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Project Delivery Systems: The Partnering Concept in Integrated and Non-Integrated Construction Projects

Endah Murtiana Sari [1,*], Agustinus Purna Irawan [2], Mochamad Agung Wibowo [3], Januar Parlaungan Siregar [4] and Arief Kusuma Among Praja [5]

[1] Faculty of Engineering, Universitas Esa Unggul, Jakarta 11510, Indonesia
[2] Faculty of Engineering, Universitas Tarumanagara, Jakarta 11480, Indonesia
[3] Department of Civil Engineering, Diponegoro University, Semarang 50275, Indonesia
[4] Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang, Pekan 26600, Malaysia
[5] Faculty of Economics and Business, Universitas Esa Unggul, Jakarta 11510, Indonesia
* Correspondence: endah.murtiana@esaunggul.ac.id

Abstract: The project delivery system has a large effect in determining the quality of a project. Strategic plans determined by the owner in the project initiation phase must ensure that project performance indicators in the form of cost and quality as well as time are accomplished. A concept of partnering that is well-managed and planned from the initiation phase will determine the quality of the construction project. Increasing the maturity of partnering is needed in order to achieve better project performance indicators. The concept of partnering in integrated and non-integrated projects has a different pattern. This study intends to discuss the concept of partnering and then recommend several key strategies according to the project life cycle. Research this study is quantitative, analyzing secondary data in the form of weekly meetings and project reports with the comparative method and cause-and-effect analysis. The results show that in the phase above 51% of ongoing projects, there is a significant difference in the pattern of partnering between integrated and non-integrated projects. In order to improve deeper partnering, this research reveals several prerequisites that must be met in order to carry out effective partnering in non-integrated projects. This research may benefit owners, contractors, and stakeholders who want to develop their understanding and knowledge of the concepts of partnering and the maturity of partnering, which will be new strategies for developing and improving project delivery systems. This study focuses on a topic from the Sustainable Development Goals (SDGs), specifically partnership for the goal.

Keywords: partnering; design-and-build; project delivery system; design bid build

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1. Introduction

A project is said to have good performance if the indicators of cost, quality, and time are achieved. From previous research, various factors have been identified as the cause of project delays. Project delay factors can cause waste in construction projects, lack of materials, unclear instructions for humans, financial difficulties for the owner, incorrect working methods, disregard for safety, and human error [1–5]. The challenge is how the contractor and owner can define various breakthroughs so that delays and waste in the project do not occur. This is greatly influenced by selecting a project delivery system and a mutually beneficial relationship between the owner and contractor, one of which is using the partnership as a trigger for a mutually beneficial long-term relationship. The project delivery system is divided into two categories for integrated and non-integrated projects: non-integrated projects usually use a Design Bid Build (DBB) system, while integrated projects usually use Design and Build (DB) and Engineering, Procurement, and Construction (EPC). The choice of a project delivery system is highly important for the owner and contractor. In a previous study regarding the presence of significant differences

in project delivery systems between integrated and non-integrated projects, integrated projects resulted in a lean construction approach that was better than non-integrated ones [6]. In the same way, there are differences in objectives that affect the project delivery system chosen. The DBB owner wants the project to be more professional and has the principle of fairness. At the same time, DBB was chosen because of the credibility and trust factor of the contractors selected by the owner to better deliver the project [6–9]. Project control must be carried out in accordance with the project life cycle. Since the initiation of strategic moves needs to be performed by the owner and contractor, collaboration and even coalitions will make the elements of lean construction achievable. The achievement of lean construction will prevent delays and wasted materials in the project.

The project life cycle consists of four phases, as stated by Egan [10], namely the initiation, planning, implementation, and closing phases. In order to create a deeper partnership from the start, the owner must think strategically [11,12]. From the project defining phase, the owner must involve credible planners and contractors, as collaborating from the initiation phase will help the owner achieve their goals better and more efficiently. In the initiation phase, partnerships can be carried out with various parties, especially contractors, in terms of specifications, financing, and other objectives the owner wants to achieve. It is proven that projects with financing agreements by contractors, such as build-operate-transfer (BOT), will make the project delivery faster, even though the form of the project delivery system is DBB.

The planning phase needs to be very decisive to ensure the timeliness of project implementation. Issues regarding design completeness, delays in executing designs, and dealing with planners who are not credible trigger project delays, especially in DBB [13]. The maturity of information is very important in project implementation. If information maturity does not occur, the partnership will not be effective.

Partnering maturity can be divided into four levels, namely competition, cooperation, collaboration, and coalescence [7]. Competition has the least maturity in partnering in construction projects. The maturity percentages of different types of partnerships that occur in integrated or non-integrated projects are the following: competition has a partnership maturity of 0–25%, cooperation has a partnership maturity of 25–50%, collaboration has a partnering maturity of 50–75%, and a coalition has a partnering maturity of 75–100%. Deeper partnering in every phase with respect to the project life cycle can create a long-term strategy.

1.1. Partnering in Construction Projects

One of the methods used to reach the goals set by lean construction indicators is forming partnerships [8]. Since it is thought to produce superior outcomes in accomplishing project objectives, this approach can be chosen. Values of trust, loyalty, communication, and investment are needed in a partnership. In addition, a partnership is seen to be a mechanism for resolving conflicts and organizing interpersonal interactions inside the organization, including resolving numerous personal issues that arise throughout projects [11,12]. Construction projects must utilize partnerships since (1) they may enhance the stability of the relationship between top management and a variety of related stakeholders, (2) they may identify problems arising during the project, as well as (3) building a project team capable of fast response in handling critical issues with the project [14]. Based on previous research, Sari [11,12] recommends conceptual partnering in project organizations as follows:

As seen in Figure 1 below, conceptual partnering is built by breaking through the borders of the owner, designer and contractor. The three take interface steps by improving relationships, communicating better, and developing effective ways to achieve common goals. As a result, stakeholders in the project can choose a better partnership between the owner, designer, and contractor. These choices shorten the PDCA (plan, do, check, act) time in which a short PDCA will achieve better project performance.

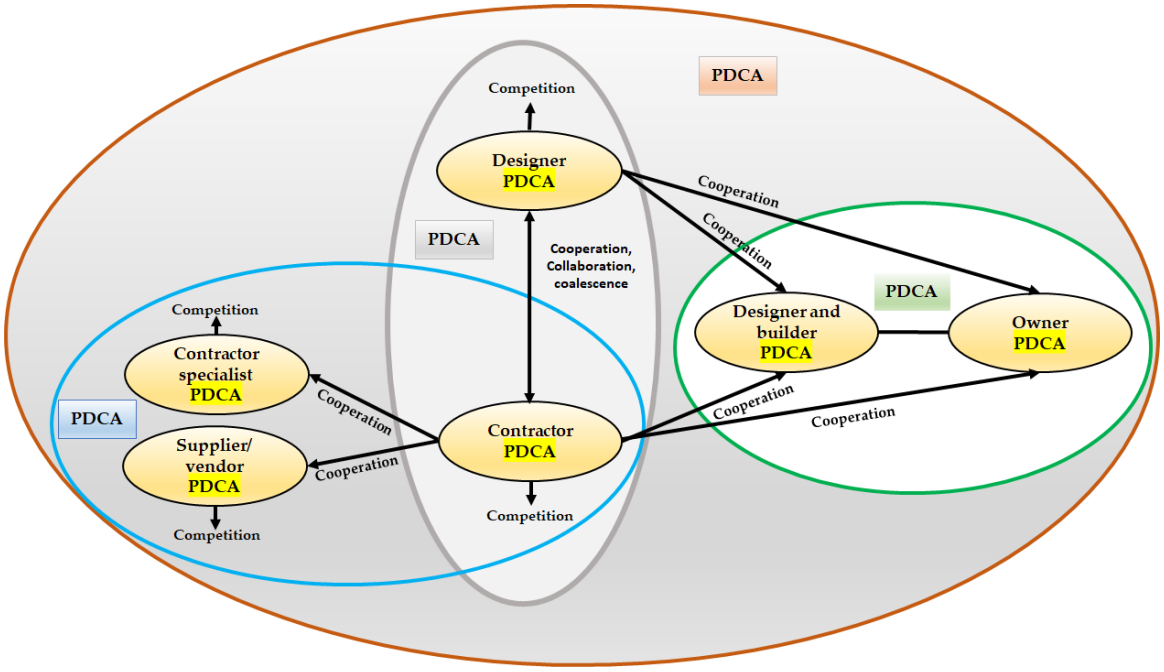

Figure 1. Conceptual diagram of partnering (first proposed by the authors).

Partnerships, in general, are used in a hierarchical fashion based on their level of maturity. Previous studies [7,15,16] define them as "competition", "cooperation", "collaboration", and "coalescence" [4,11,17]. Stakeholders are more likely to be invested in a project if the partnership process is carried out at a mature level [4,11,12,17]. To achieve optimal collaboration, each person chooses which variables need to be strengthened [8,18–20]. As one might expect, there is a strong correlation between partnership and productivity, which is defined as "the degree to which the community, planning consultants, suppliers, contractors, and owners around a project work together in ensuring that a particular project is accomplished within budget, on time, as well as according to established quality standards".

In order to highlight this concept, some researchers [7,15,21,22] have established a continuum of partnerships that outlines four main stages: competition, cooperation, collaboration, and coalescence. Moreover, "competition" describes the typical owner-contractor relationship, where every party pursues distinct objectives and "working together" is not emphasized. In the absence of a partnership, this endeavor is competitive (Thomson [7]). The last three stages—, cooperation, collaboration, and coalescence—fundamentally merge, strengthening the parties' commitment to one another's objectives. They are exemplified by the consistency that characterizes the numerous partnership applications.

In evaluating a partnership, it is necessary to evaluate the business objectives and the role that the partnership will play in achieving the organization's goals [16,23]. After determining this, the organization will be able to choose and determine the most appropriate partnership style. Through this procedure, a balance between risk and return may be achieved, and resources can be utilized to build, implement, and manage partnership connections [7,24,25].

Figure 2 illustrates the level of partnership in competition, cooperation, collaboration, and coalescence. Competition is the lowest level of partnering, while coalescence is the highest level. Partnerships in construction projects are divided into two types, namely non-integrated and integrated projects. There is a difference in partnerships between non-integrated and integrated projects. Below is an overview of the pattern of partnership that occurs in non-integrated and integrated projects.

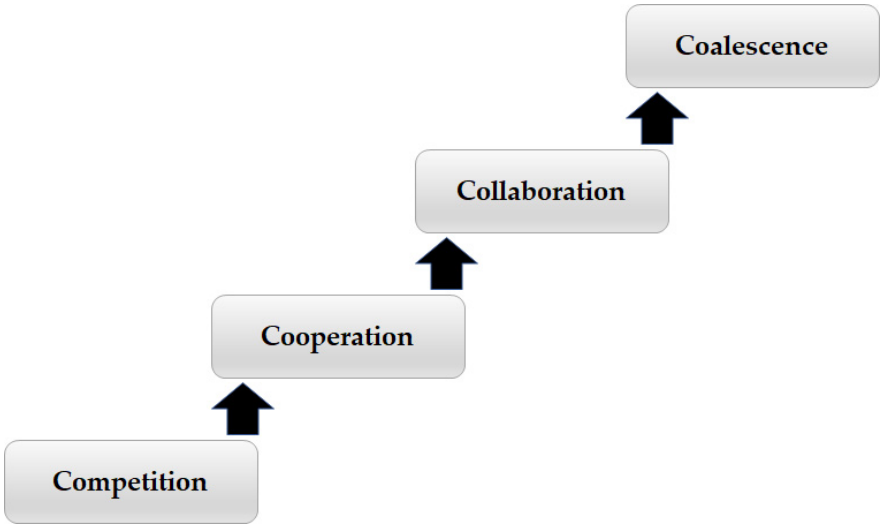

Figure 2. Level of partnership maturity.

Figure 3 shows partnerships in projects that are not integrated, which is a partnership at the level of competition and cooperation. In completing the project, the owner can choose to conduct a soft process (competition) or appoint a contractor for cooperation. A soft process (bid) separates the planner and contractor in project implementation when there is a change in design or specifications. Here, the contractor must communicate with the planner, which may cause delays in design readiness.

Project life cycle	Initiation	Design	Construction	Closing
Maturity of partnering	Competition → Cooperation	Competition → Cooperation	Competition → Cooperation	Cooperation
Stakeholder	Owner and professional consultant	Owner and designer	Owner and contractor, contractor and sub contractor (general and specialist), supplier	Owner, designer, and contactor
Affecting indicators	Cost, time, quality	Cost, time, quality, safety and environmental	Cost, time, quality, safety and environmental	Cost, time, quality

Figure 3. Partnership in a non-integrated project.

Figure 4 shows a partnership on an integrated project, where the planning and implementation are carried out by the contractor, and design changes can be quickly anticipated because they come from the same entity. The contractor has an interest in the project so as not to waste any money, so the contractor will communicate effectively with the owner to complete the project more efficiently. Owners can use competition when choosing designers and builders or directly appoint designers and builders with cooperation. The implemen-

tation of DBB can be performed using the process of joint operation (collaboration) and joint venture (coalescence). In an integrated project, there is a depth of partnering from the competition, cooperation, collaboration, and coalescence.

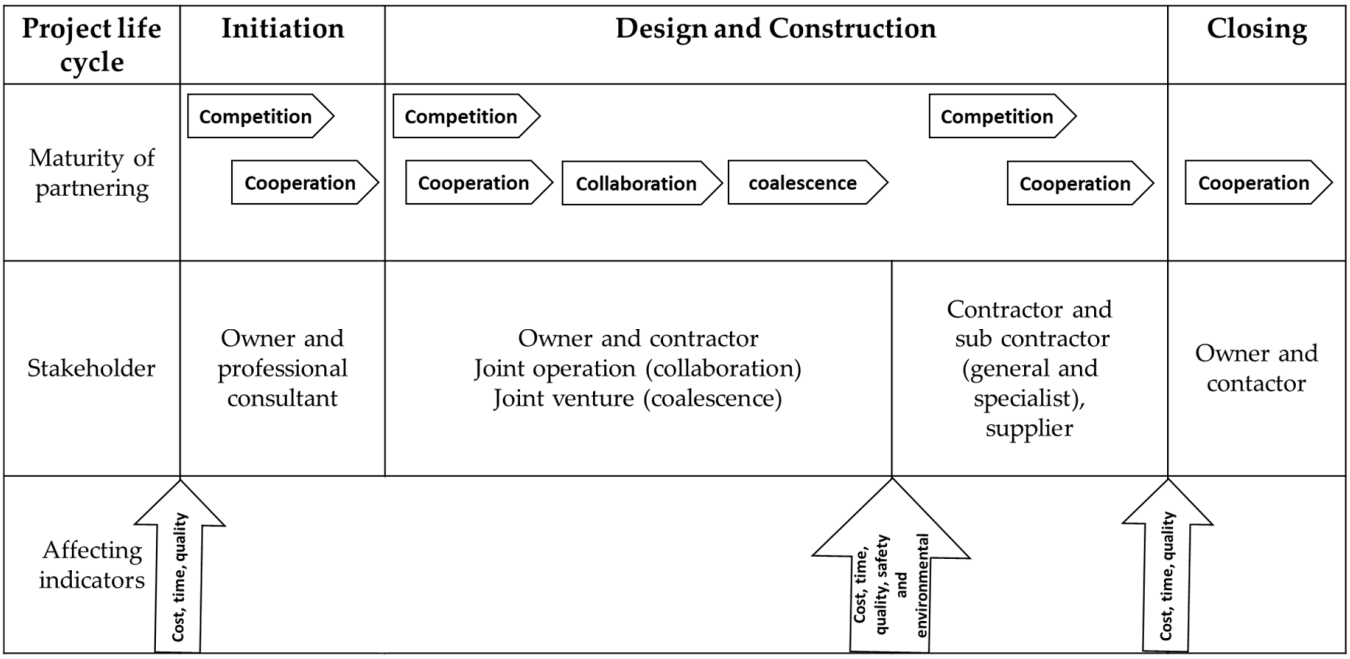

Figure 4. Partnership in an integrated project.

Figure 4 illustrates that in integrated projects there are deep partnering variations from competition, cooperation, collaboration, and coalescence, but this situation is still a competition between the owner and the General Contractor.

1.2. Critical Appraisal of Partnering in Project Delivery Systems

Critical appraisal is carried out by studying literature related to project delivery systems between non-integrated and integrated projects. Its characteristics are analyzed as a starting point for hypotheses. Non-integrated projects (DBB) have different characteristics from integrated projects (DB and EPC). Below is a comparison of DBB, DB, and EPC in each phase of the project life cycle. DBB is chosen when the owner wants a separation between the designer and builder to produce more professional results, because there are checks and balances in the work that supervise each of them. The designer is responsible for project design which will then be carried out by the builder.

Table 1 indicates that DBB in non-integrated projects experiences problems in design changes, specifications, delays in project implementation, and high-variation orders. This is because the usual partnership used in non-integrated projects is competition, and there is a separation between the designer and the builder. Non-integrated projects have different strengths and weaknesses compared to integrated projects. The absence of an integrated design is a weakness of non-integrated projects, while the advantage is fairness in choosing partners in a professional way.

In an integrated project, the designer and builder entities are combined. This also affects the depth of the partnership between the designer and builder. Design and construction work are carried out by the same entity, namely the general contractor, so that when there are problems with design changes they can be anticipated more quickly. Table 2 below states the characteristics of DB, which gives it an advantage over DBB.

Table 1. Characteristics of a Non-integrated Project (Design, Bid, Build) [6,26].

No.	Project Life Cycle Phase			
	Initiation	**Design**	**Construction**	**Closing**
1.	The project is conceptualized by the owner	Planning is based on the desired needs, not on economic feasibility, financial availability, or the ability of the owner	Project performance is lower than DB	Variation cost at the end of the project, which is higher than DB
2.	The need for specialization between designer and contractor to avoid bribery and fraud	Design planning plays a big role and is used as a reference	Tighter supervision	Handover of the project involves commissioning before being handed over to the owner
3.	Higher project costs		The contract contains incentives for punctuality and penalties for late work and cost overruns	
			Does not produce an integrated design between planners and contractors	

Table 2. Characteristics of an Integrated Project (Design-and-Build) [26,27].

No.	Project Life Cycle Phase			
	Initiation	**Design**	**Construction**	**Closing**
	Integration in the project initiation phase unites entities between project design and implementation to achieve better quality and cost management	The use of a more integrated design	The team produces the project according to the desired target.	The variation cost at the end of the project is lower than DBB
	Minimum cost overruns		Tighter supervision.	Ease of repeating the next project because this one has complete documentation
			The team produces the project according to the desired target.	No cost overruns
			Specification conflicts can be resolved quickly	

The advantages of an integrated project are that the cost of overruns and variation orders are low and sometimes do not even occur. This is believed to result in better

project quality and the complete documentation of the project implementation because the design and implementation sections are in one entity. Another advantage is a more integrated design.

Another integrated project category is EPC, which is analyzed in the following table based on projects from several studies:

Table 3 illustrates that the advantage of EPC is the collaboration and coalescence of projects in a larger scope. Hence, EPC is very suitable for projects of high complexity.

Table 3. Characteristics of an EPC project [6].

No.	Project Life Cycle Phase			
	Initiation	**Design**	**Construction**	**Closing**
	One entity in charge of design, procurement, and construction	Saving costs may have been prioritized over creativity in the design, Designer and Builder in one entities (lumpsum cost)	The system can control expenses	The system is not suitable for repair work (new contract)
			Communication between owners and stakeholders is better	There is no variation order
			Post-contract variations are difficult	The scope of maintenance on equipment is covered in the contract
			The project can be completed on time, and there is a long maintenance phase from the contractor	

From the three project delivery systems, a comparison is made on the maturity of partnership in competition, cooperation, collaboration, and coalescence groups [7]. Each of these combinations of partnerships that occur in DBB, DB, and EPC can be mapped as seen in Table 4 below:

Table 4. Comparing the maturity of partnerships (DBB, DB, EPC) [6,7,26,27].

Competition (DBB, DB)	**Cooperation (DBB, DB)**	**Collaboration (DB, EPC)**	**Coalescence (DB, EPC)**
The owner is solely responsible for any arrangements	The establishment of a long-term plan, training, and construction of a project on-site	The establishment of a long-term plan, training, and construction of a project on-site	The establishment of a long-term plan, training, and construction of a project on-site
Free competition is available; the maturity level is 0% to 25%	Independent organizations have cooperation—ad hoc. Maturity rate of 25–50%	Within an organization, there can only be mergers. Maturity rate of 50–75%	Contractors participate in the constructability process, consulting organizations merge, and buildability considerations have been included since the design stage. Maturity rate of 75–100%
Low	Middle	High	Very High

The comparison shows that integrated projects have more maturity in partnerships than non-integrated projects, which is in line with previous research submitted by Katar [6]. Here, it is said that integrated projects have better engagement due to the unification of entities [7]. Another aspect that will be shown is how to recognize embryo partnering and how far it can be improved through the project life cycle phase.

2. Materials and Methods

2.1. Materials

The materials employed in analyzing the partnership level in integrated and non-integrated project delivery systems are secondary data from contractors originating from project reports and weekly meetings that the owner and contractor have verified. The researchers submitted applications for data use to contractors with the following criteria:

1. The project is a building located on the island of Java.
2. Project value above 20 billion IDR (complex).
3. There are five projects, three of which are DBB projects, while the other two are DB projects.

The following are the similarities and differences among the project data used in the analysis shown in Table 5 below:

Table 5. Characteristics of the research project.

Project	Type	Contract Value (Billion IDR)	Location	Duration (Months)	Contractor's Company
DBB A	Building	106	Jakarta	12	Private
DBB B	Building	126	Jakarta	12	Private
DBB C	Building	27	Central Java	9	Private
DB A	Building	70	Central Java	23	Private
DB B	Building	68	Central Java	12	Private

Data collection was generated from project reports that were verified by the owner, contractor, and construction management. The data consist of weekly and monthly reports that describe the progress of the project. The project progress was then tabulated to project achievement results in percentage compared to percent project completed (PPC).

2.2. Methods

The method used in this study involves a comparison of the various progress reports that were gathered, and from the progress report, a graph comparing the monthly and quartile project progress was made. Furthermore, an analysis of the standard deviation of the existing data was carried out. Projects with a smaller standard deviation from the average had a better average progress slope than projects with a high standard deviation away from the average.

The methodology used in this paper can be briefly explained as follows:

Figure 5 describes the process of the research methodology. Step one was to classify integrated (DB) and non-integrated projects. Step two was to collect and tabulate data based on project reports that had been signed by the owner, contractor, and construction management. Furthermore, the project data that had been tabulated was used in step three to compare the existing monthly progress in accordance with project performance (cost, quality, time, safety, and environment). In step four, a comparison was made in overall and quartile progress. In step five, a comparison of the deviation standard to see the average value compared to project progress value was carried out. Projects with a standard deviation value close to the standard had better performance. The last step (step six) was to provide analysis and conclusions from the results of the analysis performed.

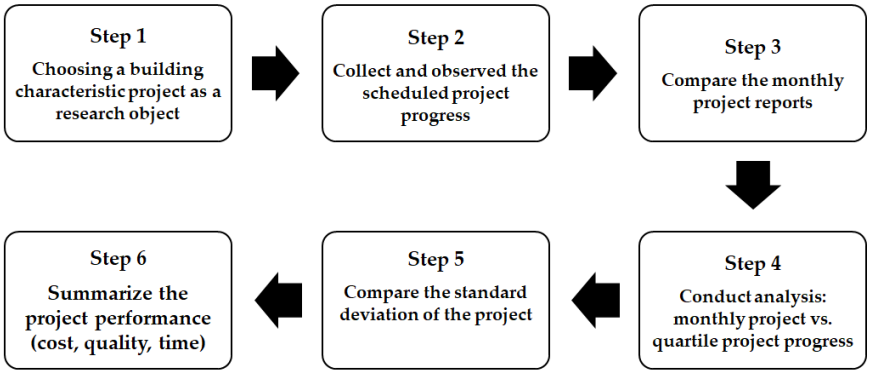

Figure 5. Research methodology.

3. Results

From the analysis of project reports in the form of weekly meetings, work was carried out every week along with monthly progress deviations. Deviation means the difference between the plan and its realization. The notation (+) indicates progress ahead of the plan. Otherwise, the notation (−) indicates the project was experiencing delays.

From Figure 6, it is seen that, in general, both "DB_B" and DB projects experienced delays. Several factors affected mastery of information, finance, and leadership for each project. In "DBB_A" and" DBB_C" project financing was carried out by the owner depending on the monthly progress; thus, it was necessary to have a common perception of progress that affected the contractor's financial condition. In "DBB_C", the project owner is the government, so the level of decision-making was also hampered. Inefficient leadership causes project delays when there is a need to make quick decisions on any changes to design, specifications, or important choices in the project. "DB_A" and "DB_B" have almost the same characteristics. Still, the owner of "DB_B" is a multinational company, so the decision-making and SOPs used tended to be better. As seen in "DB_B", the project was running according to plan and even ahead of schedule. Multinational companies are not bound by regulations such as those using government funds and have an independent level of authority based on the system established by the company. Therefore, there was a good project delivery system and mastery of information by the project owner of "DB_B".

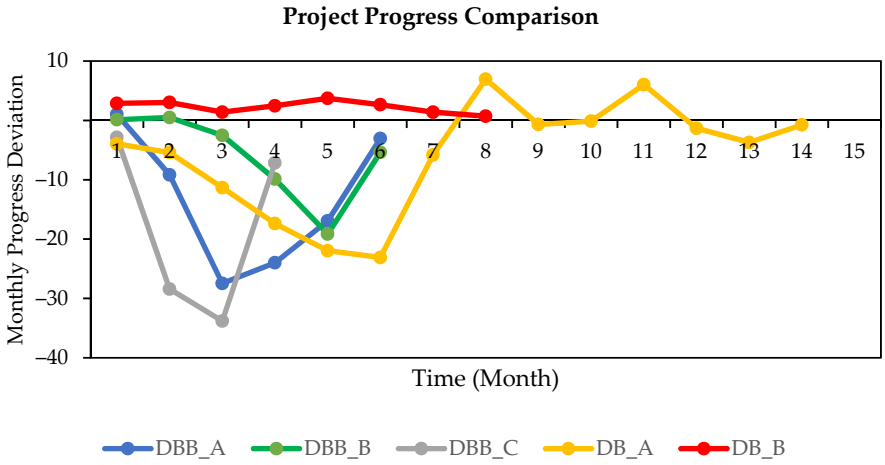

Figure 6. Project progress comparison.

It can be seen from Figure 7 that the development in quartile one and quartile two of each project, both DBBs and DBs, has almost the same pattern, but quartile three shows a significant difference. This is where the values of partnership begin to show. Projects with DBB and DB characteristics in quartiles one and two still have design and specification changes, so the speed of construction changes for DBB and DB looks different. In DBB

projects, construction is carried out by different entities, so in quartile three, the pattern is far from the plan. Still, in projects with DB characteristics, it appears that the issue of design changes does not occur. There is a high level of collaboration between the designer and contractor because they are in the same entity. In the DB projects, the partnership pattern entering the 3rd quartile has matured, which is continued until the project is handed over.

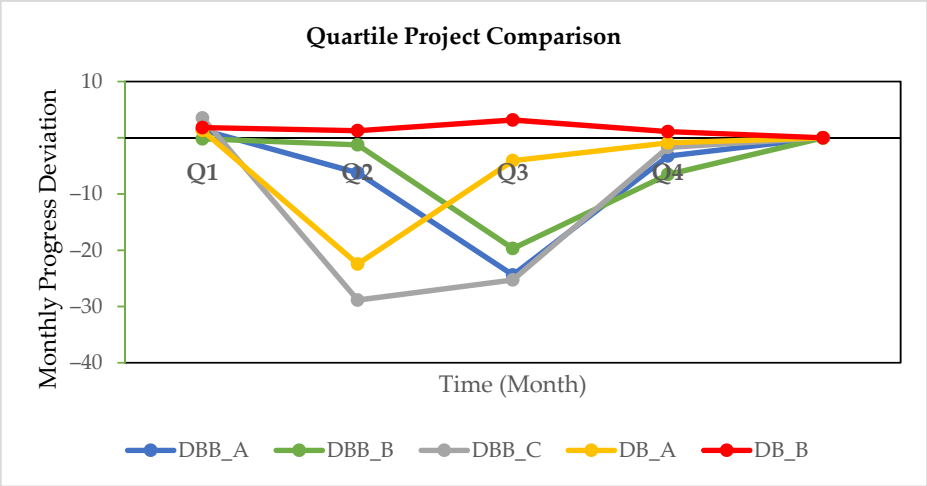

Figure 7. Project progress comparison in quartile.

Figure 8 illustrates the standard deviation with a value close to the average. Here, a good standard deviation is 1, implying that the larger it is, the further away it is from the average value. It is observed that the standard deviation of the projects with the characteristics of DB, have a better standard deviation than the DBBs. "DBB_B" has a small standard deviation compared to "DBB_A" and "DBB_C" because "DBB_B" had a contract for financial support from a contractor such as BOT, so there were no financial issues in the monthly progress. Contractors could carry out projects continuously without any financial constraints. This shows that the materials and finance are controlled by the contractor. The standard deviation indicates that the project performance was closer to the mean value, which indicates a better data slope. Here, the average performance is said to be consistent. "DBB_B" shows in-depth partnering between the owner and the contractor by implementing BOT as part of partnering cooperation.

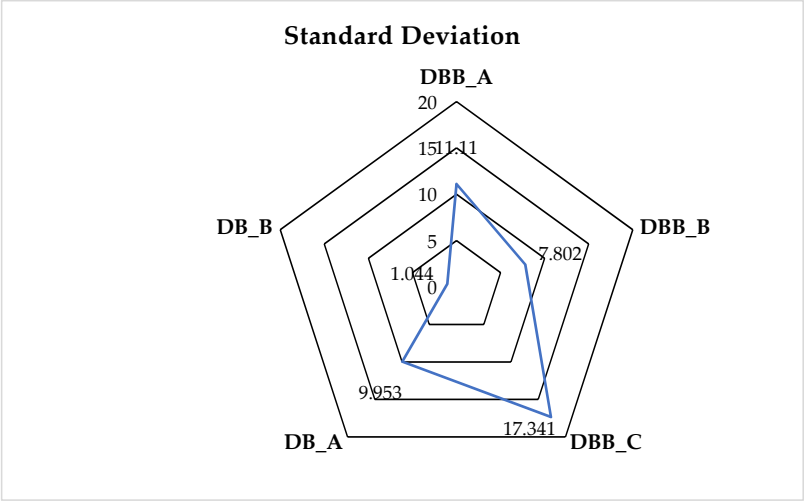

Figure 8. Standard Deviation.

4. Discussion

According to the data from the five projects mentioned above, project performance indicators include cost, quality, and time. The research is also consistent with the findings of recent studies [6,14,26] that found that integrated projects (DB) have higher productivity, do not suffer from design or specification constraints, and can be implemented quickly due to the elimination of the designer and builder roles, which means specification conflicts can be resolved quickly and internally. The integrated project unites entities in both project design and implementation to achieve better quality and save costs. Five of the top ten factors influencing the long-term performance of construction projects are categorized as construction factors, establishing that the construction process possesses the greatest impact with respect to the project's long-term performance. The fact that three criteria are categorized as being part of the inception phase demonstrates the importance of the project's inception for a future endeavor [19].

Deeper (mature) partnerships in projects result in faster project progress and work completion, as evidenced by better project completion in integrated projects. This is consistent with previous research findings that integrated projects will be better due to the absence of design change problems. If they occur, they can be predicted quickly because the design and contractor entities become united. This is consistent with the findings of recent studies [6,19] that found that integrated projects (DB) have higher productivity, do not suffer from design or specification constraints, and can be implemented quickly due to the elimination of the designer and builder roles [6,28].

The maturity of partnering in integrated projects is visible when progress exceeds 50% completion, as evidenced by improvements in speed and performance in quartiles three and four. According to previous investigations [24,29], the majority of partnerships have increased to four times the size of the competition. In addition, collaboration and coalition have advantages over cooperation and competition. In comparison to the characteristics of the previous five projects, projects with integrated databases ("DB_A" and "DB_B") had a higher level of partnership, as evidenced by higher monthly progress and standard deviation.

A project's partnering process is not integrated at the competition and cooperation levels. When the owner makes a tender (bid), the owner will choose a designer and a contractor through a competition [7,11,12]. Even if the project contract requires DBB, the owner can increase the partnership level to collaboration by involving designers and contractors in the project from the beginning. If a deeper level of partnership occurs, it will improve a variety of indicators, such as communication and service to stakeholders [14,26]. This is consistent with the philosophy of lean construction, which is to increase productivity and reduce waste throughout the project [1,11,18,28,30–32].

A project moves along more quickly and the steps and tasks needed for successful completion are accomplished quicker when there is effective communication. Conversely, ineffective communication obstructs project processing and normal project flow, as well as jeopardizes the ultimate success of the project [30].

There is a depth of partnership in integrated projects, including competition, cooperation, collaboration, and coalescence because of the nature of deeply integrated projects, which range from general cooperation to joint operations and joint ventures. The extent of this collaboration will vary between design-and-build and EPC. EPC is characterized by the fusion of engineering elements. An integrated project emphasizes collaboration, particularly at the design and build stages. This is consistent with what has been stated in previous research [4,26,31]. Work teams that collaborate with one another primarily function autonomously of their parent corporation. As per findings [4,31–33] and recommendations [25,27,34], due to its improved adaptability and flexibility, a decentralized organization is more attentive to customer demands. The proliferation of decision-making centers encourages flexibility, and structural modification to accommodate special demands is facilitated by adaptability.

5. Conclusions

1. The levels of partnering maturity in integrated and non-integrated projects are different. In an integrated project where the contractor and planner are one entity, there will be a maturity of collaboration–coalition partnering. As seen in the "DB_A" and "DB_B" projects, the project performance evaluation results showed significant values in quartiles 3 and 4, where the speed of anticipating design changes and material changes was better because the level of authority in the project lay with the general contractor responsible for the design and build (DB). This is also in line with the maturity of partnering in DB (integrated) projects where the partnering process that occurs at the general contractor level is cooperation, collaboration, and coalescence. Meanwhile, non-integrated projects will have partnering maturity from competition- cooperation.
2. The level of partnering in non-integrated projects can be increased to the maturity of partnering in integrated projects if several strategies are carried out in each project life cycle. Maturing the partnership of the project will lead to an increase in project value, especially the value of money and time. This is clearly seen in "DB_A" and "DB-B", which had faster project progress completion with better percent project complete values compared to "DBB_A", "DBB_B", and "DBB_C". This study proves that the overall performance in DB is accelerated by 5–7% (in quartile three of DB_A and DB_B).
3. Certain prerequisites are necessary to strengthen the partnership level in a project delivery system. For example, mastery of information, finance, and leadership will affect the pattern of partnering in each phase of the project life cycle.
4. There is a visible sign of partnering maturity in quartile three and so on in project implementation in the design and build projects because the changes in design planning and implementation were managed by one entity.
5. Maturity in partnering raises creativity and innovation among project stakeholders. On the other hand, competition creates fragmented projects between construction project organizers, which will eventually cause problems and losses to some or all stakeholders in the project. Meanwhile, cooperation, collaboration, and coalescence will have a positive influence with respect to the project by being the parties involved from the start, with values of trust and good governance in the implementation of construction projects.
6. This study reveals that partnership in project implementation can be improved by recognizing the maturity level of the partnership that occurs. Projects with design, bid, build (DBB) and Design & Build (DB) structures have the opportunity to perform better by increasing their level of partnering maturity.

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