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Article

Design bid build to integrated project delivery: Strategic formulation to increase partnering

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Abstract: COVID-19 pandemic has caused many design bid build projects to suffer losses. Design bid build or DBB has the disadvantage of depth partnering. The research purpose is to reveal the depth of partnering of DBB, the characteristics of existing partnering in DBB through detection in each project life cycle in DBB, then efforts to increase DBB partnering to partnering in integrated project delivery (IPD). The methodology used is secondary data from three project DBB, then validation using focused group discussions (FGD) with expert judgment, then the Delphi method to analyse and propose recommendations. This project recommends that DBB project can improve the project performance so stakeholder can increase partnering toward integrated project delivery (IPD) partnering. This research can be used for increasing partnering in DBB projects towards partnering in IPD. This research will produce strategic recommendations that can be utilized by stakeholders (owner, contractor, designer) in improving project performance to generate great value for the project, will result in long-term project sustainability, improve relationships, and learn valuable lessons for future projects. DBB projects usually experience many problems due to the competitive nature of partnering for owners, contractors, and designers, so it is necessary to develop an overall strategy as an option to improve partnering in DBB project contracts. This research will help create a sustainable project by the owner, contractor, and designer.

Keywords: design-bid-build; integrated project delivery; maturity partnering; partnering; project life cycle

1. Introduction

All construction projects always want to be successful in achieving their goals, namely the achievement of indicators of cost, quality and time in accordance with the principles that are believed and set as indicators of the project being said to be successful for handover. Previous research has revealed that there are still impeding issues in construction projects that delay the project and prevent all indicators from being met (Sari et al., 2021; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Sari, Irawan, Wibowo, Siregar, Tamin, et al., 2023). Changes in design, specification, cost overruns, and variation orders all indicate that a project is not completed properly (Ballard, 2000a; Hermanto et al., 2018; Koskela et al., 2002; Koskela, Howell, Lichtig, 2006; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Sari, Irawan, Wibowo, Siregar, Tamin, et al., 2023). The most difficult aspects of implementing lean

construction are (1) concept comprehension, (2) design and construction integration, and (3) effective communication among the various participants(Adamtey, 2021; Katar, 2019; Kraakenes et al., 2019; Lam et al., 2004; Tran et al., 2016; Xia et al., 2015). In the field, various project delivery systems have been implemented with varying goals in mind to improve project quality. A common project delivery system is design-bid-build.

1.1. Partnering in construction project

A long-term commitment between two (owner and contractor) or more organizations (owner, contractor, consultant, sub-contractors, supplier, etc.) to improve communication, engagement to achieve specific project objectives by maximizing the effectiveness of each participant's resources is defined as partnering in construction project (Eriksson, 2015; Larsson and Larsson, 2020; Thompson' et al., 1998). According to Thompson et al. (1998), partnering is classified into four levels there are competition, cooperation, collaboration, and coalescence. Each of them possesses the following characteristics, according to **Table 1**, shown the depth of partnering begins with competition and progresses through cooperation, collaboration, and coalescence (Thompson et al., 1998). Increased partnering yields numerous benefits and adds value to construction projects. Partnering have implications for risk sharing and culture sharing at the most fundamental level(Thompson et al., 1998).

Table 1. Characteristics level of partnering (Larsson and Larsson, 2020; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Thompson et al., 1998).

No.	Level of partnering	Characteristics
1)	Competition	1) There is no shared objective that is created and can cause conflict. 2) Measure the success of the project from the costs incurred. 3) Short term focus on implemented projects. 4) Not developing a comprehensive measure of the project. 5) Relations are competitive. 6) There is no overall improvement on fragmented projects. 7) Single contract on project implementation only owner and contractor. 8) Trust is not deep and there is no risk sharing in the project.
2)	Cooperation	1) Project objectives began to be prepared together. 2) There is an increase in interpersonal relationships in the project. 3) Each team member is involved in partnering that occurs in the project 4) Using previous project experience as a lesson learned to be developed in the project. 5) Communication is developed better. Trust begins to grow by developing a risk-sharing scheme in project planning.
3)	Collaboration	1) Long-term focus on strategic goals in order to participate in project implementation. 2) Project participants collaborate with one another. 3) Project and relationship measurement system that is consistent. 4) Improving the process of joint project control. 5) Relationship-based metrics linked to team incentives

Table 1. (*Continued*).

No.	Level of partnering	Characteristics
4)	Coalescence	1) Development of a comprehensive and joint measurement system. 2) Collaborative in carrying out work from start to finish. 3) Cultural integration in work management. 4) Transparency in cooperation 5) Trust is very high and risk sharing occurs.

Figure 1 describes the partnering that has been carried out since before the project started between construction project stakeholders which will result in joint evaluation, escalation, continuous improvement, and persistent leadership, to produce projects with better performance includes cost, quality, time safety and environmental (Elizar et al., 2017; Li et al., 2013; Love, 2002; Ramanathan and Narayanan, 2012).

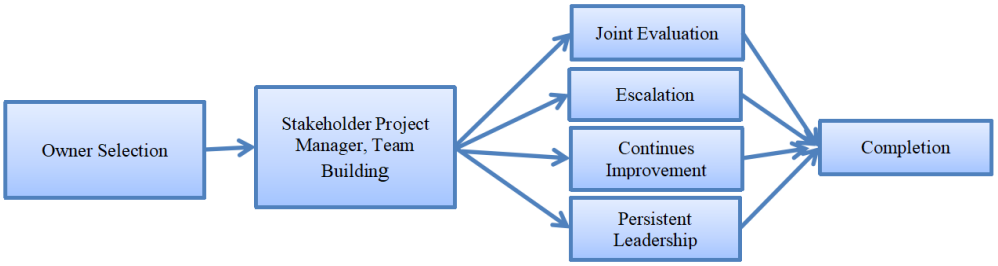

Figure 1. Project partnering framework (Larsson and Larsson, 2020).

1.2. Design bid build project

1.2.1. Characteristics

The project delivery system is a set of activities and stakeholder involvement based on the project's life cycle, which contractual relationships between stakeholders and mechanisms for managing project performance in terms of cost, quality, time, safety, and the environment (Elizar et al., 2017; Pal et al., 2017; Xia et al., 2015). The three main types of project delivery systems are design bid build (DBB), design and build (DB), and integrated project delivery (IPD) (Asmar et al., 2013; Katar, 2019; Sari, Irawan, Wibowo, Siregar, Praja, 2023). The project delivery system influences the project's communication and performance patterns (Sari, Irawan, Wibowo, Siregar, Praja, 2023; Asmar et al., 2013; Baiden et al., 2006; Eriksson, 2015; Larsson and Larsson, 2020) as well as stakeholder involvement before the project begins and stakeholder involvement throughout the project life cycle.

Design-bid-build is used when the owner wants to separate functions in the construction process. The owner prefers that a different company design and build the project. It strives for professionalism in the work performed within their respective scopes (Ashcraft, 2022; Glavinich et al., 2008; Katar, 2019; O'Connor, 2009).

In **Figure 2**, The owner first hires a team of architects and engineers to prepare design work, which leads to the preparation and development of drawings and technical specifications in accordance with construction documents that describe the

building's details. In contrast to DB projects, where the agreement is between the owner and a single entity to carry out design and construction work under the same contract, the implementation of design and construction is carried out by different entities (designer & builder). The owner creates definitive design criteria that must be followed in cases where part or all the design and construction can be completed by the designer or subcontracted to another company (Asmar et al., 2013; Katar, 2019; Kent et al., 2010; Molenaar and Johnson, 2003; Patil and Molenaar, 2011). The DB projects are under consideration.

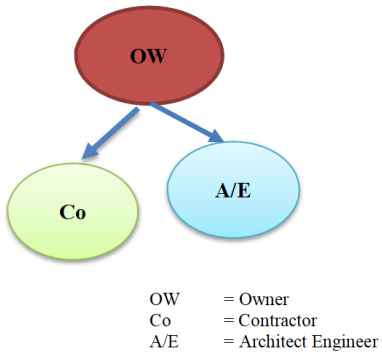

Figure 2. Design Bid Build (DBB) (Asmar et al., 2013; Katar, 2019).

Construction firms were then invited to bid on the project. Before estimating the costs to build this project, each bidding company examines the construction documents. The bids are then evaluated by the owner, and the construction contract is awarded to the bidder who he or she believes is the best fit. This decision may be made solely based on the bid price, or it may take into account other factors related to the bidder's qualifications. As a result, the construction documents become part of the construction contract, and the work is completed by the chosen company. Except for small projects, the winning company serves as general contractor, coordinating and managing the entire construction process. It may, however, rely on smaller, more specialized subcontractors to complete the majority, if not all, of the construction work. During construction, the design team continues to provide services to the owner, ensuring that the project adheres to the document requirements and answering questions about design, contractor payments, job changes, and other similar issues. As a result, the construction documents become part of the construction contract, and the chosen company completes the work. Apart from small projects, the winning firm acts as general contractor, coordinating and managing the entire construction process. However, the majority, if not all, of the construction work may be completed by smaller, more specialized subcontractors. Throughout the construction process, the design team continues to provide services to the owner, ensuring that the project adheres to the document requirements and answering questions about design, contractor payments, job changes, and other similar issues (Ballard, 2000b; Howell and Ballard, 1998; Tommelein, 2015).

1.2.2. Maturity partnering of DBB

The partnering process in the DBB project delivery system is classified based on the following stages (Katar, 2019; Schwartz et al., 2014; Tommelein and Ballard, 2007; Tommelein, 2015; Tran et al., 2016; Zimina et al., 2012):

a) Stages the owner recruits a designer consultant through an auction (bid) resulting in competition between design consultants.
b) The design implementation stage at this stage is the activity of the designer consultant preparing the design is a competition: if the design consultant conducts a tender (bid) between design sub-contractors, for example data consultants, investigative consultants, etc. (Katar, 2019).
c) Stages the owner recruits for contractors, at this stage is competition: if the owner in carrying out the selection of contractors conducts a tender (bid) so that there is competition between contractors.
d) Stages of construction implementation at this stage there were 2 (two) activities in the implementation of construction namely:
    i. The interaction between the design consultant and the contractor occurs in partnering is competition: the contractor and the design consultant supervise each other in the implementation of construction. The contractor evaluates the DED, the design consultant supervises the implementation of the DED.
    ii. The interaction between contractors and sub-contractors/suppliers in the implementation of construction, the partnering that occurs is competition: if the selection of sub-contractors/suppliers is the result of a tender (bid).

As a summary of partnering in DBB, table is presented in **Table 2**. **Table 2** shown that in the DBB project delivery system the partnering process is in the form of competition and collaboration, competition occurs when the owner chooses to make a pure bid (tender) both when selecting contractors and consultants, as well as contractors when selecting subcontractors.

Table 2. Stage partnering of design bid build (Katar, 2019; Sari, Irawan, Wibowo, Siregar, Praja, 2023; etc.).

The owner is looking for a designer	competition
Implementation of design	competition
The owner is looking for a contractor	competition
Construction execution	competition
Interaction of the contractor and the designer	competition
Contractor-subcontractor/supplier interaction	competition

1.2.3. Advantage and disadvantage DBB

Among the benefits of DBB are the project structure's simplicity, well-established legal practice, and management. The owner's direct relationship with the design team ensures that the owner retains control over the design and that a fit system of checks and balances is in place throughout the construction process. Furthermore, because the design work was completed prior to bidding on the project, the owner began construction with a fixed cost and a high level of confidence in the project's final cost. **Table 3** shows the advantage and disadvantage of the DBB project as presented by Katar (2019) (Katar, 2019; Sari et al., 2021; Sari, Irawan, Wibowo, Siregar, Praja, 2023). **Table 3** shows the researchers' similarities in terms

of advantages and disadvantages in the DBB project. Where the separation of entities between designer and contractor causes a variety of issues in design, supervision, and project variation orders.

Table 3. Advantage and disadvantage DBB (Katar, 2019; Sari, Irawan, Wibowo, Siregar, Praja, 2023).

Researcher	Advantage	Disadvantage
Sari EM (2022) (Sari, Irawan, Wibowo, Siregar, and Praja, 2023)	1) The design team is objective and looks out for the best interests of the owner. 2) The system is fair to prospective bidders and assists the owner in making better decisions. 3) It aids the owner in determining an appropriate project cost. 4) In general, project completion meets acceptable quality levels.	1) Failures in the design team may increase the cost and delay the DBB project. 2) The general contractor faces increased risk, as well as the possibility of compromising quality to reduce project costs. 3) There is little opportunity for input on cost-effective alternatives because the general contractors brought pre design to the team. 4) Pressure on the design and construction teams may result in disagreements between the architect and the general contractor.
Katar (2019)	1) Planning is driven by desired needs rather than economic feasibility, financial availability, or the owner's ability. 2) There are penalties for late work and cost overruns in the contract, as well as incentives for on-time performance.	1) The project's performance is inferior to that of DB. 2) A variation cost that is higher than the DB at the end of the project. 3) Planners and contractors do not produce an integrated design. 4) Rising project costs.

1.3. Integrated project delivery system

1.3.1. Characteristics

IPD is following three key aspects (Ashcraft and Bridgett, 2011; Asmar et al., 2013; Dossick et al., 2013; Ghassemi and Gerber-Becerik, 2011; Glick and Guggemos, 2009; Guan, 2018; Leicht and Harty, 2017; Rached et al., 2014).

a) One multiparty contract is signed by all key project stakeholders.
b) When only 0% of the design is completed, that is, before the design even begins. Many project participants, including the owner, general contractor, architect, consultants, subcontractors, and suppliers, can be regarded as key stakeholders.
c) Sharing risks and benefits.
d) It should be noted that IPD is a relatively new concept that is still evolving and far from being universally standardized, the relationships between key participants are governed by a single multiparty agreement; and these key participants are involved very early in the project, typically before the design even begins.

Figure 3 shows that the IPD is involved in the project while the design is still at 0% progress, allowing for the partnering depth of each project stakeholder to be established before the project begins, resulting in improved project performance (Asmar et al., 2013; Kent et al., 2010; Larsson and Larsson, 2020; Mollaoglu-Korkmaz et al., 2013; Thompson et al., 1998).

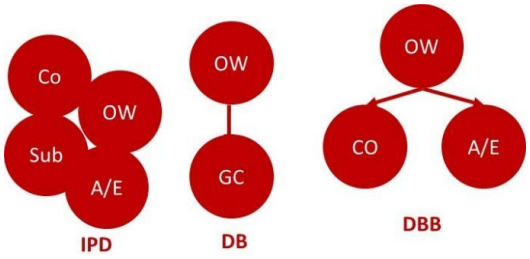

Figure 3. Difference between DBB, DB and IPD (Asmar et al., 2013, Katar, 2019).

1.3.2. Maturity partnering of IPD

In the integrated project delivery (IPD) system, the partnering process is divided into the following stages (Asmar et al., 2013, Katar, 2019):

1) The steps for the owner to looking for a designer consultant and contractor are carried out through direct appointment by the owner to the designer consultant and contractor or DB so that cooperation occurs in this process. in this process jointly laying the foundations of IPD where the three parties carry out cooperation openly, the basis is the existing basic design each of which proposes the need for design costs and construction implementation. Each stakeholder has expectations of better performance, it is even possible to have an agreement if they can provide the best value from the general ceiling (estimated) where there is an incentive distribution between owners, consultants, contractors. All clarity and agreement contained in the agreement.
2) Stages of IPD implementation (Asmar et al., 2013, Katar, 2019, Sari, Irawan, Wibowo, Siregar, Praja, 2023)

In this stage there is a quality of interaction with openness, honesty, and willingness to deliver better work so that you will get a reward for the work done. At this stage, 2 (two) activities occur in the implementation of IPD, namely:

a) Interaction between the owner, designer consultant, contractor occurs in partnering by means of cooperation.
b) The interaction between contractors and sub-contractors/suppliers in the implementation of construction, the partnering that occurs is cooperation where from the start the sub-contractors/suppliers are invited to interact to realize the success of the project since the design has not yet started.

Table 4 illustrates that all processes in the project life cycle are carried out with cooperation, the involvement of each stakeholder from the start of the project makes partnering in IPD simpler and the project life cycle will be easier to implement in a shorter period compared to project delivery other systems.

Table 4. Stage partnering in IPD (Asmar et al., 2013; Sari E.M, Irawan, Wibowo, Siregar, Praja, 2023).

Owner takes bid to looking for designer consultants and contractors	cooperation
Construction implementation	cooperation
Owner, designer consultant, and contractor interaction	cooperation
Contractor subcontractor/supplier interaction	cooperation

Table 4 shows the pattern of partnering in IPD is at the level of cooperation for all stages. This shows that there has been stakeholder involvement from the start of the project marked by in-depth interaction and shared value between project stakeholders so that the IPD project provides better added value. **Table 5** compares various delivery projects studied by previous researchers that have had an impact on project performance in terms of cost, quality, time, safety, and so on. **Table 5** shows types of project delivery systems, including DBB, DB, and IPD, affect project performance in terms of cost, quality, time, safety, and other factors.

Table 5. Comparison of research on DBB and integrated (DB and IPD) projects (Adamtey, 2021; Akadiri et al., 2012; Asmar et al., 2013; etc.).

Researchers and year	**Performance indicators**				
	Cost	**Quality**	**Time**	**Safety**	**Others**
James Pocock et al. (1996)	•		•		•
Molenaar et al. (1999)	•		•	•	•
Sanvindo and Konchar (1998)	•		•	•	
Chan, Chan, et al. (2004)	•	•	•	•	•
Debella and Ries. (2006)	•		•	•	•
Forbes (2011)	•	•	•		•
Asmar et al. (2013)	•		•		•
A. S. Hanna et al. (2019)	•	•	•		•
Yana et al. (2015)	•	•	•		
Katar (2019)	•	•	•	•	
Sari EM (2022)	•	•	•	•	•

1.3.3. Advantage and disadvantage IPD

From previous research explaining that IPD has many advantages in overcoming project problems, creating more value and can improve performance, however, IPD has not been fully implemented in government projects, where it is feared that there are elements that are not transparent in the selection of partners. The advantages and disadvantages of IPD based on the opinions of various studies are listed in **Table 6**. (Asmar et al., 2013; Bellini et al., 2016; Elghaish et al., 2020; Elghaish, Abrishami, Abu Samra, et al., 2021; Hosseini et al., 2018; Mohammad Hasanzadeh et al., 2014; Perera et al., 2014; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Wøien et al., 2016) Hall and Scott, 2016, 2019). **Table 6** shows that IPD is a solution in system delivery projects to share risks and reduce the weaknesses of design changes and variation orders. IPD makes engagement better by increasing a sense of trust between stakeholders in the project, however IPD cannot yet be implemented in government projects.

Table 6. Advantages and disadvantages of IPD.

Advantage	Disadvantage	References
1) Early construction manager involvement improves coordination (Ashcraft and Bridgett, 2011; Ghassemi and Gerber-Becerik, 2011; Glick and Guggemos, 2009; Thompson' et al., 1998.). 2) Involving the team from the start of the project, including the designer, builder, and contractors, to assist the owners in crystallizing the project's goals and objectives and collaborating throughout the project (Asmar et al., 2013; Thompson et al., 1998). 3) Team members who participate share the benefit of meeting project targets while also bearing the risk of project cost overruns (schedule and quality). 4) The parties sign a single contract agreement outlining all team members' roles and responsibilities (El-adaway et al., 2017; Hall and Scott, 2016). 5) The parties must agree on a clear and specific set of project decision-making and control criteria, which can be established based on the project goal of the owner (Thompson et al., 1998; Xia et al., 2015) . 6) To maintain a sense of fairness, contracted parties waive any claim against one another, except in the case of willful default. 7) To maintain a sense of unity and a collaborative environment, contracted parties waive any claim against one another, except in the case of willful default (Sari, Irawan, Wibowo, Siregar, Praja, 2023; Thompson et al., 1998). 8) The owner, in collaboration with the project team, establishes measurable goals and benchmarks. Achieving the objectives entails both risk and reward (Asmar et al., 2013).	1) Not yet believed by all stakeholders is the best solution in project delivery. 2) Not yet implemented in government projects.	(Asmar et al., 2013, Sari, Irawan, Wibowo, Siregar, Praja, 2023, Ashcraft and Bridgett, 2011; Dossick et al., 2013; Glick and Guggemos, 2009; Leicht and Harty, 2017; Thompson et al., 1998; Xia et al., 2015).

The objective of this research is that it is hoped that the owner can change the perspective of choosing partners through deeper collaboration with the same vision since before the project was implemented in its project life cycle. The factors of objectivity, trust, fairness can be developed more deeply through this concept by selecting partners who have the same loyalty, experience, and vision in realizing the project's success.

2. Research methodology

This research uses secondary data with three projects in Indonesia, with building qualifications with a value of over 10 billion rupiah, the results show from previous research (Adamtey, 2021; Asmar et al., 2013; Chen et al., 2016; Katar, 2019; Lam et al., 2004; Molenaar et al., 2023; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Tran et al., 2016; Xia et al., 2015) that the DBB project experienced delays due to several factors, especially design changes and material scarcity in projects (Abotaleb et al., 2019; Dixit, Mandal, et al., 2017; Conte and Gransberg, 2001; Johansen and Walter, 2007; Sari et al., 2021; Rached et al., 2014; Abdelhamid et al., 2008; Sari, Irawan, Wibowo, Siregar, raja, 2023; Tommelein, 2015). Based on the secondary data, a focus group discussion (FGD) was carried out with the aim of uncovering the causes of project delays. The FGD was held by presenting 14 experts

consisting of owners, contractors, designers, and academics. The profile of the expert must meet the following criteria:

a. Expert in construction management and/or expertise in civil and building engineering. Have experience as a construction management expert with a minimum title of Ph.D., preferably a professor of construction management at least four people.
b. Practitioners/contractors/owners in the field of civil buildings, especially buildings. Have experience in managing civil buildings, especially buildings for at least 20 years. If a project manager has at least a project manager experience of more than 10 years in the field of civil buildings.

The stages of the data analysis method are carried out based on **Figure 4** as follows:

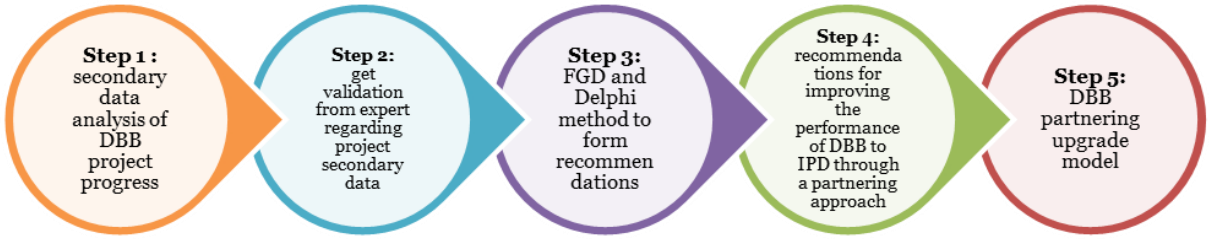

Figure 4. Step by step of the research.

Figure 4 describes the step-by-step research starting from analyzing secondary data on a national-scale DBB project, then carrying out expert judgment through in-depth interviews and expert FGDs, then carrying out Delphi analysis by developing consensus in decision making. Recommendations are built based on a consensus that is represented by all stakeholders in the construction projects are carried out.

3. Results

The findings of this study constitute a model for improving partnering in DBB projects to improve project performance in terms of cost, quality, time, safety, and the environment. This is critical for the project's long-term viability. As we know, construction projects are considered fragmented due to different perceptions of each stakeholder in the project (Asmar et al., 2013; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Sari, Irawan, Wibowo, Siregar, Tamin, et al., 2023; Thompson et al., 1998; Xia et al., 2015). **Figure 5** illustrates how conceptual partnering in DBB projects can be improved from the existing partnering condition which is competition so that it increases project performance (Ballard, 2000b; Besiktepe et al., 2020; Elizar et al., 2017; Falessi et al., 2006; Howell and Ballard, 1998; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Thompson' et al., 1998.; Viana et al., 2020; Xia et al., 2015; Zhao and Li, 2013).

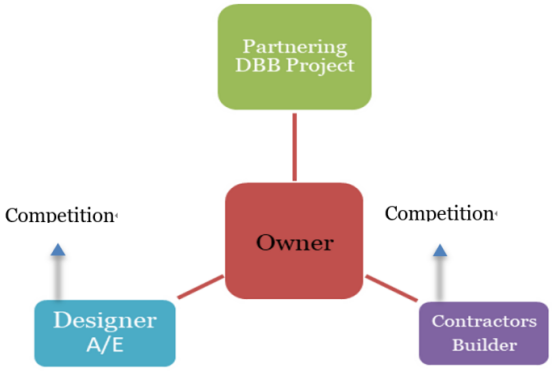

Figure 5. Conceptual improvement partnering in DBB project (Sar E.M, Irawan, Wibowo, Siregar, Praja, 2023; Sari E.M, Irawan, Wibowo, Siregar, Tamin, et al., 2023).

3.1. Quantification and statistical analysis

Quantitative analysis is carried out by comparing secondary data on DBB_A, DBB_B, and DBB_C projects based on them monthly progress achievements as shown in **Figure 6**. **Figure 6** explains that the performance of the DBB project as shown from the three projects above has experienced delays, several causes of delays are due to design changes, worker skills, material delays, slow decision making, delays in payments by the owner and due to COVID-19. Then compared the standard deviation between the three projects based on **Figure 7**.

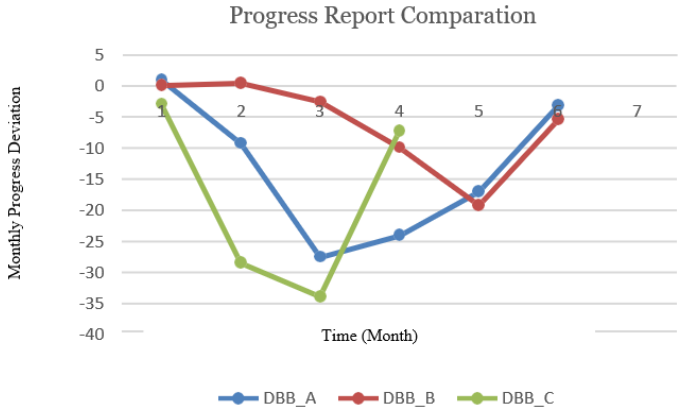

Figure 6. Monthly progress comparation (Sari, Irawan, Wibowo, Siregar, Praja, 2023).

Figure 7 illustrates deviation standard of the project, deviation standard is to show the progress of the project to the average value of the population, the closer to the value of one deviation the better. As can be seen from the numbers that occurred, all of them showed a large deviation value, so this further strengthened the fact that the DBB project had a performance that was not in accordance with the plan.

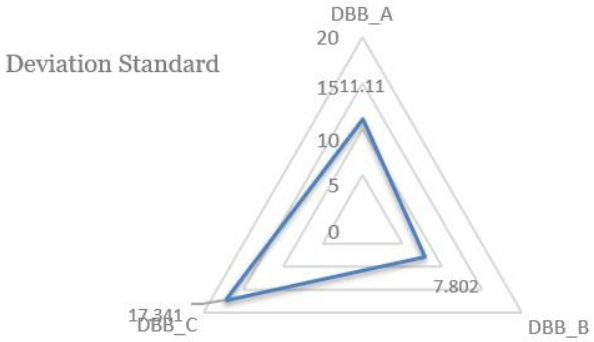

Figure 7. Deviation standard (Sari, Irawan, Wibowo, Siregar, Praja, 2023).

3.2. FGD recommendation

The increase in partnering in DBB to partnering with IPD can be implemented by changing the ways in which stakeholders are selected since the beginning of the project. Below are recommendations for increasing DBB partnering to IPD. Some of the partnership improvements that can be made are as follows:

i. The owner's process selects designers from competition to cooperation by appointing designers who have experience and project competence, have the same vision as the owner.
ii. The process of selecting contractors from competition to cooperation by inviting contractors to be involved in project development from the start.
iii. The process of contractors choosing suppliers/subcontractors from competition to long-term cooperation and sustainability by jointly thinking about materials and work operations.

The partnering change model from competition to collaboration in the DBB project can be illustrated in **Figure 8**.

From **Figure 8**, DBB projects that initially had competitive partnering have an alternative to collaboration, so that if the entire process can be carried out in cooperation, then it will form partnering as in integrated project delivery (IPD) as follows:

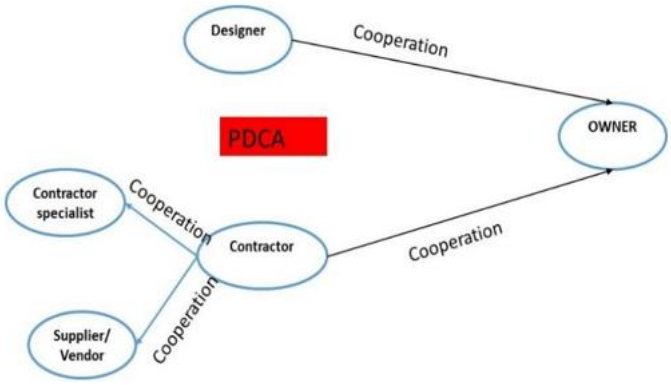

Figure 8. Partnering changes in the DBB project to IPD (Sari E. M. Irawan, Wibowo, Siregar, Praja, 2023).

Figure 8 illustrates that DBB projects can increase partnering to collaboration without having to change the DBB project contract. This is in accordance with

maturity partnering in IPD, so that the advantages in IPD can be adopted in the DBB project.

3.3. Discussion

DBB projects with separate contracts between designers and contractors can improve project performance without having to change the DBB contract. A potential solution is for the owner to change the way designers and contractors' contract by inviting designers and contractors from the start before the project starts, even if the entities are different. Likewise, contractors must enter contracts with long-term suppliers before the project starts (Thompson et al., 1998; Xia et al., 2015). Companies form collaborative relationships with "preferred" suppliers for relationships involving multiple projects with specific business objectives. Increasing the depth of partnering in construction projects can be carried out from the very beginning when the owner defines the project, the concept of sharing risks and rewards will reduce losses and understanding project contracts separately between stakeholders (Hussain et al., 2014; Adamtey, 2021; Alaloul et al., 2016; Dixit, Pandey, et al., 2017; Goh et al., 2013; Jacobson and Ok Chio, 2008; Kraakenes et al., 2019; Lam et al., 2004; Li et al., 2013; Molenaar et al., 2023; Momade et al., 2022; Songer and Walker, 2004; Xia et al., 2015).

This research takes project case studies in Indonesia where in Indonesia there are only two types of project contracts, namely DBB and DB. the alternative to becoming an IPD as happened in developed countries such as the US and Europe is a challenge in Indonesia. however, even though project contracts are not fully IPD as regulated in developed countries, project stakeholders in Indonesia can change their interaction behavior through deeper partnering in projects. The contract or type of project being carried out is still DBB without changing the characteristics of the project, but the partnering is deepened into IPD, or from competition to cooperation. With this change in behavior, it is hoped that it will create better value in the project and will result in better project performance (cost, quality, time, safety, and environment). projects with better performance will encourage long-term sustainability and generate economic profits for all stakeholders involved in the project. The achievement of project performance is influenced by the relationship in the project delivery system, a project delivery system without partnering will produce projects with short-term goals and compete. When there are unpredictable conditions such as the covid-19 pandemic, partnering development is essential to anticipate the risks that occur in the project. From the previous research (Thompson et al., 1998) some benefit increase partnering in construction projects have 10% increase worker productivity, 100% project success and reduction 50% repetitive work repeated.

4. Conclusions

Partnering in construction projects has a major impact in achieving project objectives. The design bid build project has the peculiarity of having a separate contract between designer and contractor so that there is a possibility of project delays due to different entities in deciding and communication limitations.

Partnering in DBB is generally competition so that it has goals in short-term projects, there is a possibility of conflict, there is no similarity in achieving objectives so that DBB projects often have worse performance (Ashcraft and Bridgett, 2011; Glick and Guggemos, 2009; Leicht and Harty, 2017; Sari, Irawan, Wibowo, Siregar, Praja, 2023; Sari, Irawan, Wibowo, Siregar, Tamin, et al., 2023).

Increasing DBB partnerships can be done by taking the IPD partnership philosophy where all processes are carried out through collaboration so that it will encourage specific long-term shared goals, increase trust and communication, improve interpersonal relationships, more team members are involved in projects and engagement occurs, so that project performance can be made better (Asmar et al., 2013; Katar, 2019; Lahdenperä, 2012; Hall and Scott, 2016; Xia et al., 2015).

Some of the benefits noted in various multi-project relationships from previous research are a 40% reduction in working hours of the total working hours used, a 21% reduction in labor incentives, a 10% increase in worker productivity, and in general there is a 10% reduction in the cost of the entire project, in addition there is a 100% success in meeting the budget and schedule, a 50% reduction in repetitive work repeated, so that project performance is considered better (Gadde and Dubois, 2010; Larsson and Larsson, 2020a; Thompson et al., 1998).

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References

Abotaleb IS, El-adaway IH, Ibrahim MW, et al. (2019). Causes, early warning signs, and impacts of out-of-sequence construction: Expert-based survey analysis. Journal of Management in Engineering 35(6). doi: 10.1061/(asce)me.1943-5479.0000724

Abdelhamid T, EI-Gafy MA, Salem OM (2008). Lean construction: Fundamentals and principles. Available online: https://www.researchgate.net/publication/289380759 (accessed on 10 November 2023).

Adamtey SA (2021). A case study performance analysis of design-build and integrated project delivery methods. International Journal of Construction Education and Research 17(1): 68–84. doi: 10.1080/15578771.2019.1696903

Akadiri PO, Chinyio EA, Olomolaiye PO (2012). Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. Buildings 2(2): 126–152. doi: 10.3390/buildings2020126

Alaloul WS, Liew MS, Zawawi NAWA (2016). Identification of coordination factors affecting building projects performance. Alexandria Engineering Journal 55(3): 2689–2698. doi: 10.1016/j.aej.2016.06.010

Alleman D, Antoine A, Gransberg DD, Molenaar KR (2017). Comparison of qualifications-based selection and best-value procurement for construction manager-general contractor highway construction. Transportation Research Record 2017; 2630(1): 59–67. doi: 10.3141/2630-08

Ashcraft H (2022). Transforming project delivery: Integrated project delivery. Oxford Review of Economic Policy 38(2): 369–384. doi: 10.1093/oxrep/grac001

Ashcraft HW, Bridgett PH (2011). IPD Teams: Creation, Organization and Management. HansonBridgett.

Asmar ME, Hanna AS, Loh WY (2013). Quantifying performance for the integrated project delivery system as compared to established delivery systems. Journal of Construction Engineering and Management 139(11). doi: 10.1061/(asce)co.1943-7862.0000744

Baiden BK, Price ADF, Dainty ARJ (2006). The extent of team integration within construction projects. International Journal of Project Management 24(1): 13–23. doi: 10.1016/j.ijproman.2005.05.001

Ballard HG (2000a). The Last Planner System of Production Control Acknowledgements [PhD thesis]. University of Birmingham.

Bellini A, Aarseth W, Hosseini A (2016). Effective knowledge transfer in successful partnering projects. Energy Procedia 96: 218–228. doi: 10.1016/j.egypro.2016.09.127

Besiktepe D, Ozbek M, Atadero R (2020). Identification of the criteria for building maintenance decisions in facility management: First step to developing a multi-criteria decision-making approach. Buildings 10(9): 166. doi: 10.3390/buildings10090166

Conte ASI, Gransberg DD (2001). Lean construction: From theory to practice. Available online: https://www.researchgate.net/publication/283968828 (accessed on 10 November 2023).

Calahorra-Jimenez M, Molenaar K, Torres-Machi C, et al. (2020). Structured approach for best-value evaluation criteria: US design—Build highway procurement. Journal of Management in Engineering 36(6): 04020086. doi: 10.1061/(asce)me.1943-5479.0000857

Chan APC, Chan DWM, Chiang YH, et al. (2004). Exploring critical success factors for partnering in construction projects. Journal of Construction Engineering and Management 130(2): 188–198. doi: 10.1061/(asce)0733-9364(2004)130:2(188).

Chan, A. P. C., Scott, D., & Lam, E. W. M. (2002). Framework of Success Criteria for Design/Build Projects. Journal of Management in Engineering, 18(3), 120–128. doi:10.1061/(asce)0742-597x(2002)18:3(120) 10.1061/(asce)0742-597x(2002)18:3(120).

Chen Q, Jin Z, Xia B, et al. (2016). Time and cost performance of design-build projects. Journal of Construction Engineering and Management 142(2): 04015074. doi: 10.1061/(asce)co.1943-7862.0001056

Colfer LJ, Baldwin CY (2016). The mirroring hypothesis: Theory, evidence, and exceptions. Industrial and Corporate Change 25(5): 709–738. doi: 10.1093/icc/dtw027

Col Debella, D., & Ries, R. (2006). Construction Delivery Systems: A Comparative Analysis of Their Performance within School Districts. Journal of Construction Engineering and Management, 132(11), 1131–1138. doi:10.1061/(asce)0733-9364(2006)132:11(1131).

Crane TG, Felder JP, Thompson PJ, et al. (1997). Partnering measures. Journal of Management in Engineering 15(2): 37–42. doi: 10.1061/(ASCE)0742-597X(1999)15:2(37)

Dixit S, Mandal SN, Sawhney A, Singh S (2017). Area of linkage between lean construction and sustainability in Indian construction industry. International Journal of Civil Engineering and Technology (IJCIET) 8(8): 623–636.

Dixit S, Pandey AK, Mandal SN, Bansal S (2017). A study of enabling factors affecting construction productivity: Indian scenario. International Journal of Civil Engineering and Technology (IJCIET) 8(6): 741–758.

Dossick CS, Azari R, Kim YW, El-Anwar O (2013). IPD in practice: Innovation in healthcare design and construction. In: AEI 2013: Building Solutions for Architectural Engineering. American Society of Civil Engineers.

El-adaway I, Abotaleb I, Eteifa S (2017). Framework for multiparty relational contracting. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction 9(3): 04517018. doi: 10.1061/(asce)la.1943-4170.0000238

Elghaish F, Abrishami S, Abu Samra S, et al. (2021). Cash flow system development framework within integrated project delivery (IPD) using BIM tools. International Journal of Construction Management 21(6): 555–570. doi: 10.1080/15623599.2019.1573477

Elghaish F, Abrishami S, Hosseini MR, Abu-Samra S (2020). Revolutionising cost structure for integrated project delivery: A BIM-based solution. Engineering, Construction and Architectural Management 28(4): 1214–1240. doi: 10.1108/ecam-04-2019-0222

Elizar, Suripin, Wibowo MA (2017). Model of construction waste management using AMOS-SEM for Indonesian infrastructure projects. MATEC Web of Conferences 138: 05005. doi: 10.1051/matecconf/201713805005

Eriksson PE (2015). Partnering in engineering projects: Four dimensions of supply chain integration. Journal of Purchasing and Supply Management 21(1): 38–50. doi: 10.1016/j.pursup.2014.08.003

Falessi D, Cantone G, Becker M (2006). Documenting design decision rationale to improve individual and team design decision making: An experimental evaluation. In: Proceedings of the 2006 ACM/IEEE International Symposium on Empirical Software Engineering; 21–22 September 2023; Rio de Janeiro, Brazil. pp. 134–143.

Forbes LH, Amed SH (2011). Modern Construction Lean Project Delivery & INtegrated Practices, CRC Press.

Gadde LE, Dubois A (2010). Partnering in the construction industry-problems and opportunities. Journal of Purchasing and Supply Management 16(4): 254–263. doi: 10.1016/j.pursup.2010.09.002

Ghassemi R, Gerber-Becerik B (2011). Transitioning to IPD: Potential barriers and lessons learned. Lean Construction Journal 32–52.

Glavinich TE, Contractors AG, Taylor TA (2008). Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction. Wiley.

Glick S, Guggemos AA (2009). IPD and BIM: Benefits and opportunities for regulatory agencies. In: Proceedings of the 45th ASC National Conference; 2–4 April 2009; Gainesville, US.

Goh CS, Abdul-Rahman H, Abdul Samad Z (2013). Applying risk management workshop for a public construction project: Case study. Journal of Construction Engineering and Management 139(5): 572–580. doi: 10.1061/(asce)co.1943-7862.0000599

Guan J (2018). Exploration on the methods of forming an IPD project team and the responsibility of team members. In: Wang Y, Zhu Y, Shen GQP, Al-Hussein M (editor). ICCREM 2018: Construction Enterprises and Project Management, Proceedings of the International Conference on Construction and Real Estate Management 2018; 9–10 August 2018; Charleston, South Carolina. American Society of Civil Engineers.

Hall DM, Scott WR (2016). Early stages in the institutionalization of integrated project delivery. In: Proceedings of the Engineering Project Organization Conference (EPOC 2016); 28–30 June 2016; Cle Elum, Washington, USA.

Hall DM, Scott WR (2019). Early Stages in the institutionalization of integrated project delivery. Project Management Journal 50(2): 128–143. doi: 10.1177/8756972818819915

Hussain SMAM, Krishna BV, Kumar VR (2014). Application and analysis of last planner system in the construction industry. IMPACT: International Journal of Research in Engineering & Technology 6(2): 33–44.

Hanna ES, Markham S (2019). Constructing better health and wellbeing? Understanding structural constraints on promoting health and wellbeing in the UK construction industry. International Journal of Workplace Health Management 12(3): 146–159. doi: 10.1108/ijwhm-03-2018-0031

Hanna et al. (2019), Benchmarking project performance: a guideline for assessing vulnerability of mechanical and electrical projects to productivity loss, Construction Management and Economics, pp 101-111.

Hermanto E, Soetomo S, Agung Wibowo M (2018). Toward partnership for government construction project in Indonesia. International Journal of Scientific and Research Publications (IJSRP) 8(10). doi: 10.29322/ijsrp.8.10.2018.p8286

Hosseini A, Windimu P, Klakegg OJ, et al. (2018). Project partnering in the construction industry: Theory vs. practice. Engineering Project Organization Journal 8(1): 13–35. doi: 10.25219/epoj.2018.00101

Howell G, Ballard G (1998). Implementing lean construction: Understanding and action. In: Proceedings of the 6th Annual Conference of the International Group for Lean Construction—Guarujá, Brazil-1998; 13–15 August 1998; Guarujá, Brazil.

Jacobson C, Ok Choi S (2008). Success factors: Public works and public-private partnerships. International Journal of Public Sector Management 21(6): 637–657. doi: 10.1108/09513550810896514

Jin XH (2010). Determinants of efficient risk allocation in privately financed public infrastructure projects in Australia. Journal of Construction Engineering and Management 136(2): 138–150. doi: 10.1061/ASCECO.1943-7862.0000118

Johansen E, Walter L (2007). Lean construction: Prospects for the German construction industry. Lean Construction Journal 3(1): 19–32.

Konchar M, Sanvindo V (1998). Comparison of U.S. project delivery systems. Journal of Construction Engineering and Management, 124(6), 435-444.

Katar IM (2019). Enhancing the project delivery quality; lean construction concepts of design-build & design-bid-build methods. International Journal of Management 10(6): 324–337. doi: 10.34218/IJM.10.6.2019.031

Kent DC, Asce SM, Becerik-Gerber B, Asce AM (2010). Understanding construction industry experience and attitudes toward integrated project delivery. Journal of Construction Engineering and Management 136(8): 815–825. doi: 10.1061/ASCECO.1943-7862.0000188

Koskela L, Howell G, Ballard G, Tommelein I (2002). The foundations of lean construction. In: Design and Construction, lst ed. Routledge.

Koskela L, Howell G, Lichtig W (2006). Contracts and production. In: Proceedings of the CIB W92 Symposium on Sustainability and Value through Construction Procurement; 29 November–2 December 2006; Digital World Centre, Salford Quays.

Kraakenes E, Tadayon A, Johansen A (2019). Comparing lean construction with experiences from partnering and design-build construction projects in Norway. In: Proceedings of the 27th Annual Conference of the International Group for Lean Construction, IGLC 2019; 3–5 July 2019; Dublin, Ireland. pp. 937–946.

Lahdenperä P (2012). Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery. Construction Management and Economics 30(1): 57–79. doi: 10.1080/01446193.2011.648947

Lam EWM, Chan APC, Chan DWM (2004). Benchmarking design-build procurement systems in construction. Benchmarking: An International Journal 11(3): 287–302. doi: 10.1108/14635770410538763

Larsson J, Larsson L (2020). Integration, application and importance of collaboration in sustainable project management. Sustainability (Switzerland) 12(2): 585. doi: 10.3390/su12020585

Leicht R, Harty C (2017). Influence of multiparty IPD contracts on construction innovation. In: ARCOM 2017; 4–6 September 2017; Cambridge. pp. 164–173.

Li H, Arditi D, Wang Z (2013). Factors that affect transaction costs in construction projects. Journal of Construction Engineering and Management 139(1): 60–68. doi: 10.1061/(asce)co.1943-7862.0000573

Love PED (2002). Influence of project type and procurement method on rework costs in building construction projects. Journal of Construction Engineering and Management 128(1): 18–29. doi: 10.1061/ASCE0733-93642002128:118

Mesa HA, Molenaar KR, Alarcón LF (2016). Exploring performance of the integrated project delivery process on complex building projects. International Journal of Project Management 34(7): 1089–1101. doi: 10.1016/j.ijproman.2016.05.007

Mesa HA, Molenaar KR, Alarcón LF (2019). Comparative analysis between integrated project delivery and lean project delivery. International Journal of Project Management 37(3): 395–409. doi: 10.1016/j.ijproman.2019.01.012

Mesa HA, Molenaar KR, Alarcón LF (2020). Modeling supply chain integration in an integrated project delivery system. Sustainability (Switzerland) 12(12): 5092. doi: 10.3390/su12125092

Mohammad Hasanzadeh S, Hosseinalipour M, Hafezi M (2014). Collaborative procurement in construction projects performance measures, case study: Partnering in Iranian construction industry. Procedia-Social and Behavioral Sciences 119: 811–818. doi: 10.1016/j.sbspro.2014.03.091

Molenaar KR, Johnson DE (2003). Engineering the procurement phase to achieve best value. Leadership and Management in Engineering 3(3): 137–141. doi: 10.1061/(ASCE)1532-6748(2003)3:3(137)

Molenaar KR, Sobin N, Antillón EI (2023). A synthesis of best-value procurement practices for sustainable design-build projects in the public sector. Journal of Green Building 2010; 5(4): 148–157. doi: 10.3992/jgb.5.4.148.

Molenaar et al. (1999). Public-sector design/build evolution and performance. Journal of Management Engineering, pp 54-62.

Mollaoglu-Korkmaz S, Swarup L, Riley D (2013). Delivering sustainable, high-performance buildings: Influence of project delivery methods on integration and project outcomes. Journal of Management in Engineering 29(1): 71–78. doi: 10.1061/(ASCE)ME.1943

Momade MH, Durdyev S, Van Tam N, et al. (2022). Factors influencing adoption of construction technologies in Vietnam's residential construction projects. International Journal of Building Pathology and Adaptation (18): 1–17. doi: 10.1108/IJBPA-03-2022-0048

Ndekugrp I, Turner A (1994). Building procurement by design and build approach. Journal of Construction Engineering and Management 120(2): 243–256. doi: 10.1061/(ASCE)0733-9364(1994)120:2(243)

O'Connor PJ (2009). Integrated project delivery: Collaboration through new contract forms. Available online: https://www.faegredrinker.com/webfiles/AGC-IPD%20Paper.pdf (accessed on 10 November 2023).

Pal R, Wang P, Liang X (2017). The critical factors in managing relationships in international engineering, procurement, and construction (IEPC) projects of Chinese organizations. International Journal of Project Management 35(7): 1225–1237. doi: 10.1016/j.ijproman.2017.05.010

Patil SS, Molenaar KR (2011). Risks associated with performance specifications in highway infrastructure procurement. Journal of Public Procurement 11(4): 482–508. doi: 10.1108/jopp-11-04-2011-b002

Perera BAKS, Rameezdeen R, Chileshe N, Hosseini MR (2014). Enhancing the effectiveness of risk management practices in Sri Lankan road construction projects: A Delphi approach. International Journal of Construction Management 14(1): 1–14. doi: 10.1080/15623599.2013.875271

Pocock JB, Hyun CT, Liu LY, Kim MK (1996). Relationship between Project Interaction and Performance Indicators. Journal of Construction Engineering and Management, 122(2), 165–176. doi: 10.1061/(asce)0733-9364(1996)122:2(165)

Rached F, Hraoui Y, Karam A, Hamzeh F (2014). Implementation of IPD in the middle east and its challenges. In: Proceedings of the International Group for Lean Construction, IGLC 22; 25–27 June 2014; Oslo, Norway.

Ramanathan C, Narayanan S (2012). Construction delays causing risks on time and cost-a critical review. Australasian Journal of Construction Economics and Building 12(1): 1–21. doi: 10.3316/informit.119538752826363

Sanvido, Victor; Grobler, Francois; Parfitt, Kevin; Guvenis, Moris; Coyle, Michael (1992). Critical Success Factors for Construction Projects. Journal of Construction Engineering and Management, 118(1), 94–111. doi: 10.1061/(ASCE)0733-9364(1992)118: 1(94).

Sari EM, Irawan AP, Wibowo MA (2021). Role of technical education in partnering construction project: A geographical study on Indonesia. Review of International Geographical Education (RIGEO) 11(1): 636–644. doi: 10.48047/rigeo.11.1.49

Sari EM, Irawan AP, Wibowo MA, Siregar JP, Praja AKA (2023). Project delivery systems: The partnering concept in integrated and non-integrated construction projects. Sustainability (Switzerland) 15(1): 86. doi: 10.3390/su15010086

Sari EM, Irawan AP, Wibowo MA, Siregar JP, Tamin RZ, et al. (2023). Challenge and awareness for implemented integrated project delivery (IPD) in Indonesian projects. Buildings 13(1): 262. doi: 10.3390/buildings13010262

Schwartz C, Morthland L, Mcdonald S (2014). Building a social framework: Utilising design/build to provide social learning experiences for architecture students. Architectural Theory Review 19(1): 76–91. doi: 10.1080/13264826.2014.894606

Songer AD, Walker B (2004). General contractor emotional intelligence in the construction industry. In: Proceedings of the 20th Annual ARCOM Conference; 1–3 September 2004; Heriot Watt University.

Thompson PJ, Sanders SR, Member A (1998). Peer-reviewed paper: Partnering continuum. Journal of Management in Engineering 14(5): 73–78. doi: 10.1061/(ASCE)0742-597X(1998)14:5(73)

Tommelein ID (2015). Journey toward lean construction: Pursuing a paradigm shift in the AEC industry. Journal of Construction Engineering and Management 141(6): 04015005. doi: 10.1061/(asce)co.1943-7862.0000926

Tran D, Molenaar KR, Gransberg DD (2016). Implementing best-value procurement for design-bid-build highway projects. Transportation Research Record 2573(1): 26–33. doi: 10.3141/2573-04

Viana ML, Hadikusumo BHW, Mohammad MZ, Kahvandi Z (2020). Integrated project delivery (IPD): An updated review and analysis case study. Journal of Engineering, Project, and Production Management 10(2): 147–161. doi: 10.2478/jeppm-2020-0017

Wøien J, Hosseini A, Klakegg OJ, et al. (2016). Partnering elements' importance for success in the norwegian construction industry. Energy Procedia 96: 229–240. doi: 10.1016/j.egypro.2016.09.130

Xia B, Chen Q, Xu Y, et al. (2015). Design-build contractor selection for public sustainable buildings. Journal of Management in Engineering 31(5): 04014070. doi: 10.1061/(asce)me.1943-5479.0000295

Yana et al. (2015), Analysis of factors affecting design changes in construction project with Partial Least Square (PLS), Procedia Engineering, pp 40-45.

Zhao T, Li J (2013). Decision modeling process of risk allocation in international construction projects. In: Proceedings of the 2012 IEEE 3rd International Conference on Emergency Management and Management Sciences (ICEMMS); 1–8 January 2013; China. pp. 1–4.

Zimina D, Ballard G, Pasquire C (2012). Target value design: Using collaboration and a lean approach to reduce construction cost. Construction Management and Economics 30(5): 383–398. doi: 10.1080/01446193.2012.676658