SELECTION OF PROCUREMENT METHOD FOR BUILDING MAINTENANCE MANAGEMENT: A DECISION MAKING MODEL

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Abstract
A large number of different types of procurement methods have been developed to overcome the weaknesses of the existing procurement method. Thus, it is more challenging for the decision maker to select the most appropriate procurement method for a specific building as different type of procurement method suit different type of project. It is indeed very vital to develop a systematic approach that can assist the maintenance personnel in decision making on selecting the most appropriate procurement method for a particular building. This paper presents a study of the selection of procurement method for building maintenance management through the use of Multiple criteria decision making (MCDM) particularly Analytic Hierarchy Process (AHP). This research seeks to investigate current practice of available procurement method and identify criteria for selection of procurement methods through literature review. A theoretical framework for future research on the relationship between type of procurement method and procurement selection criteria will be presented.

Keywords: analytic hierarchy process, building maintenance management, procurement method, procurement selection criteria

1. INTRODUCTION
Building is an essential element which provides people of the nation with shelter and facilities to carry out daily task. However, buildings deteriorate and dilapidate during their service lives. It is indeed very critical that building need maintenance to be functional and perform efficiently. Yik and Lai (2005) claimed that a building that has proper operation and maintenance will only continue be valuable asset. Sheng (2012) stated that the implementation of an appropriate procurement method will benefit the good functionality of the building including the mechanical and electrical elements, achieving cost savings, better comfort level, generate higher economic rent of the building space and increase corporate image as well as sustainability of the building.

The task to select the most appropriate procurement method for a specific building becoming more challenging as the number of different types of procurement methods developed had increased. This study aims to identify the available procurement method for building maintenance and identify the criteria to be considered when selecting the procurement method. The finding of this study will act as a tool to guide the decision maker to select the most suitable and appropriate procurement method which will improve the maintenance management in Malaysia. Analytic Hierarchy Process (AHP) was employed in this study to develop a tool for assessing decision maker to choose the most appropriate procurement method.
2. PROCUREMENT METHOD

According to Love et al (2002) and Adekunle (2009), procurement is defined as “an organisational system that assigns specific responsibilities and authorities to people and organisations”. Meanwhile, maintenance procurement is defined as the process on how maintenance works are carried out (Wordsworth, 2001). The types of procurement method identified through literature review for building maintenance were listed as below (Wordsworth, 2001; Sheng, 2012; RICS, 2009; Hui and Tsang, 2004; Ancarani & Capaldo, 2005; Atkin & Brooks, 2005):

- Direct Labour or Inhouse
- Outsourcing

Outsourcing can trade of service under several types of contract which include:

(a) Lump Sum Contract
(b) Term Contract
(c) Repair and Maintenance Contract (RMC)
(d) Cost Reimbursement Contract
(e) Service Level Agreement

- Out-tasking
- Public Private Partnership (PPP)
- Total Facilities Management (TFM)
- Traditional
- Partnering

3. PROCUREMENT METHOD SELECTION CRITERIA

Through literature review, there are 26 criteria identified which were divided into four main categories that were client requirement, owner or client or decision maker characteristic, project characteristic and external environment or factor. The criteria identified from the literature review can be referred to Table 1 (Chen et al., 2003; Ng et al., 2002; Hibberd and Djebarni, 1996; Al Khalil, 2002; Alhazmi & McCaffer, 2000; Love et al., 1998; Luu et al., 2003; Cheung et al., 2001).

Table 1: Procurement Method Selection Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Client Requirement</th>
<th>Owner/ Client/ Decision Maker Characteristic</th>
<th>Project Characteristic</th>
<th>External environment/ factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 1</td>
<td>Speed</td>
<td>C 2.1 Intuition and past experience of the decision maker</td>
<td>C 3.1 Existing building condition</td>
<td>C 4 External environment/ factor</td>
</tr>
<tr>
<td>C 1.1</td>
<td>Time certainty</td>
<td>C 2.2 Dissatisfaction with previous process used</td>
<td>C 3.2 Project size</td>
<td></td>
</tr>
<tr>
<td>C 1.2</td>
<td>Price/Cost certainty</td>
<td>C 2.3 Knowledge of the strategy</td>
<td>C 3.3 Client’s in house technical capability</td>
<td></td>
</tr>
<tr>
<td>C 1.3</td>
<td>Degree of complexity</td>
<td>C 2.4 Involvement of owner in the project</td>
<td>C 3.4 Client’s financial capability</td>
<td></td>
</tr>
<tr>
<td>C 1.4</td>
<td>Degree of flexibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 1.5</td>
<td>Clarity of scope</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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4. ANALYTIC HIERARCHY PROCESS (AHP)

In this study, the selection of procurement method for building maintenance management adapted Multiple criteria decision making (MCDM) particularly Analytic Hierarchy Process (AHP). Pirdashti et al. (2009) stated that Multiple criteria decision making (MCDM) is “an analytic method to evaluate the advantages and disadvantages of alternatives based on multiple criteria”. Satty (2008) explained that AHP is “a theory of measurement through pairwise comparisons and relies on the judgements of experts to derive priority scales”. The comparisons were made using a scale of absolute judgements that indicate how much more one element dominates another with respect to a given attribute (Saaty, 2008). There are three basic principles of the AHP which include (Saaty, 1982):

i. The principle of constructing hierarchies
   A complex system was structured hierarchically by decomposing the elements into constituent parts according to essential relationships towards a desired goal which can make the whole system well understood (Saaty, 1982).

ii. The principle of establishing priorities
   The first step in establishing the priorities of elements in a decision problem is to make pairwise comparison that is to compare the elements in pairs against a given criterion (Saaty, 1982). Table 2 shows the scale for pairwise comparison matrix. Saaty(1982) pointed out that experience has confirmed that a scale of nine units is reasonable and reflects the degree to which the intensity of relationships between elements can be discriminated.

Table 2: Scale for pairwise comparison matrix

<table>
<thead>
<tr>
<th>Intensity of importance</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance of both elements</td>
<td>Two criteria are of equal importance and equally contribute to the property or objectives</td>
</tr>
<tr>
<td>3</td>
<td>Weak importance of one over another</td>
<td>Experience and judgment slightly favor one criterion or element over another</td>
</tr>
<tr>
<td>5</td>
<td>Essential or strong importance of one element over another</td>
<td>Experience and judgment strongly favor one criterion or element over another</td>
</tr>
<tr>
<td>7</td>
<td>Very strong and demonstrated importance of one element over another</td>
<td>A criterion or element is strongly more important or favored and its dominance is demonstrated in practice than the other</td>
</tr>
<tr>
<td>9</td>
<td>Absolute importance of one element over another</td>
<td>The evidence favoring one criterion over another is of the highest possible order of affirmation</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>Intermediate values between adjacent scale values</td>
<td>When compromise is needed between two judgements</td>
</tr>
</tbody>
</table>
Reciprocals of above nonzero numbers assigned to it when compared with activity \( j \), then \( j \) has the reciprocal value when compared with \( i \)

A reasonable assumption

### Reciprocals

- **Rational**
  - Ratios arising from the scale

If activity \( i \) has one of the above nonzero numbers assigned to it when compared with activity \( j \), then \( j \) has the reciprocal value when compared with \( i \)

A reasonable assumption

### Source


### iii. The principle of logical consistency

Logical consistency ensures that elements are grouped logically and ranked consistently according to a logical criterion (Saaty, 1982). The consistency of the comparison matrix is monitored by an inconsistency ratio (IR) or consistency ratio (CR) calculated by (Cheung et al., 2001 & Saaty, 1982):

**Consistency Ratio (CR) = Consistency index (II)/ Random Index (RI)**

where, \( II = \left( \lambda_{\text{max}} - n \right)/(n-1) \), with \( n \) the number of elements in the matrix

\( L_{\text{max}} \) = the maximum eigenvalue of the comparison matrix.

Table 3 show Random Index (RI) for consistency index of a randomly generated reciprocal matrix within a scale of 1 to 9.

<table>
<thead>
<tr>
<th>Size of matrix</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random consistency</td>
<td>0.00</td>
<td>0.00</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
</tr>
</tbody>
</table>

Source: Saaty (1982)

### 5. RESEARCH METHODOLOGY

This research was conducted through literature review. The procurement strategy available, the current practice in selecting procurement method and the criteria for procurement methods selection in building maintenance management were identified by reviewing the journal articles and other reliable reference sources. In addition, Multiple criteria decision making (MCDM) particularly Analytic Hierarchy Process (AHP) was studied as well to be employed in this research in order to develop a tool for assessing decision maker to choose the most appropriate procurement method. A theoretical framework was produced to indicate the idea for future research.

The approach of the methodology that is implemented in the future research is mixed method. According to Osborne (2008), mixed method is “the combination of best aspects of both qualitative and quantitative methods or research that involving multiple methods”. A preliminary questionnaires survey was employed to get a general overview of the characteristics of building maintenance procurement strategy implemented in this country and short-list the type of procurement, criteria that maintenance personnel take into consideration when selecting procurement method and understand the process in selecting procurement method in building maintenance management in Malaysia. The second stage of the study involved semi-structured interview to clarify variables and test the decision
6. FINDING
A theoretical framework was produced through literature review as shown in Figure 1. The theoretical framework developed will be adapted in future research.

![Figure 1: Theoretical framework]

7. CONCLUSION
The maintenance personnel can determine the availability of maintenance procurement and the criteria to be considered before deciding which procurement strategy to be adopted through the finding of this research. In addition, the model produced in future research can assist the maintenance personnel in decision making on selecting procurement method for a particular building. The study expected to produce an Analytic Hierarchy Process (AHP) decision making model for the selection of procurement strategy in building maintenance management which can bring a lot of
benefits to the maintenance personnel, clients or owner of the buildings, building users and the academicians that are related to maintenance industry.

8. REFERENCES


