**SUSTAINABLE ASSET MANAGEMENT ON DECISION MAKING FACTORS OF BUILDING RETROFITTING**

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# Abstract

This paper presents the significant factors considered during decision making in retrofitting process of public ownership such as hospital and school buildings. One of the major issues in facility planning is to retrofit the existing facility. In fact, for government assets, they have to be economically managed by knowing the holding cost, so that it is viable to be retained in long run. The objectives of this paper are to list down the entire decision making factors that considered in asset decision making. The aim of this paper is to propose the innovative model that will become a framework or guideline as to improve and as an added value to the existing procedure. This model will also consider some adaptation from the existing model that has been implemented by our countries. The results expected that could be used by organizations especially for the decision makers as a guideline or a tool to make a wise and good decision in building replacement related activities.

# Keywords:

Sustainable Asset Management, Retrofitting, Decision Making & Public Building

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# BACKGROUND OF STUDY

# Sustainable asset management crystallized the concept of 'cradle to the grave' into existence. It basically puts forth the consideration for maintenance right from the design stage all the way to the operation of the building, as well as making it ready for adaptive re-use. Based on Figure 1, achieving sustainable asset management basically deals with the business process, human resources and information technology system. (A.I.Che-Ani, Badaruzzaman, 2010).

**Sustainable Asset Management**

(2) **Information Technology**

(3) **Human Resources**

(1) **Business Process**

# Figure 1: Sustainable Asset Management Factors (The Ingeniuer, 2010)

# In terms of business process, The Prime Minister Department has given an instruction under the "Pekeliling Am Bil. 1 Tahun 2003, Arahan Penyelengaraan Bangunan Kerajaan di Putrajaya dated February 11th 2003," building maintenances must be efficiently and properly executed. The Government has also given instructions to all their agencies to carry out maintenances of all their building in the very early stage so that to reduce the cost of maintenance and to avoid risk of higher maintenance cost due to negligent through time. (N.Mohd Noor, 2011). Furthermore, The Malaysia industry reference point for asset management has to be the TAM Manual (Total Aset Management Manual), part of DPAK (Dasar Pengurusan Aset Kerajaan). Launched in April 2009 by former Prime Minister Y.A.B. Dato' Seri Abdullah Hj. Ahmad Badawi, this document provides the key idea and direction for the whole life cycle of our assets. According to the manual, asset refers to moveable assets (aset alih), fixed assets (aset tidak alih), life asset (aset hidup) and intellectual property (harta intelek). (Pekeliling Am Bil. 1 Tahun 2009, Kerajaan Malaysia).

# With the wide coverage of assets, an asset management team is no longer focused on building only. It has to be integrated to achieve the aspiration of TAM Manual. The existing practices of building retrofitting in government are Tatacara Pengurusan Aset Tak Alih Kerajaan 2012: Procedure that has been used by government as a guideline in asset decision making. The details of the procedure are in the ‘Bab F: Pemulihan/Ubah Suai/ Naiktaraf Aset’ and ‘Bab G: Pelupusan Aset’. (Pekeliling Am Bil. 2 Tahun 2012, Kerajaan Malaysia).

# In terms of information technology, this is reflected to current information system. Information is critical to the management process. Therefore, in order to implement effective property management process and strategies, sufficient and precise information need to be provided. This information can be used to make better decisions related to the implementation of property management activities. (Shardy Abdullah, 2011). The determination of the cost for maintenance work in government-own buildings is the federal government or the state government building has always been a headache and conflict between the contractor and client. Worsening the scenario, it is always a problem and it is usually a very hard task to determine the exact cost of maintenance works such as repairs, replacement or internal maintenance works and estimated cost usually go haywire and far from the actual cost. (N.Mohd Noor, 2011).

# In term of human factor which is more reflected to the owners and the consumers. The owners themselves fail to set goals and objectives that are clear and comprehensive and the users fails to understand or fulfil management requirements and regulations set by government agencies who own these public properties. (Shardy Abdullah, 2011) Since decision not only affects the organization in which they are taken but also the society, it is not surprising that decision making process has been heavily researched. One stream of these researches has focused on the decision-making process and factor influencing the process (Hussien, 2012). The objective of the study is to identify all the decision-making factors in building retrofitting and then create the asset innovative model that will become a framework or a guideline in order to improve and as an added value to the existing procedure.

# RESEARCH METHODOLOGY

# The processes involved in this study are summarized in Figure 2. This figure illustrated three distinct levels of data collection, namely the first level (Literature Review) followed by the second level (Interview Experts) and ended up with the third level (Questionnaires Surveys). The first level is based on primary data collected from published books, research papers, seminar papers and journals while second level used objective data from official sources of government experts. The third or final level used questionnaires survey in order to validate the data from both of Level 1 and Level 2 of the methodology of study.

# Figure 2: Methodology of Study

# In Level 2, validating a factor is a process that starts with the researcher, who then seeks validation among experts. While in Level 3, the interviews conducted with the questionnaire survey consisted of variables thought to have effects on project’s replacement cost to obtain detailed investigation information of the building replacement during their life cycle. The study adopted closed and open interviews in order to tap as much as possible information form parties interviewed. Furthermore, the objectives of Level 3 are to investigate about what extent the factors identified in the earlier phases had affected projects selected under the pilot studies and to identify other factors that could contribute to the replacement cost in project selected under the pilot studies.

# All the data are analysed using IBM SPSS Software as a tool for statically analysis. IBM SPSS Modeller is a data mining and text analytics software application from IBM. It is used to build predictive models and conduct other analytic tasks. It has a visual interface which allows users to leverage statistical and data mining algorithms without programming. For this study, the data from 11 experts and 60 retrofitting projects of Heat, Ventilation & Air Conditioning (HVAC) system are used. HVAC system is the one of the biggest component in building retrofitting. The analysis of Normality Test, Reliability Test and Descriptive Analysis are presented in the next section.

# RESULTS AND DISCUSSION

# Normality Test is employed to establish whether the distribution of data is normal or is skewed to one-sided (Kellar&Warrack,2004). Skewness is the extent to which the data points lack symmetry. This test is applicable to interval or ratio type of data where the decision must be made to use either parametric or non-parametric methods. The result shows that the tests of normality and the significant value have a reading of 0.200, which indicates that the scale and data obtained is normal for this study. Furthermore, the Reliability Statics Test is done. It is vital to use a reliable scale in the study. Reliability is the consistency of the measurement or the degree to which an instrument measures the same way each time it is used under similar conditions with the same subjects (Pallant, 2001). In this study, Cronbach’s Alpha coefficient showed a reading of 0.761, which indicates that the scale and data obtained is reliable.

# The results in Table 1 show almost all the 21 factors listed are important in decision making of retrofitting. Number 5.0 is represented the most important and number 1.0 is represented the less important in decision making. The entire factors are above 3.0 points except an Individual Profiles, Information Database and Business Changes. The top 5 important factors of building retrofitting decision making are depending on Availability Funding, Asset Condition, Skill & Experience of Manager, Asset Age and Level of Competency.

# Table 1: Item Statics

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mean | Std. Deviation | N |
| **Level of Competency** | **4.45** | .811 | 60 |
| **Skill & Experience** | **4.68** | .537 | 60 |
| Individual Profiles | 2.65 | 1.448 | 60 |
| Self Confidence | 4.38 | .865 | 60 |
| Level of Commitment | 3.22 | 1.585 | 60 |
| Project's Owner (Stakeholders) | 4.32 | 1.157 | 60 |
| Feedback Reviewed (User) | 4.12 | 1.329 | 60 |
| **Asset Condition (Physically)** | **4.75** | .600 | 60 |
| **Asset Age (Obsolete)** | **4.53** | .965 | 60 |
| Performance (Utilization) | 4.32 | 1.172 | 60 |
| Energy Efficiency (Green Technology) | 3.70 | 1.293 | 60 |
| Security Risk (Breakdown Frequency) | 3.93 | 1.118 | 60 |
| IT System (Latest Technology) | 3.23 | 1.477 | 60 |
| Life Cycle Cost (Value of Asset) | 3.33 | 1.481 | 60 |
| **Availability Funding (Annual Budget)** | **4.70** | .743 | 60 |
| Policy (Asset Management) | 3.65 | 1.313 | 60 |
| Safety & Health (Risk/Hazard Possibilities) | 4.33 | 1.068 | 60 |
| History Record (Achievement) | 3.35 | 1.424 | 60 |
| Informed Decision (Original Equipment Manufacturer Manual) | 4.20 | 1.312 | 60 |
| Information Database (Organization SOP) | 2.75 | 1.772 | 60 |
| Business Changes (Organization Function) | 1.90 | 1.469 | 60 |

# CONCLUSIONS

# For the conclusion, the entire decision-making factors that considered in asset decision making are listed down in this paper. The innovative model that will become a framework or guideline as to improve and as an added value to the existing procedure is also proposed. The results successfully expected that could be used by organizations especially for the decision makers as a guideline or a tool to make a wise and good decision in building replacement related activities.

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# Figure 3: Asset Decision Making Factor

# From Figure 3, it shows the three types of asset decision making factors. The competence, experience, individual, personal, commitment, client and user are categorized as human factor while condition, age, performance, energy, security, IT system and life cycle cost are categorized as technical factor. Lastly, the organizational factor is funding, policy, safety, history, informed, database and changes. For the future work, regression analysis using SPSS software can be done on these factors in order to create the novel decision-making model. Finally, Sustainable Asset Management is depending on the three factors which are human factor, technical factor and organizational factor.

**References**

Shardy Abdullah, Arman Abdul Razak, Mohd Hanizun Hanafi, Mohd Najib Salleh (2011). Managing Government Property Assets: The Main Issues From The Malaysian Perspective, Vol.3, No. 1, Pages 35-52.

A.I Che-Ani, W.H.W. Badaruzzaman,T.Z.T. Mahmood, M.S.I. Syahrizal (2010). Sustainability in Asset Management, The Ingeniuer, Vol. 45, Pages 6-10.

N. Mohd Noor, Hamid, Abdul Ghani, Haron (2011). Building Maintenance Budget Determination: An Exploration Study in The Malaysia Government Practice. Procedia Engineering, 20, Pages 435-444.

Hussien Ahmad Al Tarawneh (2012). The Main Factors Beyond Decision Making, Journal of Management Research Vol.4, No. 1:E18.

Dasar Pengurusan Aset Kerajaan, DPAK (2009). Kerajaan Malaysia.

Manual Pengurusan Aset Menyeluruh , TAM (2009). Kerajaan Malaysia.

Tatacara Pengurusan Aset Tak Alih Kerajaan, TPATA (2012). Kerajaan Malaysia.

Pekeliling Am Bil. 1 Tahun 2003. Arahan Penyelengaraan Bangunan Kerajaan di Putrajaya. Kerajaan Malaysia.

Pekeliling Am Bil. 2 Tahun 2012. TPATA. Kerajaan Malaysia.