Partnering Tools To Achieve Lean Construction Goals

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Abstract

The selection of a project delivery system in a construction project will have various consequences because it is related to the risk of the selection made. Many projects have experienced losses to both the owner and the contractor, due to not knowing and anticipating the various possibilities and consequences of the chosen project delivery system. Various kinds of project delivery systems will be analyzed and compared based on related stakeholders so that a method that is closer to the lean construction indicator will be found. This study makes a comparison of various relevant literature studies, which will result in a comparison between design bid build, design & build, Engineering Procurement Construction (EPC), Build Operate Transfer (BOT) and Partnering. The results of this study indicate that partnering is a type of project delivery system that can be developed to achieve lean construction indicators and goals. This research is expected to be used to consider the selection of a project delivery system that will be used by

the owner and contractor as well as to anticipate the weaknesses of each of the options used so that the project can run well following the desired goals of all parties.

Keywords: project delivery system, partnering, lean construction

Introduction

Construction Industry is very unique and interesting to always be studied, various problems require a comprehensive solution by knowing the root of the problem that occurs so that the solution becomes right on target. Construction projects play an important role in the economy in Indonesia, at least 10, 76% of the total GDP of the Indonesian state (Ministry of Industry, BPS, 2019). His big role certainly causes many problems to occur. Building failures often occur due to aspects of service providers/contractors related to skills and training, use of substandard materials, planning errors (not following technical standards and regulations) and legal problems [4]. Another problem is the existence of low productivity and waste that occurs due to delays in procuring materials, delays in material arrival, unpredictable transportation, etc. [3,4,10].

If seen and traced more deeply into the implementation of construction, it needs to be evaluated from each phase in the project life cycle, how each phase can be controlled properly so that there are no problems with building failure, low productivity and waste that results in not achieving project objectives as desired. In the project life cycle phase, of course, we know the phases of initiation, tender, detailed engineering design, construction implementation, operation and maintenance [3]. The project life cycle is controlled by different stakeholders depending on the project delivery system chosen by the owner. The project delivery system is a way of controlling the construction project of each project life cycle through a formal contract entered into by the owner and its stakeholders. Each selected project delivery system contains various risks, risk analysis can be carried out using various tools (PMBOK, AS / NZS, ISO) following the owner's objectives [2]. In the construction industry, most various kinds of project delivery systems including design bid build, design & build, Engineering Procurement Construction (EPC), Build Operate Transfer (BOT) and Partnering and various derivatives of each of these delivery projects [3,7,11].

Project Delivery System

Design-Bid-Build

The Design-Bid-Build process can be briefly explained through the figure. 1 below:

Figure 1. Design-Bid-Build (Taylor, 2011)

Formal Contract

Engineering Design

Information :
OW = Owner
A/E = Designer
CO = Contractor
SubCo= Sub Contractor
GC = General Contractor
Inv = Investor

Design-Bid-Build occurs when the owner wants a separation of functions in the construction process. The owner wants a different company to design and build the project. This aims to be professional in carrying out the work carried out following their respective scopes. Engagement factors between the owner and the contractor, such as share value, loyalty [1] are very low in the design-bid-build project delivery system model. Variation order risks and design changes are frequent.

Design & Build

The Design & Build process is a process where the owner makes a Design and Build work contract to a General Contractor company appointed through a tender (Bid). The scope of work includes design (architecture and engineering) and project development per the owner's goals. The design of the resulting image must be approved by the owner, then calculated based on the appropriate unit price. The General Contractor (GC) will collaborate with the Design Company, subcontractors and suppliers to complete the project. Figure 2. below illustrates Design & Build.

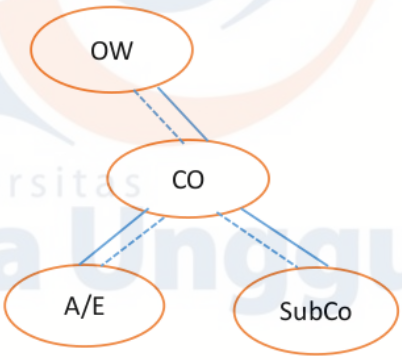

Figure 2. *Design & Build* (Taylor, 2011)

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Engineering Procurement Construction (EPC)

The Engineering, Procurement, Construction (EPC) process is almost similar to Design & Build, but EPC is usually used in more complex projects that require a more diverse procurement process. The owner appoints an EPC company to complete the project in the Engineering, Procurement and Construction contracts. Furthermore, the contractor will contract with 3 companies in different fields or according to needs. In EPC the risk of design failure, the mismatch of material between the drawings and the minimal implementation occurs because from the beginning the designing contractor knows the type of material used. However, the risk of material delays can still occur because the specifications desired by the owner are not purchased by the contractor from the start, especially imported materials that require time to purchase. Figure 3. Below explains how the EPC process in the project delivery system is carried out.

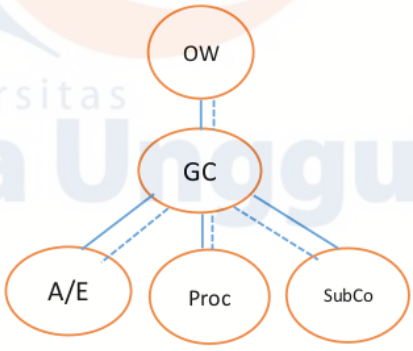

Figure 3. Engineering Procurement Construction (PC) (Taylor, 2011)

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Build Operate Transfer (BOT)

Build Operate Transfer (BOT) occurs when land rights holders need financial support from investors to build projects. Investors will build the project together with

the General Contractor (GC) using the desired project delivery system (Design-Bid-Build, Design & Build, EPC, Partnering) and then operate the building that is the object of the agreement for a certain period, then the building is handed over to the Rightsholder for managed.

Build Operate and Transfer, which is often referred to by many parties as a build, use and transfer transaction, namely building, managing and handing over is a form of cooperation between the government and the private sector in the context of building an infrastructure project. According to point 1 sub (12) Government Regulation (PP) Number 38/ 2008 concerning Management of State-Regional Property, which states that Build for transfer is the use of state / regional property in the form of land by other parties by constructing buildings and/or facilities. The following facilities are then utilized by the other party for a certain agreed period, to be subsequently handed back the land and buildings and/or facilities and facilities after the expiration of the period. Whereas point 1 sub (13) states that building handover is the use of state / regional property in the form of land by another party by constructing buildings and/or facilities and facilities, and after the construction is completed, it is handed over to be utilized by the other party within a certain period of time agreed.

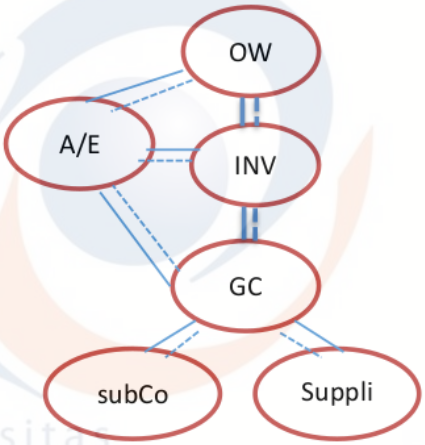

Figure 4. Build Operate Transfer (proceed by researcher)

Partnering

Partnering allows the Owner since the initiation of the project to collaborate and collaborate with various stakeholders to complete the project both with the planning consultant as the project planner, various suppliers and subcontractors that have been defined from the start by the owner as a part of the partner who will work together with the contractor to complete the project. Formal contracts between stakeholders are carried out since the beginning of the project, the contractor is responsible for managing the construction implementation.

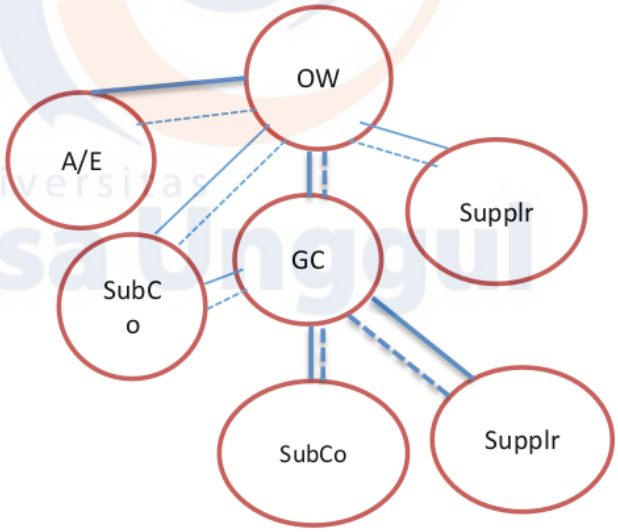

Figure 5. *Partnering (proceed by researcher)*

When the design has been agreed upon, then it defines the material specifications as well as appoints the procurement company/supplier that will be involved, agrees on purchasing and delivery (transportation), the material on-site schedule. So that from the start there was no change in the desired design and material specifications. Furthermore, the owner appoints a General Contractor (GC) to build the project with a procurement contract with the desired supplier. The values of loyalty, share value, rescue, support, interaction, communication [1] are very much needed in partnering.

Lean Construction

The term "lean construction" was coined by the International Group for Lean Construction at its first meeting in 1993 (Howell, 1999). The term "lean" comes from the Toyota Production System (TPS) which was developed in the 1990s. This illustrates the strategy adopted by the company to increase efficiency in production and consumption automatically [6,7,8,9,13,14]. His historical lean concept stems from Henry Ford's invention of the conveyor belt which led to the mass production being observed in the 19th century [14]. There are at least five main principles of "lean construction" that result in production effectiveness in construction [7,8] These principles consist of (1). The value of the construction is identified based on the views of the customer; (2). The planned value is implemented in the delivery of the material, (3). Reduction/elimination of "waste" in various processes that affect the flow in the work process; (4). Making a system to ensure the accuracy of delivery of materials until needed; (5). organizing accuracy and perfection work that aims to improve the systems and processes needed consistently. The five principles aim to create the necessary system optimization and can increase morale in work [7,8,9,13,14].

Lean Construction brings many benefits when implemented in a construction project. The main advantage is that the construction industry can reduce construction costs due

to the use of correct materials and less "waste" [7,8,9,13,14]. Proper project planning will shorten the duration of the construction project and promote the quality and sustainability of the project itself [7,8,9,13,14]. Lean Construction involves designing a project to minimize the "waste" of material, time, and human effort, to generate high productivity [7,8]. This is related to holistic planning and continuous improvement in design, construction, construction activities, maintenance, rescue and recycling in construction projects [5]. This system recommends identifying the root causes of waste, removing it by using related tools and techniques and encouraging waste prevention rather than taking corrective actions to overcome the negative effects of lost profits. [7,8,9,13,14].

Lean Construction in research believed to lead to increased quality and productivity in the construction industry. the implementation of the lean construction concept increases the quality and productivity of construction projects by around 77%. Also, lean construction results in improved working conditions and can reduce physical and psychological stress [3,4]. Lean construction increases workflow by reducing the occurrence of variability and can improve coordination within projects [3]. [6] The Benefits of implementing lean construction in general in the construction industry includes:

1. increase in customer satisfaction):

2. Quality Improvement;

3. Increase Productivity

4. Reduced Construction Time

5. Improve the construction process;

6. Better Health and safety record;

7. Improve relationships with suppliers;

8. Better inventory control / reduced;

9. Increase market share;

10. Employee satisfaction.

Discussion

From Figure 1 to Figure 5 above, it is clear that the collaboration process in each delivery system project is clear. Each project delivery system has different actors and risks. The table below explains the comparison between types in a project delivery system through 5W + 1H analysis, this analysis will show how each process is controlled and has operational advantages. The description of the project delivery system below provides a difference that the engagement between the owner, contractor, subcontractor, supplier,

investor for each type of delivery system project is very different, partnering has a tighter engagement since the initial project was initiated, while the design bid build has low engagement compared to the project other delivery systems. The owner is aware that working with stakeholders from the start will facilitate the operationalization of the project. Engagement will build loyalty and share value among partners so that together they will realize the project objectives well. Collaboration like this will increase productivity and reduce waste in the project due to material delays, material scarcity, unpredictable transportation, etc. The use of resources that are not on target (unutilized) is often the cause of the project experiencing a profit that is not according to the initial plan, with the partnering owner being able to appoint partners in the field of resources needed professionally based on the factors considered. According to Taylor and Francis Group, LLC (2011)) a partnership is proven to make projects more successful, design failures and variation orders are minimal, financial guarantees are according to planning so that productivity increases and waste can be reduced in the construction project implementation process. Increasing productivity and reducing waste in construction projects are the main principles of lean construction.

Table. 1 Comparison of *project delivery system*

No	Aspect	DBB	DB	EPC	BOT	Partnering
1	Who	OW-A/E OW-GC GC-subCo	OW-GC GC-A/E GC-SubCo	OW-GC GC-A/E GC-Proc GC-SubCo	OW-INV; OW-A/E INV-A/E INV-GC	OW-A/E OW-GC OW-Proc-Supp GC-Proc, Supp
2	What	Design-A/E Build-GC	DB-GC	EPC-GC	Investment-Invr Design-A/E Build-GC Operate-Inv	Design-A/E Proc-Subcont Proc Build-GC

No	Aspect	DBB	DB	EPC	BOT	Partnering
3	When	The owner separates the contract between design and build	Owner put together Design & Build contract, GC has contract with A / E, subcont and supplier	The owner brings together the EPC. GC has with A / E, Proc, Subcont	The owner needs investors to build the project. inv has a contract with GC, A / E has a contract with OW	OW has many contracts with A / E, GC, Proc, Supplier / Subcont
4	Why	The separation of responsibilities is more professional, design and build risks are separated.	Owner minimizes the risk of design and builds errors so that when delivery is only related to one party. There is no risk of design failure for the owner	Owner minimizes the risk of design and builds errors so that when delivery is only related to one party. There is no risk of design failure for the owner	Owner collaborates with investors to finance the project, according to the operating period, then handed over to the owner. The owner has no risk of project failure, design failure, project loss, etc.	Since the design owner ensures the specs, material delivery is on time, there is no design failure due to material scarcity, can be on time, related parties are mapped from the start.
5	Where	Engagement (+) between Owner –A/E and GC	Engagement ++ between Owner dan GC	Engagement ++ between Owner dan GC	Engagement ++ owner – Investor	Engagement +++ between Owner, GC, Subcont, Supplier, Proc

No	Aspect	DBB	DB	EPC	BOT	Partnering
6	How	The lack of material, specification non-conformity, specification replacement, design change, contractor suffering loss (variation order> 10%.	The lack of material still exists, small design failures, material delays (if it requires special specifications from the owner), variation Orders occur <10%, small design changes.	The lack of material still exists, small design failures, material delays (if it requires special specifications from the owner), variation Orders occur <10%, small design changes.	- Investors with Design-Bid-Build risk following the design-bid-build. - Investors with Design & Build / EPC then risk according to Design & Build / EPC	The lack of material, material delays incoming does not occur, the process is identified from the start, who the perpetrators are, waste in small projects.

(source: proceed by researcher)

Table 2. Below illustrates the linkage between partnering and lean construction where the positive things that become partnering's advantages are mapped in the lean construction indicator. It can be seen that almost 95% of partnering excellence is one way of achieving indicators in lean construction.

Table 2. Linkage *Partnering* dan *Lean construction*

	Lean Construction				
Partnering	***High Productivity***	***Reduce Waste***	***Resources MGT***	***Energy Min***	***Elimination Non-Value added Process***
Minimize design errors	V	V		V	V
Material Management on time and no delivery delay	V	V	V	V	
Minimization of material spec errors and material scarcity	V	V	V	V	V
Better communication and coordination	V	V		V	V
Bigger profit than traditional	V		V		V
Minimizing Variation Orders	V	V	V	V	V
Budget Financial Guarantee	V	V	V	V	V

(source: proceed by researcher)

From Table 2. Mapping the indicators for lean construction and partnering is something that goes hand in hand in making the project more successful. Partnering is a tool lean construction indicators, by collaborating from the start in the initiation phase, ensuring more precise specifications, preventing material shortages and unexpected design changes. Partnering is a recommendation for a project delivery system by including from the start which parties are invited to cooperate with formal contracts issued by the joint owner of each stakeholder who will be involved. The project document can add the initials of each party that will be invited to collaborate from the start, so that engagement is very strong in completing the project. Several important factors that must be considered by the owner are the things that influence the occurrence of attractive partnerships in choosing the involved stakeholders [1]. The factors of communication, loyalty, interaction, share value must be the basis for this collaboration because the principles of trust that are developed to achieve project objectives are better. High commitment is required in partnering, so that material accuracy, material transportation problems and material arrival will be on time and according to the schedule developed in the project. Financial certainty between each stakeholder is predictable with a minimum of design changes, material specification changes and onsite material delays which often cause variation orders and extreme delays exceeding tolerances.

Conclusions

From the above explanation, this research draws the following conclusions:

1. The comparative results of the project delivery system show that the partnering model is very effective in achieving lean construction indicators and goals in construction projects. Partnering can increase trust, loyalty, commitment, shared value between owners and stakeholders.
2. Lean construction provides various benefits in implementing construction projects, developing lean construction-based partnering will make the project more effective and efficient.
3. Partnering can be a reference in starting a construction project by compiling a framework of reference in the form of partnering.
4. It is necessary to reveal the significant factors that influence partnering to obtain mutually beneficial cooperation from all parties, the important values in attractive partnerships need to be developed to obtain a cooperation model that benefits all parties.

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I declare the required data in this journal available if necessary.

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