A Case Study Approach to EPCM in Light of Construction Project Success in Malaysia

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Abstract

It is undoubtedly true that procurement methods are positively related to the success of any construction project. As the construction industry expand rapidly, the need for a variety of procurement methods increases simultaneously. Taking into account the dynamic nature of large industrial projects, a more flexible and effective procurement method is needed. To address the problem, Engineering, Procurement, Construction and Management (EPCM) is perceived as an alternative solution, though minimal works on the EPCM contract have been undertaken. Drawing from the analyses of data collected in case studies of EPCM construction projects, the results of this paper demonstrate that the EPCM contract is the ideal procurement method for warehouse projects with respect to the time, cost, and quality that a customer will demand. The limitation and future research directions related to the EPCM contract are also discussed in this paper.

Key words: construction industry, construction management, procurement, Malaysia

1. Introduction

The dynamic nature of the construction industry necessitates an appropriate procurement model to ensure the overall success of a project. A study conducted by Sanvido et al. (1992) and Phua (2004) considered project contracts, which encouraged various specialists to work as a team without conflicts, as a project success factor. A recent study conducted by Shokri-Ghasabeh and Kavousi-Chabok (2009) posited that contracts can be designed for a project to facilitate the project execution and help the management optimize the cost of the project. As the industry expands rapidly, traditional procurement methods have insufficiently addressed the changing nature of scope of construction projects. Consequently, various procurement methods have emerged, including international joint venture (Adnan et al., 2011); Build, Operate, and Transfer (Tiong et al., 1992); and Engineering, Procurement, and Construction (EPC), more popularly known as the turnkey model. Of these procurement methods, international joint venture is vulnerable to disputes because it involves the joint venture of more than one country.

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Traditional procurement methods have found to fail to satisfy owners' needs, especially in addressing complex construction projects (Lam, 2000). Build, Operate and Transfer is less flexible, and if the EPC contractor is not willing to assume responsibility for basic engineering, an EPC contract is not an option at all (Loots and Henchie, 2007).

The EPC contract covers all activities in three main phases, namely, design or engineering, procurement, and construction (PMI, 1997). EPC is a contracting method in which an EPC contractor is employed to perform the construction process from the design phase and, procurement to physically constructing the product. It is not uncommon for an EPC contractor to partially outsource the scope of work of a project. EPC contract has reigned supreme because of its nature of bearing more risk in the project implementation process (Chen, 2009). Previous studies on EPC contracts have focused mainly on studying issues of risk (Qi et al.,2010; Wu et al., 2010; Guo et al., 2010; Gu et al., 2011), management (Ning and Teo, 2000; Mahmoud-Jouini et al., 2004; Carrillo, 2005; Hui and Qin, 2010), and information management (Moreau and Back, 2000; Wu et al., 2010). This paper raises concern over another contracting method namely Engineering, Procurement, Construction and Management (EPCM), an improvised version of EPC.

Few studies that compare EPCM contracts have been performed. Therefore, this paper specifically addresses the EPCM contract in light of construction project success in Malaysia. The rationale of this paper holds that theoretical saturation occurs, whereby additional analysis no longer contributes to discovering anything new about a category (Locke, 2001) with particular regard to EPCM. Loots and Henchie (2007) echo this reasoning by explaining that not a single article about EPCM contracts was found;, only a list of EPCM contracts and EPCM contractors was found by searching Google. Thus, there is a need for the author to address this research gap. This paper aims to go one step further by addressing a research question that is emerged from the data. The question regards how EPCM can be considered an ideal option for delivering construction projects. The research question immediately leads to another question about how to assess the success of a construction project to further qualify the EPCM as an ideal option. The overall objective of this paper is to provide justification to the questions. Therefore, the literature review in the subsequent section covers EPCM and the notion of construction project success.

2. Literature Review

2.1 Engineering, Procurement, Construction, and Management (EPCM)

The exact origin of EPCM cannot be traced. The idea emerged in the mining sector and has more recently become prevalent in the construction industry, particular in respect to international infrastructure and major construction works (Loots and Henchie, 2007). The EPCM model differs from the EPC model in that it does not feature the concept of sole responsibility for a project, substitutes a single contractor (the Engineer) to design the project and calls for others (suppliers and contractors) to equip and construct it (Charles, 2009). In other words, the unique characteristic of EPCM is that a third party will be employed to build the product with the consent of the owner. The EPCM contractor will only supervise and manage the process of construction process.

Charles (2009) has drawn ten points of comparison between EPC and EPCM, which includes cost and schedule, defective work versus defective services, intellectual property, change of orders and changes to the contract, standards for performance, termination or suspension of rights, insurance and indemnification, dispute resolution and governing law, liability limits and security of tenure. The study is conducted from the owner's perspective. As such, the study benefits owners in formulating the ultimate EPCM agreement. From the study, one may easily point out that EPCM is a more flexible contracting method compared to EPC because it involves the client in the execution of a project. On the other hand, it is also more risky because the consultant is not suited for a timely and cost-effective project.

Beddoes et al. (2009) reported a case study on the Dampier Port Upgrade project, which is the largest project in Rio Tinto Iron Ore's expansion program. They found that EPCM is a flexible model that is specially suited to upgrade project, which require new facilities to be constructed without major disruption to the existing operation. They further found that EPCM facilitates realization of the execution time and cost of a project provided the client team is integrated and that the project team continues to cooperate accordingly. On the other hand, Duggan and Blayden (2001) and Chattopadhyay and Mo (2010) made use of an EPCM-orientated company as a case study for wider application.

The former found that the involvement of operation and maintenance staff at the outset of a project will increase the likelihood of project success, while the latter suggested an enterprise executable model, which possessed four different views: global, task decomposition, kaleidoscopic and resources. Studies of EPCM-orientated companies generally share one common characteristic: people are the main asset and are irreplaceable regardless of how radical change is precipitated by tomorrow's information technology.

2.2 Project Success

Research into project success generally falls into either one of the avenues that examine project success factors or deal with success criteria (Ika, 2009). Rockart (1982) defines the terminology critical success factors (CSFs) as those few key factors that are absolutely necessary to reach project goals. It is worth noting that research into CSFs generally falls under the trend of establishing a list of success factors that are said to be critical to various types of projects. For example, Belassi and Tukel (1996) categorized project success factors into factors related to the project, factors related to the project manager and team members, factors related to the organization, and factors related to the external environment. Sanvido et al. (1992) suggested another four CSFs namely a comprehensive facility team, teamwork boosting policy, sufficient experience in handling various aspects of facilities, and optimization of information in the planning and design stage.

Apart from considering CSFs, Turner, (1999) suggested that one should identify the success criteria in the first place before establishing the associated CSFs. Turner (2009) further defined success criteria as the dependent variables that will be used to assess the successful outcome of a project. In this regard, the popular project management success criteria are time, cost and quality (Navarre and Schaan, 1990; Belassi and Tukel, 1996; Hatush and Skitmore, 1997; Atkinson, 1999; Baccarini, 1999; Shokri-Ghasabeh and Kavousi-Chabok, 2009; Al-Tmeemy et al., 2011), which are used as success criteria in this paper.

Most research papers either intentionally or unintentionally abandon philosophical stances in their discussion (Maanen et al., 2007; Biedenbach & Müller, 2011). Within the context of project success, positivism, interpretivism, and empiricism are the most common philosophical positions. Fundamentally, positivism deals with explaining human behavior, while interpretivism is concerned with understanding it (Amaratunga and Baldry, 2001). Meanwhile, empiricism tends to work in an inductive manner to develop theories from data. Each of the paradigms consists of advantages and disadvantages. Consequently, Söderlund (2010) posits the idea of applying pluralism in project management, while Dainty (2007) proposes methodological pluralism in conducting construction management research. With respect to these suggestions, this paper employed a case study approach in examining the EPCM contracting method in light of project success.

3. Research Methodology

Comparison of case studies is the main sources of data. In general, a case study is widely used to better understand the circumstances of an event. It emphasizes process, context and discovery rather than outcomes, a specific variable or confirmation (Laws and McLeod, 2004). The methodological background of this paper is built on interpretive case studies. The setting of the case study begins with the formulation of a research question. The overall objective of this paper is to provide an answer for "how can an EPCM contract be considered as the ideal contracting option for construction projects in Malaysia". The data collection focuses on the real issues of time, cost, and quality of three warehouse case studies. Because this paper is an empirical case study based, the focus is directed to the most popular success criteria in construction industry. The three case studies are the featured warehouse projects of an EPCM company. Instead of a single case study, three cases studies were used to enhance the burden of persuasion (Taylor et al., 2011). The case studies were assessed from the aspect of time variation, cost variation and quality. Lastly, overall satisfaction can be calculated as an indicator to aid discussion. Other factors that may affect the outcome of a construction project, such as the political, local market condition and luck, were not completely collected for this paper and were therefore not available for analysis.

4. Result and Data Analysis

4.1 Background of the EPCM

This section presents the result of an analysis of the data collected. It starts with a brief description of the EPCM consultant's scope of work and follows with a background of the case studies as well as the interpretation of applying success criteria to each case study. The EPCM consultant provides five scopes of professional services: planning, design, procurement, construction and final completion.

For the planning stage, recurring dialogue will be held with an owner to determine the feasibility of a project. This includes such factors as the site's location and boundary as well as soil conditions. If the project is given the green light, then the subsequent work will include obtaining the necessary requirements from local authorities, producing the proposed master plan for the project and, most importantly, proposing cost estimation plan for the project. It is the responsibility of the consultant to act as a liaison with relevant authorities.

For the design stage, the owner's concept will be advised and subsequently transferred into a drawing. The designs that are generally involved are architectural design, civil work design, structural design, mechanical and electrical design, fire protection system design and landscape design. The last design will vary across owners. Having these designs in mind, the consultant will update the proposed master schedule program and cost estimation plan. The "E" in EPCM represents the planning and design stage in the context of Malaysian EPCM.

For the procurement stage, the work associated with general procurement includes preparing tendering documents, inviting potential bidders for various portions of work, analyzing the potential bidder's price, advising the owner on selecting the bidder among potential candidates, and lastly preparing an award letter and a contract document to finalize the procurement work in this stage.

For the construction stage, the responsibilities of the consultant will be closely related to the work associated with keeping the whole project on time, within budget and within specifications. The consultant will provide a team of competent personnel including a Site Manager, Project Engineer, and Quantity Surveyor to achieve the aforementioned purpose. Moreover, this stage includes advising the owner regarding time extensions for various portions of work, certification of progress claims, and the implementation of legal safety and health requirements on site.

Finally, for the final completion stage, the consultant will first verify the project's completion before the issuance of relevant certificates for occupation. Then the consultant will prepare the final account and coordinate the work related to rectification of defects that may arise from occasionally during the Defect Liability Period.

4.2 Case studies: background and application of success criteria

To avoid conflicts of interest and to maintain confidentiality, the three case studies involved are presented as Case 1, Case 2 and Case 3. All three case studies are warehouse projects. The background information for each case study is summarized in Table 1. Of the three case studies, Case 1 and Case 3 have received a testimonial from the owner that the projects are perceived with "complete satisfaction" and "full satisfaction", respectively. On the contrary, Case 2 has received no testimonial from the owner. The testimonial is used as an indirect indicator of the quality of a given project. The rationale for this is the fact that relevant industrial projects are undertaken for production purposes. In this regard, the quality of projects is vital to ensuring production. The positive comments from owners reflect mainly the quality of projects.

All three projects account no variation of time. In other words, the projects were completes within the proposed period of time without any extension. As a second assessment criterion, cost variation was calculated based on the difference between the original contract sum and final contract sum. Then, the difference was divided by the original contract sum. The final result is the cost variation in percentage, which indicates the extent to which the project exceeded the proposed budget. In this sense, Case 1 was 9.6 percent over budget, while Case 2 was the highest percentage over budget at: 19.8 percent. On the contrary, Case 3 was controlled within budget to as much as 2.0 percent. Lastly, quality was assessed by the owner's comments. Because there is no better way to assess the quality of the projects, this method is universally acceptable but adequate for the purposes of this study. The quality of every case study project was converted to an overall satisfaction percentage. This was done by dividing the number of success criteria achieved by the total number of success criteria.

4.3 Interpretation on application success criteria result

The case studies reveal unique results for every single project. The results of each project vary across the success criteria except for the variation of time because all of the projects required no time extension. All three case studies projects were successfully controlled within the proposed time frame. Case 1 and Case 2 record cost performance of 9.6 percent and 19.8 percent, respectively. In contrast, Case 3 was considered completely successful from a cost variation point of view, recording a cost performance of -2.0 percent, which indicates that the project was completed within budget.

Although Case 3 possesses the largest land area and built-up area, the project only consisted of one project component. This is the reason why the project could be controlled within budget. The quality of the completed projects was assessed using the comments from the owner. Case 1 and Case 3 were perceived as "complete success" and "full satisfaction" projects from the owner's perspective. Meanwhile, Case 2 received no comments. To date, all three case studies projects are operating on site. Table 2 compares the three cases in terms of the success criteria. Case 2 involved the largest quantity of work packages, which included the construction of a reinforced earth wall system and the installation of a passenger lift. Additionally, it was a two-year project, which is the longest time scale of construction among the three case studies. As the number of work packages increases, the risk of not finishing the project on time and within package also increases due to the fact that more unavoidable factors are foreseeable. In short, the EPCM contracting model is recommended as an ideal option in procuring warehouse projects in Malaysia given that the time, cost and quality issues are well within the proposed idea. Nevertheless, more research studies are needed to confirm the theory and few limitations can be drawn from this paper, as is discussed in the following section.

5. Limitation

The first limitation deals with the generic criticism of case studies, which involves the addressing of particular rather than general issues. As such, Yin (1984) suggested that researchers provide justification on how to make generalizations from a limited number of samples. Yin (1984) further posited that a lack of standards and guidance in terms of methodology will lead to insufficient precision and rigor in the majority of case study research. Second this paper was deliberately limited to the standard success criteria of time, cost and quality. In this sense also, the assessment of project from the aspect of quality is based on the owner's satisfaction. It is not a procedure that generally accepted particularly from the engineering protagonist. No attempt was made also to assess the impact of other success criteria on project outcome. Lim and Mohammad (1999) and Crawford and Pollack (2004) highlighted that soft dimensions, such as end-users' satisfaction are needed to fully assess project success. Meanwhile, it is important to note that this paper regards characteristics such as political, local market, luck, condition, scope, time and location as being constant. The impact of these constants on this study has not been substantiated. Lastly, the generalization of the results to different industries is limited to avoid significant discrepancies.

6. Significance of the Research

The paper contributes to the body of knowledge by providing sound evidence that EPCM may be considered an ideal procurement option for construction projects. This point is not found in any other previous work. Furthermore, the study of grounded EPCM case studies is the first to emerge from the literature. Chan and Chan (2004) have demonstrated similar work, but their main focus lies in the discussion of the key performance indicators in the construction industry. Likewise, this paper shows that EPCM could serve as a success factor in producing timely, cost-effective and high-quality construction projects. Indeed, the result may benefit the owner. This is mainly due to the profit-maximizing nature of the specific stakeholder. Lastly, as highlighted by a study conducted by Taylor et al. (2011), causation in the construction domain is difficult to prove because various factors such as individual attitudes, group dynamics, local market conditions, luck, and project momentum can impact the performance of projects before variations across business practices, management techniques, and technology application are even considered. This paper acknowledges this limitation by only addressing the root factor that is the procurement method in proving causation.

7. Conclusions and Recommendations

EPCM is an improved contracting method. It differs from EPC in various aspects. The most significant difference is that the EPCM contractor only manages a project on an owner's behalf but does not carry the responsibility of building the project. In EPCM, the owner will decide on major issues such as the selection of a construction site and the selection of a competent contractor for various work packages based on the advice provided by the consultant. In this sense, it involves the owner to a greater extent in the pre-construction, construction and post-construction stages. In other words, EPCM is more flexible and facilitates the construction of new facilities without affecting the existing operation. This research has demonstrated how EPCM can be considered an ideal option for procuring warehouse projects based on the evaluation of three case studies validation with respect to time, cost, and quality. The outcome of this research provides valuable insights into EPCM because it involves real case studies in the discussion of applying the associated success criteria.

With the associated limitations in mind, future research should focus on wider range of success indicators in proving causation. The results of this study serve as a platform for attracting more attention to EPCM contracts, which are not very popular in the literature but are effective in addressing the performance of construction projects. Lastly, because this paper is conducted within the context of the Malaysian construction industry, it is important that future research place emphasis on the issue of generalization.

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Table 1. Summary of case studies.

Background	Case Study 1	Case Study 2	Case Study 3
Type of project	Warehouse	Warehouse	Warehouse
Project component	Production area, warehouse, office block	Production area, warehouse, office building, canteen	Production area and warehouse
Procurement	EPCM	EPCM	EPCM
Land area	18,215 m^2	71,730 m^2	123,090 m^2
Build up floor area	8,112 m^2	21,019 m^2	92,047 m^2
Original contract sum	RM5.2 millions	RM18.7 millions	RM2.491 millions
Final contract sum	RM5.7 millions	RM22.4 millions	RM2.438 millions
Date of commencement	29 April 2004	8 January 2007	12 August 2005
Date of practical commencement	28 September 2005	25 February 2008	20 December 2006
Extension of Time	0 day	0 day	0 day

Table 2. Summary of success criteria comparison.

Success Criteria	Case Study 1	Case Study 2	Case Study 3
Time variation	0 per cent	0 per cent	0 per cent
Cost variation	8.9 per cent	16.6 per cent	-2.2 per cent
Quality satisfaction	Complete success	N/A	Full satisfaction