

Value Management (VM): A Strategic Approach for Improving Energy Efficiency

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Abstract— Value Management (VM) is a multi-disciplinary process, consist of team oriented, structured, analytical process and systematic analysis of function, to seeks best value in the project process and meet the client's needs. While the important of Energy Efficiency (EE) in buildings is a must nowadays because of energy consumption rising very high and this situation occurs not only in developed countries but also in developing countries such as Malaysia. In fact, there is demand towards building with energy efficiency features at this time, however most of the current buildings types are still being constructed with conventional designs thus contribute to inefficient of energy consumption during the operation stage of the building. Based on the relevant literatures, VM has provides an efficient and effective delivery system to fulfil the objectives and client's requirements. Therefore, this paper presents the concept and the application of VM approach and potential to improve energy efficiency within pre-construction process and contribute to better optimize the energy consumption in a building by seeking the best value energy efficiency through the design and construction process.

Keywords: Value Management, energy efficiency, building construction

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1. Introduction

The rise of energy designs demand in buildings will continue in the near future because of growth in population, long-term use of buildings and increasing demand for improved building comfort

important role in everyday life, especially when it involves a huge amount of electricity consumption for the commercial sector such as HVAC system (heating, ventilating, and air conditioning which to provide acceptable thermal comfort and indoor air quality. The main energy source produced from a variety of sources, such as oil, coal, natural gas and renewable sources such as wind, solar and hydro. These energy sources are converted into electricity and supplied to consumers through power lines and other transmission infrastructure to public buildings, commercial, industrial and residential. The lack of environmental and climate consideration during the building design stage have made commercial buildings are energy inefficient. Most of the current buildings types are still being constructed with conventional designs, thus contribute to inefficient of energy consumption and negative impact on the total energy performance during the operation stage of the building [3, 4, 5, 6, 7].

Energy consumption of Malaysia is relatively high compared to other developing countries, which increasing energy consumption is due to high economic growth for the past few years, particularly in the residential and commercial sectors which are expending about half of the total electricity generated [3]. As a consequence, the rising of energy demand in Malaysia and poor energy performance in the buildings will deplete the limited energy resources at some point and the energy efficiency of buildings is become a major concern for energy savings implementation.

2. Background of the Study

Energy efficiency is defined as a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers

more services for the same energy input, or the same services for less energy input [4]. The implementation of energy efficiency measures at the design and execution stages of a building's lifecycle ensures lower energy consumption during its operation stage [5].

Previous studies found that applying energy efficiency measures in design stage could reduce energy consumption significantly [8, 9, 10, 11, 12, 13]. Therefore, action in pre-construction stage or design stage is needed if economic, social and environmental sustainability is to be achieved [11]. Indeed, all the project process with the right decisions made on energy efficiency in the pre-construction stage would have significant impact on the overall construction project, and mostly during post-construction (operational and maintenance stage).

Generally, a construction project includes several activities contained in the three main stages of pre-construction, construction and post-construction. Pre-Construction is the early stage of building construction consists of planning and designing a building. It plays an important role in the construction of a building to emphasize a few important criteria to ensure that a building that will be constructed in a satisfactory condition, comfortable, easy to maintain, according to its operations and weather conditions.

The design concept and approach have been clarified and numerous previous studies specified the importance of early stage of building construction to overcome any uncertainties in building variations or environmental changes that could influenced the energy consumption for the whole building during the operational and maintenance stage.

Energy efficiency concepts should be integrated into all activities within the construction project process with close interaction between clients and their consultants. It will be easier to determine the appropriate method or methods for implementation and requirements of element of energy efficiency in the construction process, especially when it involves the early stages of construction planning and design. At this early stage, to determine aspects such as room sizes, building exterior, interior design, materials selection, lighting fixtures as well as building elements is very crucial to avoid the

loss or waste of resources at a later stage of post-construction.

This research suggests that value management (VM) has the potential method to promote energy efficiency concepts into the design and planning stages as this stage have significant impact on the overall project. VM is believed to play an important role in ensuring that this judgment can be implemented. Therefore, the importance of this study is to ascertain the extent to which the VM can be used as a tool to integrate energy efficiency in the early stages of construction. According to Che Mat [12], the main contribution by the VM technique is to eliminate the unnecessary cost which does not contribute to the value of the services, products and systems includes the construction projects. This means that many opportunities for cost savings resulting from the implementation of the VM without ignoring the value of output produced.

Therefore, one effective strategy to promote integration during the pre-construction stage is to use a VM. Through previous studies, VM has been widely used to improve the design process and reduce issues of communication and integration in the construction process.

3. Current Issues

Most of the current buildings types are still being constructed with conventional designs, thus contribute to inefficient of energy consumption and negative impact on the total energy performance during the operation stage of the building [13]–[19].

Previous study by Malaysia Green Technology Corporation (MGTC) revealed that majority of Malaysian office buildings had BEI in the range of 200 kWh/ m²/ year to 250kWh/ m²/ year (Figure 2) and that shows the inefficient use of energy during operation stage [20]. Seeing that, one of the causes is most of the buildings in Malaysia were design without taking energy conservation (in the form of electricity) into account and supported by literatures [9], [10], [19].

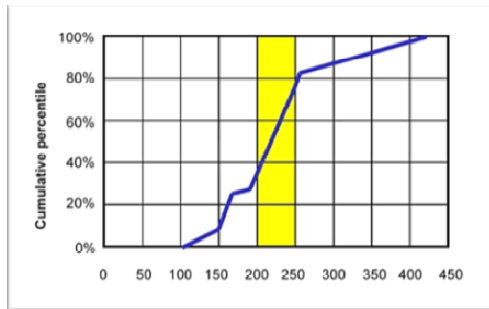


Figure 1 Building energy efficiency index (kWh/m²/year) [20]

According to Holmes and Hacker in [17] conventional building design processes can have a negative impact on the thermal performance of building envelopes. Thus it has effected to the building maintenance and operation process such as increasing the utilities and electricity cost [15], [17], [18].

In the early stages of construction project processes, issues of energy efficiency design have been carried out through design strategies [17], [21], [22]. Through this strategy, researchers found that it is better to determine the factors that contribute to the waste of electricity resources as appropriate to the local climate and designing buildings according to energy efficiency elements that have been identified earlier. In fact, there were limited numbers of literature that discussed energy efficiency design to achieve value for money and to satisfy client's needs.

4. Value Management towards Energy Efficiency

In fact, many researchers have proposed or implemented several very technical, more to the process engineering or computer software and involve the provision of a very high cost for the purchase of equipment or fittings. These approaches seem to optimize energy consumption in the building and minimizing the energy cost but why should involve more costs in the early stages of construction or on the stage after the building is occupied to overcome the problem of wastage of electricity? This is a surprising method to solve the problem of energy inefficiency when dealt with the completed buildings, it will involve more initial

costs and take a lot of time to achieve the desired level of efficiency.

However, based on the previous literatures almost all the methods that have been carried out requires very high initial costs despite the aim to achieve energy savings in buildings but basically has a cost that is not affordable to implement. For the purpose of this study, the current energy efficiency approaches have been categorized to control system [23]–[25], energy prediction [25]–[27], design strategies [17], [21], [22], and intelligent system [28]–[30].

5. Value Management as Systematic Method

5.1 A Brief History of Value Management

Value Management (VM), as a technique or strategy for enhancing client value in projects, products, processes and systems, in fact it has been widely perceived. Basically VM links with engineering through Value Engineering (VE) which this concept evolved from the work of Lawrence Miles in the 1940s was a purchasing engineer with General Electric Company (GEC) [12], [31]. During World War II, United States was searching for alternative product components to compensate the shortages of materials. At that time, the manufacturing industry in the USA was running at maximum capacity to supply the Allies. It was discovered that by searching for alternative methods to fulfill the function of the component, lower product costs could be achieved without reducing its quality. This process, which is called Value Analysis, was maintained after the war as a means of removing unnecessary costs from products. VM is very much accepted and quickly spread to other industries including construction in several countries such as the United States of America, United Kingdom, Japan, Korea, Australia, Saudi Arabia as well as Malaysia [12].

5.2 Background of Value Management in Malaysia

According to Che Mat [12], Value Management in Malaysia was formally introduced by Assoc. Professor Roy Barton from Canberra University,

Australia to the Quantity Surveying Department in the Universiti Teknologi Malaysia (UTM) in 1986. Barton made another subsequent visit to Malaysia in 1990 together with Mohd Mazlan Che Mat to introduce Value Management concept to many organization such as PETRONAS and Ministry of Defense. Since the method of VM emphasized on the increased awareness to achieve value for money, which could benefit the local construction industry, the idea to adopt the technique was taken seriously by Mohd Mazlan Che Mat.

Value Management subject was taught at some of the major public universities such as Housing, Building and Planning, Universiti Sains Malaysia (USM), Department of Quantity Surveying, Universiti Teknologi Malaysia (UTM), Universiti Malaya (UM), The Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA (UiTM), Universiti Islam Antarabangsa (UIA), Polytechnic and other private institutions. Indeed, Institute of Value Management of Malaysia (IVMM) was registered in May 2000 due to the positive response from the construction and manufacturing industries with 20 founding members to promote the value culture into the country to the public and private sectors.

5.3 Definition of Value Management

Value is a relationship between time, cost and the variables that determine the quality of the client seeks from the finished project. Further, Jaapar [32] has defined Value Management (VM) as a multi-disciplinary, team oriented, structured, analytical process and systematic analysis of function, which seeks best value via the design and construction process, to meet the client's perceived needs. VM is the name given to a process in which the functional benefits of a project are made explicit and appraised consistent with a value system determined by the client [33]. VM also seeks to contribute to cost savings and very competitive in determining the success of a project.

Additionally, Che Mat [12] defined VM as a rigorous, systematic and innovative methodology with multi-disciplinary approach to achieve better value for projects, products, facilities and systems without sacrificing the required performance level.

In addition, VM is part of management style to guiding people to improving overall project performance and construction projects with its effective methodology. As a structured approach, VM capable to establish proactive, creative and problem-solving processes, in order to maximizing the value of a project to achieve the value requirements of the clients.

5.4 The Purposes of Value Management

The main purpose of VM is to achieve the essential functions at the lowest cost according to the clients' needs and requirements in terms of performance, reliability and maintainability. VM and it structured process with effective tools and techniques to ensure the need to solve problems in the project. According to Jaapar [32] VM as a methodology that enhance the work relationship among the team and in the meantime able to achieve better value for money and imperative idea to be executed in the Malaysian construction industry particularly in the public projects. In the public projects, the Economic Planning Unit

(EPU) implements VM as a method achieve the essential functions at the reasonable cost and fulfilled the clients' needs.

According to EPU, VM is implemented to produce effective results by:

- a) to improve the accuracy of estimates used during planning;
- b) identify actual needs to achieve the defined function;
- c) promote and generate creative ideas;
- d) optimize the use of resources;
- e) accelerate decision making process;
- f) ensuring and enhancing the standards, methods, procedures and criteria for a project to be in line with current developments and needs;
- g) enhancing performance and synergies of participants engaged in group;
- h) minimizing *gold plating*, and
- i) taking into account the use of Life Cycle Cost

VM is able to achieve the essential functions at a cost that fits with the needed purpose, performance,

reliability and maintainability. Implementation of VM is to identify, provide the best option and remove components as well as costs that do not contribute to the value of the projects, programs, facilities and systems without compromising the objectives and functions defined. VM is a systematic multidisciplinary approach and innovative in order to study the function of a program requirements, design, products, services, projects, facilities and systems to achieve better value and cost optimization without compromising the performance of the projects, programs, facilities and systems.

Value can be defined as follows:

$$Value = \frac{Function + Quality}{Cost}$$

Where:

Function = The specific worth that a design or item must perform

Quality = The required needs, desires, and expectations from client and stakeholder

Cost = The life cycle cost of the project

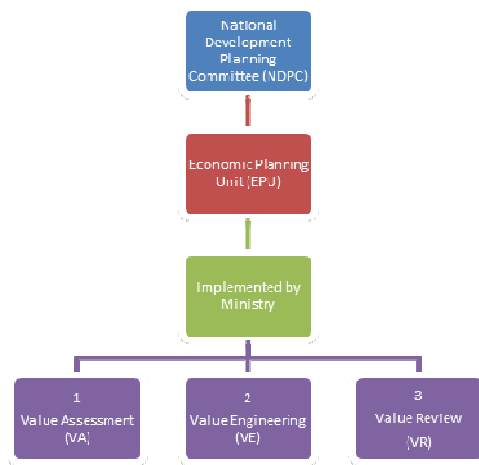


Figure 2 Organizational structure for VM implementation in public projects (adopted and modified from [34])

In the government projects National Development Planning Committee (NDPC) is responsible to monitor and to ensure the implementation of VM by introducing three stages in VM application for public projects. Every stage is taken care by different government agency. Based on the

Implementation Manual of Value Management in Government Project issued by the EPU in 2011, the procedure of VM application is being separated into three which are the Value Assessment (VA), Value Engineering (VE) and Value Review (VR). Figure shows the organizational structure for VM implementation in public projects.

5.5 Function Analysis

Function Analysis is the basic situation we need to know regarding any matter or thing. According to Che Mat [35] Function Analysis includes obviously distinguishing what things really do, or what they must do to accomplish the task or project objectives. Through the analysis, it is conceivable to distinguish the wastage, duplication and unnecessary expenditure giving the chance to maximize the functional value as well as persistently expanding the value provides to the client.

6. The Advantage Of Considering Value Management in Pre-Construction

The benefits of the VM in the building construction are abundant and most of the studies are more into the whole construction process starting from pre-construction, construction and post-construction. Due to a very wide scope, this study only focuses on pre-construction stage as has been supported by many literatures about the advantages of using VM when starting the construction process [13, 14, 15]. This is because, at the stage of design it is easier to make any changes or anything related design and other considerations such as improvements and solutions to problems that may occurs and resources costs. This certainly would be more economical in terms of cost and time when no additional cost allocation when VM considered at the earliest design stage.

Table 1 shows the previous studies and application of VM in several construction processes especially in design stage.

No.	Vm In Design/ Construction Process	Sources
1.	VM in design planning for multi-disciplinary team involvement	[38]
2.	VM as a strategic approach for reducing faulty design and maintainability issue	[37]
3.	Investigates the awareness of VM practice by professional civil, electrical and mechanical engineers in the South African construction industry	[31]
4.	Highlight the potential of VM approach in design and construction process to minimize the fragmentation issue towards sustainable building	[39]
5.	Review the gaps, particularly on how VM is being practiced in Malaysian Construction Industry (Public Projects)	[32]
6.	Conceptualizing Value for construction. Case studies of Social Housing Projects in Chile	[40]
7.	Use the analytical methods of value management during the three phases of construction project	[36]

Table 1 VM in construction process

7. The Importance of Value Management as a Method to Increase Energy Efficiency in the Building

At present, the issue of energy efficiency has gained the attention of many parties in the construction industry with various studies and research have been done to increase the rate of energy saving in building a better and at the same time maintaining the comfort of the occupants.

In fact, many policies and initiatives on the importance of energy efficiency in the building sector was introduced by the government such as the National Green Technology Policy (GTP), Malaysian Guidelines for Energy Efficiency in Buildings and minimum standards for the Green

Building Index (GBI) rating tools for energy efficient design. Most policies and energy efficiency related initiatives are taking some interest and initial studies that have been done by many researchers.

Recent studies show that researchers concern to the issues specifically related to the implementation of energy saving measures that can provide returns in terms of operation and maintenance cost savings in later stages of post-construction. Currently the implementation of the VM in the public projects been noticed especially in the construction industry since the authorization of VM Circular 3/2009 by the Economic Planning Unit (EPU). The circular has made all public projects exceeding RM50 million to implement the VM studies has produced significant impact in so many government projects [32].

The purpose of VM as discussed in previous section has explained how the VM can play a role as effective tools and techniques to solve problems in the project through providing better value for projects without sacrificing the required performance level. All of this makes the VM was as a management tool to aid decision-making and resource planning from an early stage of project as a highly efficient and successful to be considered.

In recent years, an increasing awareness and interest in the construction industry in matters related to the energy efficiency should deserve a place in VM practice. This is due to the fact that, both have the potential of its own and has been described in detail by previous studies. However, research carried out in this field will provide more opportunities for VM in considering and promoting energy efficiency for construction projects.

It is because the potential that exists in the VM is very widespread, but through the study of literature shows the scarcities of information which may relate energy efficiency with VM. This deficiency proves that the subject area has yet to be fully explored, although there are studies conducted by the VM community. In fact, Implementation Manual of Value Management in Government Project issued by the EPU in 2011 clearly shows that energy efficiency elements stated as an added value only (in the development phase).

This situation gives the impression that the importance of considering energy efficiency issues and their relations to the quality of the VM outcome was ignored. As VM exists as a value enhancement in the project, it should focus to energy efficiency to be considered in the VM practice. This is because of issues related to energy efficiency in buildings contributes to the opportunity for enhance value and achieve value for money in a construction project.

So far there is very limited information and reference material relates energy efficiency with VM in construction. Through this research to improve the consideration of energy efficiency in VM, would allow VM to be more visible role in bringing the issue of energy efficiency in construction projects. It can be seen the extent to which issues relating to energy efficiency also are included in the VM. With regard to related issues and a clear understanding of VM practice will help facilitate the assessment process and pave the way for new studies in the future.

8. The Implementation of Value Management in the Study

By looking at the literature reviews prior to this, the study will begin by conducting investigation to determine the level of energy efficiency consideration in the VM and constraints in the current VM practices. The sample for this research consists of architects, consultant, design engineer, project manager, contractor and for those who have been involved in VM projects. Further details for this will be explained in the next chapter of Research Method.

To implement the VM in this study will refer to the VM Job Plan as a guide detailing such matters as pre-study preparation to define the value management (VM) which has the potential to enable the integration of energy efficiency concepts into the early stages of construction process, conducting the *Information Phase* as the first task to understanding the decisions that may influenced the development of the proposed building design and uses of Function Analysis System Technique (FAST) as a method to understand the project through the perspective function of project.

Further in *Creativity Phase*, participants generate as many ideas, brainstorm and emphasize alternative means or methods that enable energy efficiency function. Next, go through the next phases to evaluate the ideas, then short-listed energy efficiency ideas are developed into alternatives that increase the value of projects in terms of energy efficient alternative that might be in the form of design sketches, illustrations, drawings, diagrams and calculations, information and other specific materials.

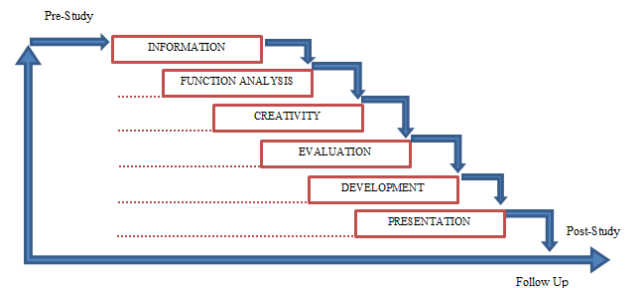


Figure 3 Value Management Job Plan (adopted and modified from [35])

9. Conclusion

This paper aims to conduct a study to increase energy efficiency in the building by using VM as a strategic approach. The practice of VM could be useful in pre-construction stage as an effective strategy to ensure optimal energy consumption, to solve several issues associated with energy efficiency in building construction, as well as considering the benefits or advantages of energy efficiency in pre-construction. Initially for VM, this paper has described the concept and background, definitions of VM, the VM purposes and advantages considering VM in pre-construction as well as the importance of VM as a method to increase energy efficiency in the building. For the purpose of this study, current situation in the construction sector shows that the industry is concerned with aspects of energy management to achieve optimum energy-saving by implementing energy efficiency measures.

Despite the awareness that arises because of the determination of the government's new policy in terms of energy efficiency, however there is still a lot of efforts and research in both subject are

needed to better understand this scenario. Studies in both fields and incorporate them are very important and can bridge the information gap existing in the industry. As was previously stated, VM can provide considerable benefits to building sector and construction industry in order to overcome the energy efficiency issues in the building construction. Data collection will be conducted in several government office buildings and other buildings in one of the university campus within Northern region to validate the findings based on case studies, survey and VM workshop.

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