0.5	1	80%
CF16	1	1	0.5	1	1	90%

In this step of integration of data, the output data was combined to answer the research questions. For our research questions, the narrative synthesis method was used for the answers. Table 2 presents the primary studies and relevance of studies according to research questions.

Table 2. Primary Studies

ID	AUTHORS	R1	R2
E1	Chang et al., 2010	●	●
E2	Cheng & Tsai, 2008	●	●
E3	Memon et al., 2014	●	●
E4	Zidane & Andersen, 2018	●	●
E5	Osmani, 2013	●	●
E6	Urup, 2016	●	●
E7	Rahman et al., 2021	●	●
E8	Alaloul et al., 2016	●	
E9	Azhar et al., 2021	●	
E10	Yap et al., 2021	●	
E11	Wong and Soo, 2019	●	
E12	Amoah et al., 2011		●
E13	Enshassi, 2010		●
E14	Ismail, 2012	●	●

The construction sector affects the economy of any country. The overall economic activities were boosted by the uprising construction industry. However, the construction industry is still facing a problem that is directly affecting the performance of construction projects. This, therefore, instigates the need to understand the specific problems directly hitting the performance of construction projects. The scope of this study focuses and narrows the research to a specific type of contract, a specific type of project, and a certain area and subject. The scope of this research is as follows:

1. This research focuses on DB projects.
2. This research studies the important coordination factors influencing DB project performance.
3. Coordination factors have been identified in each aspect of DB projects such as design factors, human resource factors, scheduling and planning factors, documentation factors, contract implementation factors, technology factors, quality factors, and management factors.

III. RESULTS AND DISCUSSION

The review of the literature and analysis of selected studies found that there is a dearth of literature on the coordination factors in DB projects. The filtration techniques provided only 16 studies relevant to the topic. It is further, found that the candidate studies were made 87.5% from journals, and the

remaining 12.5% were studies selected from conferences.

A. Coordination Challenges in Design and Build (DB) Projects

The construction industry uses different delivery methods, such as the design bid build (DBB) and the design and build (DB) method. The DBB method, also known as the traditional delivery method, involves dividing the work into two phases: the technical study and design stage, and the implementation stage. The bid process starts after the completion of the design stage, and the contractor is selected based on their financial and technical offers. In the DBB approach, the contractor isn't accountable for the designs, and the owner has the option of hiring a consultant to supervise the construction operations. Despite this, DBB projects have encountered several issues such as delays, conflicts, and extra expenses (Chang et al., 2010; Lee et al., 2020). In the DB type, the owner appoints a single party who is in control of the construction and design processes. In contrast to the DBB method, the contractor can begin construction activity instantly after the designer completes the preliminary designs. This is to keep off the delay faced by traditional projects. From a construction industry perspective, every project should be examined on a case-by-case basis to identify the most suitable project delivery method (Ding et al., 2018).

The little information on DB projects and unfamiliarity with the coordination flow in DB projects caused the failure of most DB projects (de Carvalho et al., 2015). Hence, a significant need has been addressed to identify critical factors affecting the DB projects performance (Lee et al., 2020). Research by Chen et al. (2016) showed that using the DB approach can result in good time performance, as more than 75% of DB projects are finished on time or earlier than expected. However, over 50% of DB projects go over budget, which raises doubts about whether the cost-saving benefits of DB are reliable (Chen et al., 2016, p. 1; Moon et al., 2020). Moon and colleagues (2020).pointed out that there are situations where DB may not be better than DBB, despite the lower cost growth.

In recent times, construction projects have become more intricate as designs have become more difficult and the number of users has become more diverse. As a result of this complexity, coordination issues may arise in DB projects because of the abundance of complex information and numerous actors involved in the design and construction process (Thunberg et al., 2017; Wu et al., 2017; Yap et al., 2021).

Few coordination studies are carried out on DB problems and most of the problems in DB projects are related to coordination (Chang et al., 2010; El-Sabek & McCabe, 2018). The issues with design and construction overlap can take various forms, including a lack of collaboration and inadequate coordination between the designer and builder, incomplete information and designs, as well as insufficient relevant experience (Cheng & Tsai, 2008; Yap et al., 2021).

The DB projects will lose their advantages if the problems in coordination persist. If there is no right coordination process and collaboration in transforming data between the contractor and designer, the DB projects will fail to keep their advantages over traditional projects (Chang et al., 2010; Tayeh et al., 2018). Consequently, the coordination process is a crucial factor that affects the performance of DB projects (Chen et al., 2021; Urup, 2016). Finding a proper solution for coordination problems will make the performance better in the DB project (Azhar et al., 2021; Chang et al., 2010). Lee et al. (2020) conducted a study for public sector construction projects and stated that DB projects are significant in lowering the project risk as the designing and construction of the project are at the same time which reduces the coordination gaps. Dang and Le-Hoai (2017) argued that in DB projects, communication with team members is the responsibility of the contractor which is good to have a single contact point. The major coordination issues in construction projects are ill-defined project goals, low written agreement clarifications, and irregularity in progress reports (Lee et al., 2020). In line with this (Lu et al., 2017) found that major factors that influence the performance of DB projects are related to coordination like the contractor’s ability to communicate with the team and experience to handle and smoothly resolve the communication gaps between team and manager. Few studies were established on the DB project problems and most of the issues are usually related to coordination (Chang et al., 2010; Yap et al., 2021). Previous research emphasises on upstream issues such as conditions for selecting the contractor, however, few researchers address the design and the problems of construction coordination and correlate the performance of DB projects with the coordination process. In conclusion, no comprehensive research has been conducted to examine the crucial coordination factors in DB projects.

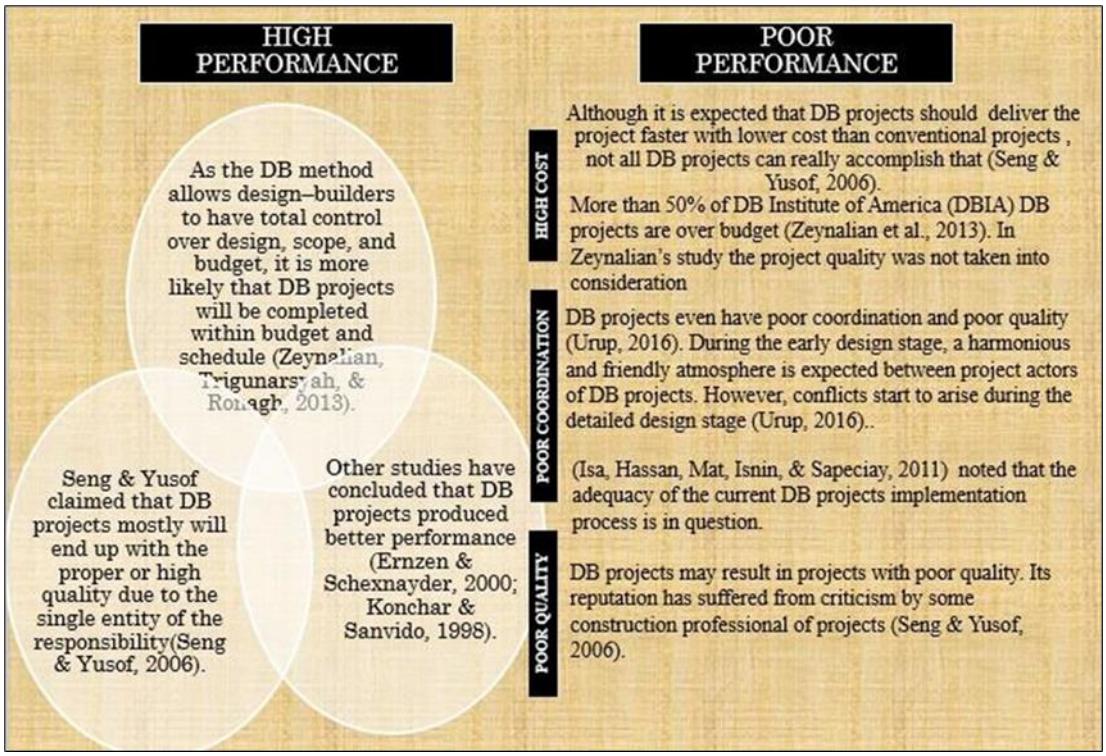

Fig. 1. Previous Researchers' views on DB Projects Performance

B. Coordination and Design Management Challenges in Design-Build Projects

The design and construction (DC) overlap in DB projects may give rise to issues which is not the character of design bid build (DBB) projects (Chang et al., 2010; Kalach et al., 2021; Saaidin et al., 2016). In DB contracts, participants must engage in a collaborative process to ensure the quality of the project, which is sensitive to the coordination process (Feghaly et al., 2021; Urup, 2016; Yap & Skitmore, 2018). Based on Chang et al. (2010) study, the issues encountered in DB projects, such as the absence of cooperation and coordination between the construction team and designer, insufficient completed information on drawings, and lack of relevant experience, can lead to extra expenses, delays, and even project failure.

In addition to the construction coordination problems, DB projects sometimes face design management issues. DB projects have imposed on contractors the need to manage design to maintain competitiveness. Therefore, design management requires proper coordination between the contractor and the designer. Many stakeholders such as designers, project managers, engineers, and consultants are involved. Therefore, feedback from construction activities sometimes takes a long time to be received by the designer and tends to be ineffective (Townsend & Gershon, 2020).

Unfortunately, most of the literature has been focused to highlight the importance of the construction process while measuring the process delays and hindrances (Rahman et al., 2012). Although some works have been conducted to explain the coordination issues in the construction project mainly focused on interpersonal communication problems (Chang et al., 2010; Latiffi & Zulkiffli, 2021). Chen et al. (2021) argued that effective coordination is necessary between the designer and contractor to avoid designing issues and timely feedback on the site. This may lead to effective time management in the completion of construction projects and save costs incurred due to faulty designs.

Even though design and build contracts are waived the risk of designs between the owner and the contractor, DB projects still have some risks. The risks of delays and disputes remain due to internal poor coordination amongst the builder, designer, and the owner or the project manager (who usually represents the owner). In general, the problems of DB projects are not severe compared to traditional projects. This is due to the separation of construction works and design (Chang et al., 2010). However, proper coordination, planning, and related experience will eliminate delays and cost issues. Moreover, the significance of coordination issues increases when an owner persuades a designer and a contractor who has never been co-design builders with each other to team up for the owner's project (Renz & Solas, 2016).

Another problem that may arise in DB projects is design waste. The design waste occurs because of the lack of proper coordination between the contractor and designer. This may lead to inadequate follow-up with the requirements of the owner and an increase in change orders during the construction stage which ultimately hit the efficiency of the project (Osmani, 2013). Lack of proper coordination and communication between the various project stakeholders can lead to design waste in all project stages (Ajayi & Oyedele, 2018b; Osmani, 2013). Ajayi & Oyedele (2018a) have also contended that design waste arises from the disjointed result of poor coordination and communication among project members.

C. What are the coordination factors? Why are they important for construction projects?

There is no existing coordination theory in literature as construction projects vary in nature, condition, and type. Therefore, it is difficult to find a typical coordination theory that suits all construction projects. It is hard to find a clear definition of coordination theory and there is no certain definition of coordination theory (Alaloul et al., 2016; Urup, 2016).

When dealing with coordination, professionals mostly mention the dependency condition or difficulty to work together (Hai et al., 2012). However, coordination factors are considered as a group of processes such as a plan of procurement, critical tasks' priorities, task dependencies identification, plans, reports, and meetings to establish a harmonious working environment (Alaloul et al., 2016). It can be realized that there is no well-founded definition of coordination in this field. Although the coordination process in construction projects has not yet been determined, it is considered by many researchers as a critical procedure that influences project performance and success.

Coordination issues can occur in Design-Build projects as a result of inadequate planning and implementation (Chen et al., 2021). Inappropriate planning can involve excessively detailed concept designs, while implementation may include an inconsistent amount of design concurrence (DC), lengthy review processes, and slow feedback between builders and designers (Yap et al., 2021). The absence of DC coordination can result in cost and time overruns and even conflicts (Al Nahyan et al., 2019). Furthermore, it can be challenging for the designer to work closely with the construction team, primarily due to limited feedback from the construction site. As a result, a proper coordination process is crucial for the successful execution of DB projects.

Although projects can be unique, the overlaps among them can vary depending on the project. Thus, it is increasingly important to coordinate the scheduling process in DB projects. Some cases have been reported where poor coordination among contractors, designers, and subcontractors led to postponed projects (Urup, 2016; Zidane & Andersen, 2018). Coordination is also crucial in scheduling, and it is considered a major cause of delays in construction projects (Yap et al., 2021). According to several studies conducted on the performance of construction projects, improper scheduling by the main contractor played a significant role in affecting project performance (Amoah et al., 2011; Shahid et al., 2015; Zidane & Andersen, 2018). Zidane & Andersen (2018) identified weak coordination in planning and scheduling and poor communication and coordination among the parties of the project as the top universal time-lag factors in construction projects.

Construction projects still encounter coordination issues. The construction industry is highly fragmented, and its project participants have poor coordination which leads to challenges in controlling material with time and cost overrun. According to several studies, inadequate communication during scheduling by contractors is the most serious problem affecting construction costs (Al Nahyan et al., 2019; Hameed Memon et al., 2014). As per Memon et al. (2014), improper scheduling and planning by the main contractor is a significant factor that influences the project's cost performance.

Recognizing the importance of communication, it is vital to schedule regular design progress and construction progress meetings between the designer and builder. Essential regular project meetings include those with the project manager (PM), the contractor, the designer, and subcontractors, as reported Mutha and Ghadge (2018). Rahman et al. (2012) further reported that frequent coordination and progress meetings between designers and contractors are crucial for controlling time and cost in construction projects in the central and southern regions of peninsular Malaysia. Ongoing progress meetings are also necessary to maintain a continuous feedback cycle. The benefits of DB projects cannot be fully realized if the feedback loop between the designer and constructor does not function properly (Construction Management Association of America, 2015; Park & Kwak, 2017). Chang et al. (2010) emphasized that adequate coordination in planning is essential for clearly defined tasks and the necessary time for each task. Therefore, an overall construction project management (CPM) schedule

that includes all project tasks should be developed to present the work breakdown structure (WBS). Coordination among team members is also important for task prioritization.

To enhance collaboration and team synergy, it is important to establish an effective coordination process, as indicated by Doloi et al. (2012). Such a process can improve relationships between various groups within an organization, with coordination playing a critical role in ensuring collaboration and a cooperative working environment for all stakeholders involved in the project's tasks and activities. The absence of proper coordination procedures among project participants has resulted in an increased number of discrepancies and delays in the construction process. Despite the challenges that are often encountered in coordinating various aspects of construction projects, the ability to work cooperatively is fundamental to the success of the project, as noted by Yap et al. (2021) and Yap et al. (2020).

Effective coordination is especially important for the procurement process and internal resources, such as human resources (Hai et al., 2012; Razak et al., 2015). To explore the relationship between performance and internal resources, mediated by coordination, a framework has been proposed based on resource-based theory. As construction projects can differ, further research is needed to investigate this proposed framework. Coordination issues can arise due to the unique structures of DB procurement methods and the lack of experience of staff in these types of projects, which in turn can impact project performance (Lee et al., 2020, 2021; Zidane & Andersen, 2018). Therefore, the main contractor and the PM must have adequate knowledge and experience in DB contracts. Failure to do so may result in problems and the loss of benefits associated with DB projects. Moreover, insufficiently trained team leaders can lead to poor coordination and communication with team members, which can negatively impact project performance (Townsend & Gershon, 2020).

The proper documentation process is crucial for capturing the fast-paced nature of DB projects. If the documentation is incomplete or contains errors, it can cause delays and inadequate design, which can eventually affect the performance of the construction project (Zidane & Andersen, 2018). To minimize costs and complete the construction project within the specified budget, waste effectiveness is a significant factor that needs to be considered, taking into account material, design, quantity, timetable, and budget (Ajayi & Oyedele, 2018b). Coordination is also important during the project construction phase for the proper execution of drawings, directives, and verbal instructions, which can improve the overall project performance (Alaloul et al., 2016; Alaloul et al., 2021).

Although critical, coordination in construction projects is often not well understood (Alaloul, Liew, & Zawawi, 2016). Researchers have emphasized the importance of coordination processes in construction projects, considering them as significant as designs and construction. Therefore, experts must adopt appropriate coordination processes in construction projects. High-quality and effective coordination among participants in construction projects leads to better project performance. Coordination is essential to establish teamwork and integration in a work environment, and it is a fundamental factor for the success of a construction project (Hai et al., 2012; Tabassi et al., 2019).

D. What are the critical coordination factors affecting the DB project performance?

One proposed solution for coordinating Design-Build (DB) projects is through cooperation and collaboration among participants, according to Urup (2016). Poor coordination and communication between stakeholders have been identified by Ajayi and Oyedele (2018a) and Osmani (2013) as major causes of design waste throughout all stages of a project. The frequency of indicators of coordination factor in literature grouped according to the nature of coordination and summarized as follows:

1) Scheduling and Planning Coordination

The planning and scheduling coordination involves coordination in writing a project brief, methods of execution, and plans of activities delivered by the owner/contractor/consultant. In addition, coordination in schedule preparation and updates of schedules (Alaloul et al., 2016) is crucial for maintaining a systematic control mechanism coordination plays a vital role. Furthermore, information gathering about all requirements to be used in scheduling and planning before the project start is important for coordination (Memon et al., 2014). It is vital to identify the urgent activities to give them priority hence, proper coordination is of the utmost need among all relevant parties (Amoah et al., 2011). The tracking of the completed task is also important to hand over finished parts of the project to the owner and without coordination among different departments, it can result in some delays (Rahman et al., 2012). Additionally, the identification of task dependencies to facilitate scheduling and planning

needs coordination among relevant stakeholders, therefore, a liaise with a designer, subcontractors, and suppliers plays a significant role (Chang et al., 2010).

2) Human Resource Coordination

Human resource coordination is an integral element for the success of construction projects (Memon et al., 2014). The estimation of the workforce for each task needs coordination with all the relevant departments. The proper placement of staff according to experience and expertise also needs coordination between contractor and manager (Amoah et al., 2011). Further, to avoid frequent staff turnover a communication channel is necessary to coordinate with staff members to mitigate the difficulties faced by staff. Moreover, the capability of the project manager is also important to coordinate with the owner, designer, and other contractors.

Informal contacts to facilitate work and solve any arising issues is also significant (Alaloul et al., 2021). Frequent communication among human resources is significant to facilitate information transfer (Al Nahyan et al., 2019). Hence the use of information technology is also good to smoothen information sharing and integration of designs (Abazid et al., 2019).

3) Documentation and Record Coordination

Multiple indicators were used in prior studies to measure documentation and record in construction projects. The written correspondence among different parties using letters, memos and reports are required for clarification and documentation of record (Alaloul et al., 2016; Amoah et al., 2011). Moreover, record-keeping of quantities of work completed and detailed information required for as-built drawings coordination and giving execution plan of responsibilities to all parties are important (Wong & Soo, 2019).

4) Contract Implementation Coordination

The implementation of the agreement requires that the contract must be understandable. A contact person must be appointed to coordinate with all the relevant parties. Further, ongoing communication is necessary to make necessary changes to the contract and to obtain specifications and technical information (Wong & Soo, 2019).

5) Value Engineering (VE) and Quality Assurance

Maintaining consistency between the architect's directives and updated working drawings is crucial for ensuring conformity in the application of value engineering (VE) and quality assurance (Tayeh et al., 2018). The research has been conducted to determine the time and cost performance for the success of the project, it has been reported that the construction industry of Malaysia faced poor performance and failure in the achievement of time and cost constraints, which further increased the cost (Rahman et al., 2012).

6) Technical Coordination

One way to evaluate technical coordination in a project is to use a coordination program that can identify issues with project performance and work management scheduling (Memon et al., 2014). Consistent technical support from the head office is crucial for maintaining effective coordination.

7) Design Coordination

Design coordination is measured by legislation between designers and contractors to avoid design changes and variations (Amoah et al., 2011; Wong & Soo, 2019). Similarly, to avoid a large amount of design construction concurrence frequent feedback between the designer and builder is crucial (Kamaruddeen et al., 2020). Additionally, time-to-time communication is performed to avoid time delays in the design review process by the designer.

8) Management Coordination

Management coordination is measured with coordination for clear job duties and a clear communication path for the authority of front-line staff (Memon et al., 2014). A working coordination channel between management and the project manager for the proper paperwork to record each step of the project. The feedback is adequately directed to avoid construction mistakes and defective work. Further, the project manager (PM) is coordinating with top management, and proper feedback by the client is being coordinated with top management (Enshassi et al., 2010).

9) External Coordination Factors

Effective coordination with external entities is crucial for successful construction project

performance, as external coordination factors can have a significant impact. It is essential to work with relevant authorities to prevent obstacles that may result in significant setbacks in terms of cost or time. For instance, the environmental department is always concerned with air and noise pollution due to construction. The management of waste on-site is also a matter of concern for authorities that need to understand and coordinate timely. Moreover, getting permits from the municipality at the appropriate time and updated information on changes in laws by the government could not be achieved without an efficient communication channel (Enshassi et al., 2010; Kumar, 2016). Periodic progress and evaluation meetings between the top management, site personnel, the designer, and the contractor are necessary to obtain certificates and inspection by the third party if needed. Effective collaboration and communication between the project manager and the legal team are crucial for minimizing the adverse effects of external factors.

IV. CONCLUSION

The construction industry has seen significant growth in recent years, leading to an increase in project complexity and the need for effective coordination among project stakeholders. Poor coordination can negatively affect project performance in terms of quality, time, and cost. The current study focuses on design-build (DB) projects in Malaysia and identifies critical coordination factors that impact project performance in various aspects of the project, including design, human resources, scheduling and planning, documentation, contract implementation, technology, quality, and management. Risks associated with DB projects include delays, disruptions, and wastage of design due to poor coordination and communication. Effective communication and coordination can improve project performance and establish well-developed relationships between project members. The study aims to establish a coordination framework for DB projects in Malaysia to enhance project performance and fill the gap in the literature by comprehensively addressing the coordination factors that affect DB project performance. The study's objectives are achieved by assessing the under-discussed phenomenon and determining the coordination factors that impact DB project performance and establishing a framework for effective coordination and communication. The study contributes to enhancing DB project performance in the construction industry and provides practitioners and academicians with a better understanding of the importance of coordination and communication in construction projects.

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