

# The influence of procurement methods on project performance: A conceptual framework

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## Abstract

*Project performance is highly influenced by the type of construction procurement method used to deliver the project. By virtue of this relationship, project clients often seek to select the best method that will help achieve better project performance. Although a lot of studies have been done with the view to developing models/tools for aiding the selection process, there is very little research that have looked at how procurement methods actually influence project performance. As a contribution in this regard, this paper reports on a conceptual framework that demonstrates the existence of this influence. The framework, developed based on extensive review of literature, forms part of an on-going wider study aimed at developing a quantitative model for establishing exactly the nature and level of the influence that exists. The review was carried out to determine the main criteria for selecting procurement methods and for project performance measurements. Thirteen (13) procurement selection criteria commonly cited in the literature were identified. A review on how each of these criterion suits the use of Traditional procurement method and Design and Build were also carried out. This latter review is to facilitate ranking of each of the criterion on a rating scale for purposes of predicting the actual level of influence a particular procurement method exerts on performance of a project. Besides offering a deeper understanding of procurement method relationships with project performance, the proposed conceptual framework forms basis for the development of the quantitative model at subsequent stages of the on-going study. The model's main objective is to serve as a tool for identifying which procurement method is likely to result in poor performance or vice versa, for any given project. This, hopefully, will assist clients in their procurement selection task, particularly for clients where the use of any of the existing selection model is not applicable.*

**Key words:** Construction procurement strategies, traditional procurement method, design and build, procurement criteria, project performance criteria

# 1. Introduction

The term 'construction procurement method' has been given different definitions in the literature. For instance, Chan (2007) defined it as the system that represents the organizational structure adopted by clients for the implementation of project processes and eventual operation of the project. On the other hand, Molenaar *et al.* (2009) defined procurement method as a comprehensive process by which designers, constructors, and various consultants provide services for design and construction to deliver a complete project to the client. As this definition suggests, wide range of processes are involved in a procurement strategy. These processes are often interrelated and sequential in nature and their effectiveness and efficiency impact considerably on the success or failure of projects

In addition, the last few decades have witnessed the proliferation of numerous different types of construction procurement for delivering projects. The most common types include: Traditional Method (also known as Design, Bid and Build (DBB) approach), Design and Build (DB), Management Contracting, Construction Management, Project Finance and Partnering. They differ from each other in terms of allocation of responsibilities, activities sequencing, process and procedure, and organizational approach in project delivery (Abdul Rashid *et al.*, 2006; Alhazmi and McCaffer, 2000). The complex nature of procurement selection and their subsequent management therefore pose great difficulties to clients and any failure to rise up to this challenge has often resulted in poor project performance. Such consequence has long been recognised by a number of researchers (Mohsini and Davidson, 1991; Molenaar *et al.*, 2009). Various attempts have thus been made by researchers over the years towards addressing these procurement issues.

The studies done so far can be put into three categories. The first category involves studies that compare existing procurement methods in a bid to find out their efficiencies as used in practice (see for e.g. Mohsini, *et al.*, 1995; wardani, *et al.*, 2006). The second category involves research carried out to identify the criteria or factors that determine the right procurement method to use (for e.g. Alhazimi and McCaffer, 2000, Luu *et al.*, 2003 and Hashim *et al.*, 2008). The third category of the studies, focus on using these criteria to develop models by which clients can employ to select the most suitable procurement method. For instance, Chan (2007) developed a procurement selection model called fuzzy procurement selection model. It is a mathematical rank model that is adaptable to local circumstances. Alhazmi and McCaffer (2000) proposed a model called project procurement system selection model (PPSSM) for assisting government agencies in Saudi Arabia to select the most appropriate procurement method. The model consists of four screening levels to be followed in selection process: feasibility ranking, evaluation by comparison, weighted evaluation, analytic hierarchy processes. Based on a Delphi study, a multi-attribute decision analysis was used to develop a procurement selection model by Chan *et al.* (2001). Luu *et al.* (2003) developed a procurement selection model based on case-based reasoning (CBR) approach. The suitability of CBR approaches was subsequently examined in a study by Luu and Chan (2005), who indicated that the approach has the potential to ensure high quality decisions on procurement selection. The approach was also found to deal effectively with variability in the characteristics of the clients, project and extremely environment.

However, there seem to be very little research reported in the literature on which aspects of procurement method and/or features has the most influence or otherwise on project performance criteria. Such information will be of invaluable benefits to clients, such as helping them to understand the aspects of procurement methods they need to concentrate on to improve project performance. As a contribution in this direction, this paper reports on a conceptual framework developed as part of a wider on-going study aimed at developing a model on the relationship between construction procurement selection criteria and project performance criteria. The framework, developed based on extensive review of the literature, not only seeks to establish the basis of the relationship between these criteria, it also aims to serve as the basis for developing a quantitative model (at later stage of the study) for establishing the exact nature and level of the influence procurement method exerts on project performance.

The rest of the paper is structured as follows. First, a review on factors influencing the selection of suitable procurement methods is presented followed by project performance criteria review. Subsequently, review on DBB and DB procurement methods with their suitability in the light of key selection criteria are presented. This is then followed by a proposed conceptual framework on influence of these criteria and project performance. The final section of the paper presents a summary and key conclusion.

## **2. Construction Procurement Selection**

As highlighted in the previous section, the different procurement methods now available has partly made clients' decisions to adopt any of the method for any given project a complex task to grapple with. Various factors have to be taken into consideration before any informed decision can be made on the right procurement choice. The factors can be classified into two groups (Love *et al.*, 1998; Luu, and Chen, 2005; Ratnasabapathy *et al.* 2006):

- External environment such as economics, politics, finance, legal, nature disasters, technology factors and;
- Internal environment which can be divided under three main factors; project characteristics, client's characteristics and client's requirement.

Client requirements can be sub-divided into cost related factors, time related factors and quality related factors. All these factors and their relationships have been nicely summarised by Ratnasabapathy *et al.* (2006) in Figure 1 below. The figure shows how the factors relate and interrelate with each other, which go to explains how the task involved in selecting the right procurement method can be extremely complex and difficult. The nature of the selection process therefore calls for employment of sound systematic procedure by clients. Such approach is likely to yield the best procurement method that best meets the needs for a particular type of works (Ali *et al.*, 2011).

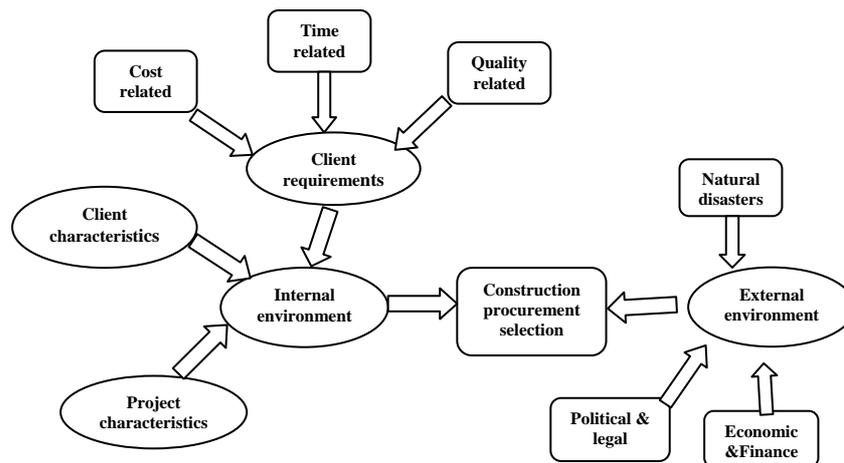
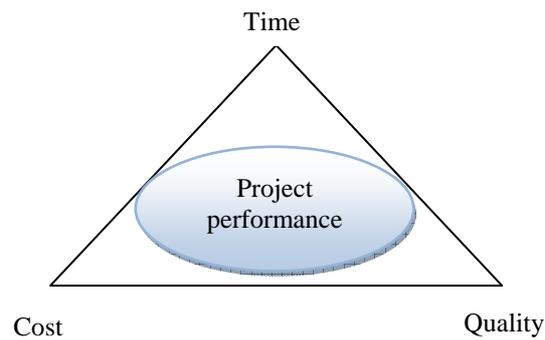


Figure 1: Factor effecting selection of a procurement method (Source: Ratnasabapathy et al. 2006)

According to Love et al. (2008), the selection of an appropriate procurement strategy has two main components. The first component involves analysing and establishing priorities for project objectives and client attitudes to risk. The second involves considering possible options, evaluating them and finally selecting the most appropriate. The accuracy and clarity of the client’s requirements and needs are crucial ingredients here. Fortunately, the selection criteria to be used have been researched extensive and documented in the literature. A critical review of the literature suggests that there are 13 procurement selection criteria that are commonly cited in the literature (see Table 1). The review was restricted to studies conducted from 1998 to date, as the adoption of different procurement routes is relatively new in the construction industry. These criteria thus represent the most current criteria that are of relevance to procurement selection for which researchers involved in further development of the selection process should find beneficial.

### 3. Project performance criteria

Traditionally, a project is considered to have achieved a high level of performance if it is delivered at the right time, right price and good quality level. It should also provide the client with a high level of satisfaction. Bryde and Brown (2004) concluded that the traditional distinction between good and poor project performance focused on the meeting of cost, time and product quality-related criteria. These criteria have been described as the iron triangle of project performance. Figure 2 shows the iron triangle as adopted by Atkinson (1999)



*Figure 2: Project performance criteria trade-off triangle (source: Atkinson, 1999)*

Project success is usually measured differently from the perspectives of the different parties. Jing et al. (2010) compared success criteria as measured by contractors and clients and found out that clients put more emphasis on satisfying the needs of other stakeholders, while contractors emphasis on minimizing project cost and duration. They also found that all project stakeholders put products satisfying owner's needs as the first criteria.

In last decades, several researchers within the multidimensional construct of project performance have proposed different criteria or indicators based on empirical research. While some focused on using these measures as strategic weapons, others emphasized the proper delineation of the measures and groupings into classes that will make tracking and management reasonable. Most of the studies (see for example, Bassioni et al., 2004; Jin et al., 2007; Cheung et al., 2004) agree that project performance can be measured and evaluated using a large number of performance indicators or criteria but time, cost and quality appear to be the three commonly preferred performance evaluation dimensions.

Table 1: Criteria for selecting construction procurement method

Procurement criteria Authors	Price certainty	Price competition	construction Speed	Time certainty	Quality level	Integrate design & construction	Effective communication	Flexibility of changes	Clear Scope definition	Complexity of design	Allocation of responsibility	Client involvement	Controllable variation
Ratnasabapathy et al. (2006 )	-	✓	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-
Hashim et al. (2008 )	✓	-	-	-	✓	-	-	-	✓	✓	✓	-	✓
Seng & Yusof (2006 )	-	✓	✓	-	✓	✓	✓	-	✓	-	-	-	-
Alkhatil (2002)	-	-	-	-	-	-	-	-	✓	✓	✓	✓	✓
Cheung et al. (2001)	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	-	✓
Luu et al. (2003)	✓	-	✓	-	✓	✓	-	✓	-	✓	✓	-	✓
Luu, Ng & Chen (2005)	-	✓	✓	✓	✓	-	-	✓	✓	-	✓	✓	-
Love et al. (1998)	✓	✓	✓	✓	✓	-	-	✓	✓	-	✓	-	✓
Masterman & Gameson (2010)	✓	-	✓	✓	✓	✓	✓	✓	✓	-	-	✓	-
Hibberd & Djebarni (2010)	-	-	✓	-	-	-	-	-	✓	-	-	-	-
Edmond et al. (2008)	-	-	-	-	-	-	✓	-	✓	✓	✓	✓	✓
Chan et al. (2001 )	-	✓	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-
Alhazmi & McCaffer (2000 )	-	✓	✓	-	-	✓	-	✓	✓	-	✓	✓	✓
Chan (2007)	✓	✓	-	✓	✓	-	-	✓	-	✓	✓	-	-
Total	6	8	10	5	10	7	5	9	10	8	11	7	7

## 4. Procurement methods and their influence on project performance

### 4.1 Traditional procurement method (DBB)

Traditional procurement is the oldest form of construction procurement. It is considered as a popular form of separated-and-cooperative procurement method. It can be defined as a project delivery strategy in which two separate organizations (design team and contractor) do carry out all project processes and are individually responsible directly to the client (see Figure 3 below).

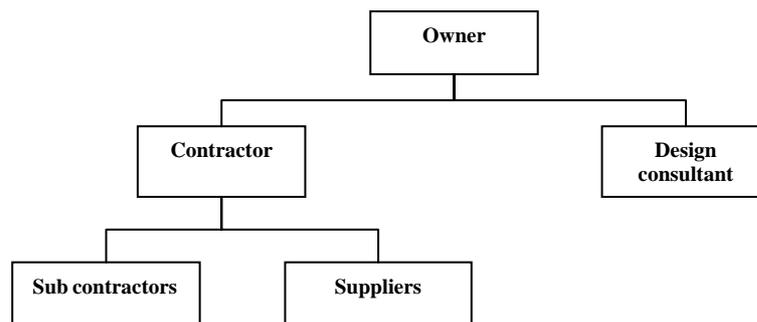


Figure 3: Project organization structure for DBB method

The circumstances in which this method is generally considered appropriate include the following:

- The service of a designer has already been procured
- The designer is experienced enough to oversee both the design and construction
- The design is substantially complete by the time the contractor is selected
- Contractor is selected on the basis of price with a general acceptance that the price may be wrong
- It is important for client to use a contract form with fair and familiar distribution of risk
- When neither the employer or his advisers raise this as an issue
- Full tender documentation exist to ensure price certainty
- The bill of quantities can be used for valuing variations
- Client desires competitive tendering
- Scope of work is clear and well defined to facilitate detailed design

### 4.2 Design and Build (DB)

It is classified as one of the integrated form of procurement method, whereby the client provides his/her requirements and needs for the specified project and signed contract with only one organization namely the contractor. This organization is responsible for the design, supervision and construction services of the project as Figure 4 below depicts.

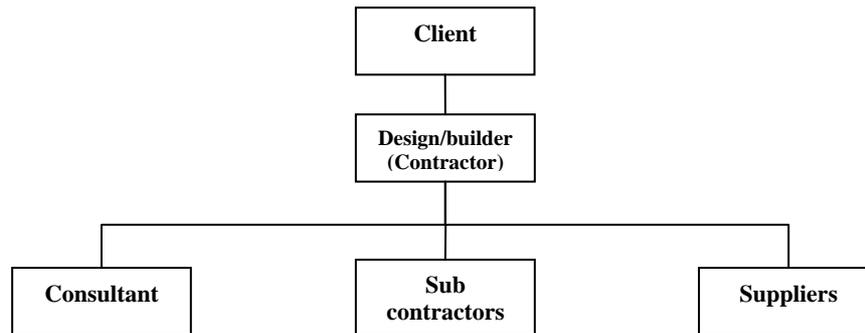


Figure 4: Project organization structure for DB procurement method

The circumstances in which this approach is generally considered appropriate include the following:

- Client not familiar with the construction process
- Project is technically complexity
- There is a low likelihood of variations to the project
- Client desires a single point of responsibility
- The employer desires a quick start to work on site
- Client desires to prioritize either – time, quality, price or value for money etc.
- Client desires an opportunity for effective direct communication/interaction with contractors
- Client desires for an integration of the design and construction process

## 5. A conceptual framework on influence of procurement methods on project performance

Figure 5 shows a conceptual framework that illustrates how knowledge of procurement selection criteria can help establish their impact on project performance. Each of the criterion could impact differently on time, cost and quality, depending on the suitability of the criterion with respect to a given procurement method. The extent of influence each criterion exerts for any given project could be determine by assigning a number using a scale of 1-7; where 1-3 indicates negative influence on performance and 5-7 indicates positive influence, with 4 as no influence or neutral. The criteria to be used are the 13 factors identified from literature and presented in Table 1. The suitability of these criteria as far as DBB and DB methods are concerned would also be rated to enable each method's influence to be established. Table 2 provides a list on suitability information (as reviewed from literature) to aid with this assessment. It must be noted that out of the many procurement methods available, only these two were focussed on as they are considered the most commonly used strategies (Molenaar et al., 2009; Masurier et al., 2006).

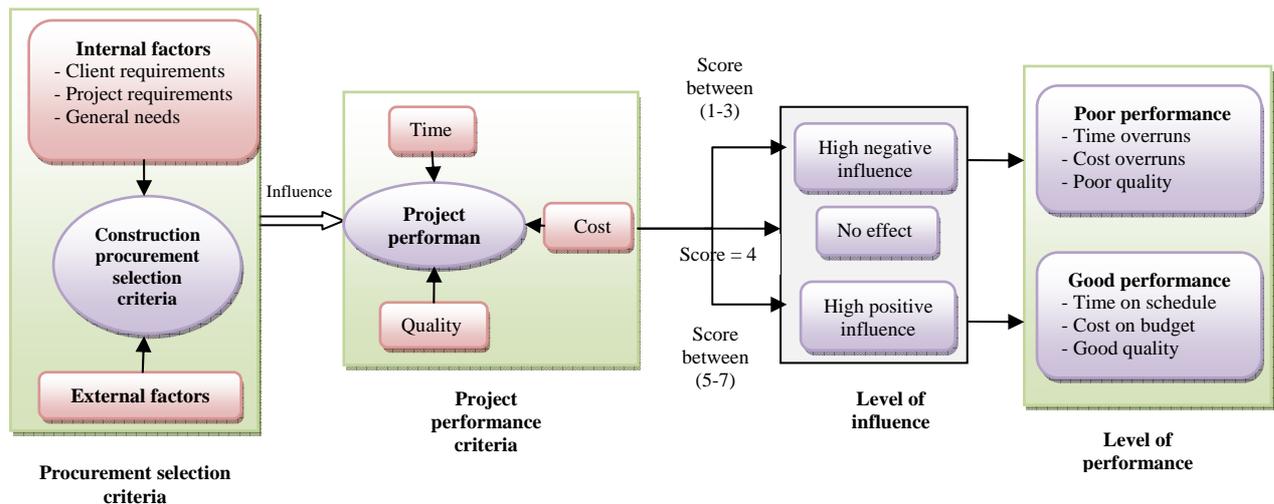


Figure 5: Conceptual framework of construction procurement influence on project performance

Table 2: selection procurement criteria for traditional method and design and build method

	Criteria	Traditional (DBB)	Design & build (D&B)	Authors
1	Price competition	(DBB)	-	Cheung et al. (2001), Luu et al. (2003), Luu, Ng & Chen (2005), Love et al. (1998), Chan et al. (2001), Alhazmi & McCaffer (2000), Hashim et al. (2008), Ratnasabapathy et al. (2006), Ng et al. (2002)
2	Clarity of scope definition	(DBB)	-	Alkhalil (2002), Thomas et al. (2002)
3	Complexity of design	(DBB)	(D&B)	Cheung et al. (2001), Luu et al. (2003), Love et al. (1998), Chan et al. (2001), Hashim et al. (2008), Ratnasabapathy et al. (2006), Edmond et al. (2008), Chan (2007), Seng & Yusof (2006), love et al. (2008), Ng et al. (2002)
4	Quality level	(DBB)	-	Cheung et al. (2001), Luu et al. (2003), Love et al. (1998), Chan et al. (2001), Hashim et al. (2008), Ratnasabapathy et al. (2006), Chan (2007), Seng & Yusof (2006), love et al. (2008), Alkhalil (2002), Luu, Ng & Chen (2005), Masterman & Gameson (1999), Alhazmi & McCaffer (2000), Thomas et al. (2002), Ng et al. (2002)
5	Client involvement	(DBB)	-	Alkhalil (2002), Edmond et al. (2008), Chan et al. (2001), Alhazmi & McCaffer (2000), Ratnasabapathy et al. (2006)
6	Flexibility of changes	-	(D&B)	Cheung et al. (2001), Luu et al. (2003), Luu, Ng & Chen (2005), Love et al. (1998), Masterman & Gameson (1999), Chan et al. (2001), Ratnasabapathy et al. (2006), Chan (2007), Ng et al. (2002)
7	Controllable variation	(DBB)	-	Hashim et al. (2008), Alhazmi & McCaffer (2000)
8	Speed of construction	-	(D&B)	Seng & Yusof (2006), Luu et al. (2003), Masterman & Gameson (1999), Alhazmi & McCaffer (2000), Chan (2007), Hibberd & Djebarni (1998), Ng et al. (2002)

9	<i>Time certainty</i>	-	(D&B)	<i>Seng &amp; Yusof (2006), Cheung et al. (2001), Hibberd &amp; Djebarni (1998), Ratnasabapathy et al. (2006)</i>
10	<i>Effective communication</i>	-	(D&B)	<i>Seng &amp; Yusof (2006), Edmond et al. (2008)</i>
11	<i>Allocation of responsibility</i>	(DBB)	-	<i>Alkhalil (2002), Luu et al. (2003), Luu,Ng &amp; Chen (2005), Love et al. (1998), Chan et al. (2001), Alhazmi &amp; McCaffer (2000), Hashim et al. (2008), Ratnasabapathy et al. (2006), Chan (2007), Ng et al. (2002)</i>
12	<i>Integrating design and construction</i>	-	(D&B)	<i>Chan et al. (2001), Alhazmi &amp; McCaffer (2000) Ratnasabapathy et al. (2006)</i>
13	<i>Price certainty</i>	(DBB)	-	<i>Luu, Ng &amp; Chen (2005), Love et al. (1998), Hashim et al. (2008), Ng et al. (2002)</i>

## 6. Summary and Conclusion

Different forms of construction procurement methods are available for clients to choose from. Each form differs from the other in term of allocation of responsibilities, activities sequencing, process and procedure and organizational approach in project delivery. It is well established that these methods have strong relationships with project performance outcome (time, cost quality), making the selection of the most appreciate method an important decision for every project. Yet such decisions pose difficulties to clients, partly due to the complex task involved in trading-off various numerous factors that underpin the selection process. These factors have received a lot of research attention over the years with the aim of aiding the selection process through the development of models/tools. However, an area that has received very little research is how procurement methods affect project performance.

As a contribution in this regard, a conceptual framework on how the methods influence project performance has been developed, which seeks to offer a deeper understanding of this subject matter. The framework was developed based on intensive literature review, which was used to identify the various procurement selection criteria and the suitability of DBB and DB methods as far as each criterion is concerned. Thirteen (13) procurement selection criteria were identified as the most commonly cited in literature. These are: price competition, price certainty, construction speed, time certainty, quality level, integrates design & construction, effective communication, flexibility of changes, clear scope definition, complexity of design, allocation of responsibility, client involvement, and controllable variation. A review on how each of these suits the use DBB and DB were also presented which will facilitate their ratings on a scale, which would be used to predict the actual level of influence a particular procurement method exerts on the performance of a project.

Developing this framework forms part of a wider study aimed at developing a model that would establish exactly the nature of the relationship here. Such a model has potential benefits to clients, who could employ them to identify which procurement method is likely to result in poor performance or vice versa. This will be particularly helpful in construction industries where the use of any of the existing selection model is not applicable.

## 7. References

- Abdul Rashid, R., Mat Taib, I., Wan Ahmad, W.B., Nasid, M.A., Wan Ali, W.N. and Mohd Zainordin, Z. (2006) "Effect of procurement systems on the performance of construction projects", *Padang*, pp. 1-13.
- Alhazmi, T. and McCaffer, R. (2000) "Project procurement system selection model", *Journal of Construction Engineering and Management*, vol. 126, no. 3, pp. 176-184.
- Ali, Z.A., Zakaria, N. and Che-Ani, A.I. (2011) "The Effect of Procurement System towards the Performance of Refurbishment Works", *America*, pp. 70-75.
- Al Khalil, M.I. (2002) "Selecting the appropriate project delivery method using AHP", *International Journal of Project Management*, vol. 20, no. 6, pp. 464-469.
- Atkinson, R. (1999) "Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria", vol. 17, no. 6, pp. 337-342.
- Bassioni, H.A., Price, A.D.F. and Hassan, T.M. (2004) "Performance measurement in construction", *Journal of Management in Engineering*, vol. 20, no. 2, pp. 42-50.
- Bryde, D. and Brown, D. (2004) "The influence of a project performance measurement system on the success of a contract for maintaining motorways and trunk roads", *project management journal*, vol. 35, no. 4, pp. 57-65.
- Chan, A.P.C., Yung, E.H.K., Lam, P.T.I., Tam, C.M. and Cheung, S.O. (2001) "Application of Delphi method in selection of procurement systems for construction projects", *Construction Management and Economics*, vol. 19, no. 7, pp. 699-718.
- Chan, C.T.W. (2007) "Fuzzy procurement selection model for construction projects", *Construction Management and Economics*, vol. 25, no. 6, pp. 611-618.
- Cheung, S.O., LAM, T.I., Leung, M.Y. and Wan, Y.W. (2001) "An analytical hierarchy process based procurementsselection method", vol. 19, pp. 427-437.
- Cheung, S.O., Suen, H.C.H. and Cheung, K.K.W. (2004) "PPMS: A Web-based construction Project Performance Monitoring System", *Automation in Construction*, vol. 13, no. 3, pp. 361-376.
- Edmond, W. M., Albert, P. C. and Daniel W. M. (2008) "Determinants of Successful Design-Build Projects", vol. 134, no. 5, pp. 333-341.
- Hashim, M., Hashim, M., Yuet Li, M.C., Yin, N.C., Hooi, N.S., Heng, S.M. and and Young, T.L. (2006) "Factors Influencing The Selection Of Procurement Systems By Clients", , pp. 1-10.
- Hibberd, P. and Djebarni, R. (1998) "Criteria of choice for procurement methods". Available at: [http://www.rics.org/site/scripts/download\\_info.aspx?fileID=2330&categoryID=450](http://www.rics.org/site/scripts/download_info.aspx?fileID=2330&categoryID=450) Jin, X.H., Doloi, H. and Gao, S.Y. (2007) "Relationship-based determinants of building project performance in China", *Construction Management and Economics*, vol. 25, no. 3, pp. 297-304.

- Jing-min, N., Lechler, T. and Jun-long, J. (2010) "Success Criteria Framework for Real Estate Project", vol. 4, no. 3, pp. 10-23.
- Love, P., Davis, P., Baccarini, D., Wilson, G. and Lopez, R. (2008) "Procurement selection in the public sector: A tale of two states", pp. 1-11.
- Love, P.E.D., Skitmore, M. and Earl, G. (1998) "Selecting a suitable procurement method for a building project", *Construction Management and Economics*, vol. 16, no. 2, pp. 221-233.
- Luu, D.T., Ng, S.T. and Chen, S.E. (2005) "Formulating procurement selection criteria through case-based reasoning approach", *Journal of Computing in Civil Engineering*, vol. 19, no. 3, pp. 269-276.
- Luu, D.T., Thomas Ng, S. and Chen, S.E. (2003) "A case-based procurement advisory system for construction", *Advances in Engineering Software*, vol. 34, no. 7, pp. 429-438.
- Masterman, J.W.E. and Gameson, R.N. (1999) "Client characteristics and needs in relation to their selection of building procurement system". Available at: <http://www.irbnet.de/daten/iconda/CIB12576.pdf>
- Masurier, J.L., Wilkinson, S. and Shestakova, Y. (2006) "An analysis of the alliancing procurement method for reconstruction following an earthquake", *Proceedings of the 8th U.S. National Conference on Earthquake Engineering*, pp. 1.
- Mohsini, R. and Davidson, C.H. (1991) "Building procurement-key to improved performance", *Building Research and Information*, vol. 19, no. 2, pp. 106-113.
- Mohsini, R.A., Sirpala, R. and Davidson, C.H. (1995) "Procurement: A comparative analysis of construction management and traditional building processes", vol. 23, no. 5, pp. 285-290.
- Molenaar, K., Sobin, N., Gransberg, D., Tamera McCuen, T.L., Sinem Korkmaz, S. and Horman, M. (2009) "Sustainable, High Performance Projects and Project Delivery Methods", The Charles Pankow Foundation and The Design-Build Institute of America.
- Ng, S.T., Duc, T.L., Swee, E.C. and Ka, C.L. (2002) "Fuzzy membership functions of procurement selection criteria", *Construction Management & Economics*, vol. 20, no. 3, pp. 285-296.
- Ratnasabapathy, S., Rameezdeen, R. and Gamage, I. (2006) "Macro level factors affecting the construction procurement selection: A multi criteria model", pp. 581- 591.
- Seng, N.W. and Md Yusof, A.M. (2006) "The success factors of design and build procurement method: a literature visit", *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference*, pp. 1-11.
- Wardani, M.A., Messner, J.I. and Horman, M.J. (2006) "Comparing procurement methods for design-build projects", *Journal of Construction Engineering and Management*, vol. 132, no. 3, pp. 230-238.