MANAGEMENT OF NON-MONETARY ATTRIBUTES FOR VALUE ENGINEERING IN CONSTRUCTION PROJECTS

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ABSTRACT

The ability to optimise resources is key to a sustainable project. It is shown that projects can control their resources better with value engineering. Non-monetary attributes are often neglected as they cannot be valued without proper methods. Therefore, this research aims to contribute towards the value engineering element in defining the non-monetary attributes in construction projects. Data were collected through document review, MentiMeter, Google Form and expert interviews. The data was then analysed using content and statistical analysis. Based on the document review, thirty-six non-monetary attributes were extracted. Ten were chosen to be further explored. The ten non-monetary attributes are job security, expectation, safety and health, qualification, customer satisfaction, progress efficiency, reputation, energy consumption, carbon emission and renewable energy. These attributes were later studied to find the factors affecting the non-monetary attributes.

***Keywords**: Non-Monetary Attributes; Value Engineering; Sustainable construction project*

1.0 INTRODUCTION

Value engineering (VE) is a design engineering method that involves critically assessing and analysing a component's design with its functional value. It is a disciplined action system focused on one single need, such as completing the functions that the client requires and desires at the lowest possible cost (Miles, 1992). It is a systematic and structured approach to improving projects, products, and processes. Identifying key factors or attributes for VE success enables the appropriate allocation of limited time and resources to achieve better output (Shen and Liu, 2003). As adopted from cost-benefit analysis, this concept includes intangible value and intangible basis rather than descriptive benefits. Monetary (tangible) and non-

monetary (intangible) factors are significant in establishing a more precise expense appraisal model for the VE process.

A clear understanding of these factors will be instrumental in overcoming constraints caused by the higher demands of clients. The factors that affect VE vary from monetary attributes to the non-monetary value of elements. Therefore, various attributes that include monetary and non-monetary components determine the success of VE studies. Non-monetary attributes are expenses or another type of sacrifice consumers sense while purchasing and utilising a service (Abd Rashid et al., 2019). Time, search, and psychological costs are frequently considered when deciding whether to buy or rebuy a service. It relates to the process or element described to purchase in construction projects. In other words, non-monetary attributes are goods a corporation has but for which a monetary value cannot be determined.

This study focuses on identifying and listing the non-monetary attributes in construction projects. The current categorisation of non-monetary attributes in construction is still unclear. Malaysian industry still lacks awareness regarding the importance of putting value into non-monetary attributes that are as important as the other issued problems in the sector moreover construction projects (Cheah and Seng, 2005). Non-monetary attributes such as reputation, carbon emission, qualification, etc., are not adequately addressed. This is because non-monetary attributes are abstract and very hard to determine. However, for a comprehensive VE process, non-monetary attributes are very vital. Hence, there is a need to identify the non-monetary attributes in construction.

However, non-monetary attributes are very complex. Evaluation for non-monetary attributes utilises a wide variety of measurement units to assess. Therefore, a study about the attributes contributing factors needs to be conducted concurrently to value these non-monetary attributes. This is because the factors are elements that will affect the value of the non-monetary attributes. This study focused on the non-monetary attributes of construction projects. Non-monetary attributes constantly gather attention as they usually cannot be defined in terms of cash and value, making it hard to make decisions.

2.0 ATTRIBUTES IN VALUE ENGINEERING

The goal of value engineering in construction projects is to present strategies that can be implemented to solve problems, reduce costs, and increase quality (performance), all of which depend on attention to project function. However, achieving the objectives in the shortest possible time is critical (Wilson, 2005). Another goal of value engineering is to discover the best balance of function, quality, and cost in building projects.

Monetary assets are those with a fixed monetary value. It has a definite economic value expected to be obtained when liquidated (Neupane and Gustavson, 2008). Monetary assets include cash and currency equivalents such as cash on hand, bank deposits, investment accounts, accounts receivable (A.R.), and notes receivable, which can be easily changed into a fixed or precisely determinable quantity of money (Zong and Chen, 2020). Non-monetary assets are those whose monetary value is modified by market forces. It is frequently incomparable because their measurement units are not comparable, making multi-attribute decision-making extremely challenging (Bettman et al., 1998). Non-monetary attributes such

as human well-being or biodiversity, lack a clear physical equivalent and are thus more "complex" examples, in the sense that they are "tough to separate and assess." (Nunes and van den Bergh, 2001). Several lists of proposed non-monetary attributes are summarised in Table 1.

Table 1: List of Non-Monetary Attributes

Non- Monetary Attributes	Description
Job Security	The expectations of continuation in one's current job (Davy et al., 1997)
Expectation	Stakeholders' views, forecasts, wishes, and needs, i.e. what they believe a service provider should supply (Ling and Chong, 2005)
Safety and Health	Safety concerns threats to people that emerge from unexpected harsh situations, while health concerns unpleasant responses to poisonous or otherwise harmful hazards. (Goetsch, 2019)
Qualification	The process of establishing that an entity or process is capable of achieving or surpassing the defined standards (Wang et. al., 2008)
Customer Satisfaction	Consumer's fulfillment response. It is a judgment that a product or service feature, or the product of service itself, provided (or is providing) a pleasurable level of consumption-related fulfillment, including levels of under- or over-fulfillment (Oliver, 1997).
Progress Efficiency	The (often measured) capacity to avoid wasting resources, energy, efforts, money, and time while accomplishing something or obtaining a desired outcome is referred to as efficiency. In a broader sense, it is the capacity to execute things properly, successfully, and efficiently. (Richards, 2002)
Reputation	Person's subjective qualitative perception about a brand, person, business, product, or service. (Carpenter. 2002)
Energy Consumption	All of the energy consumed to accomplish an activity, create something, or just occupy a facility (Christina, 2018)
Carbon Emission	Release of greenhouse gases and/or their precursors into the atmosphere over a particular geographical region and time period. (Christina, 2018)
Renewable Energy	Renewable energy is derived from replenishing resources or processes. These energies consist of solar energy, wind energy, geothermal energy, and hydroelectricity. Green energy and clean energy are generally connected with renewable sources. (Gielan, 2019)

Construction projects have several distinct characteristics that distinguish construction organisations from other enterprises. These characteristics necessitate unique management attention, which differs from management tasks in other organisations. Construction project management necessitates a focus on issue solutions as it arises during the project. There are several aspects that influence project success.

3.0 METHODOLOGY

This study starts with an analysis of literature review on the monetary and non-monetary issues that are related to VE in the construction industry. The resources of the study are mostly from the secondary data which is journals and articles, conference proceedings, The journal article mostly retrieved from Scopus, ResearchGate and Google Scholar using keywords “Value Engineering”, “Value Management" and “Monetary attributes". After extraction, 36 attributes were chosen into consideration. A survey by MentiMeter was then conducted to filter and sort these 36 attributes. The final ten attributes that are applicable and relevant to the construction project were chosen. Two experts were chosen to validate the list of attributes. The validation discussion was divided into three parts: briefing or introduction on the topic research followed by discussion on the relevancy of each attribute and finally validation for each chosen attribute

The validated attributes list was then analysed. The selected attributes were then studied further to search for their related affecting factors. This was done by distributing questionnaires to selected respondents. The questionnaire consists of two parts which are Part A (demographic and general information) and Part B (factor affecting the non-monetary attributes). The questionnaire used 6-point Likert scales as described in Table 2.

Table 2: 6-point Likert Scales (Taherdoost, 2019)

1.00 - 1.99	**2.00 - 2.99**	**3.00 - 3.99**	**4.00 - 4.99**	**5.00 - 5.99**	**6.00 - 6.99**
Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly Agree

All the data acquired from the questionnaire were further analysed to obtain more information regarding the attribute of non-monetary attributes in construction sites. Microsoft Excel was the platform of analysis to calculate the mean, mode and general conclusion and outcome from the data collected. The mean score difference was calculated using the formula in equation (1).

$$mean\ score\ difference = \frac{mean\ high\ score - mean\ score}{number\ of\ score\ categories} \quad (1)$$

4.0 RESULT AND DISCUSSION

Thirty-six attributes were extracted from literature. However, only ten were selected. Figure 1 shows the final chosen non-monetary attributes. Non-Monetary attributes contribute towards quantifying quality in calculating value. It is often mentioned that quality in the equation always refers back to non-monetary attributes. With no guidelines and research made specifically regarding non-monetary attributes, it makes it hard to actually run the process of Value Engineering without taking non-monetary attributes as a part of the elements.

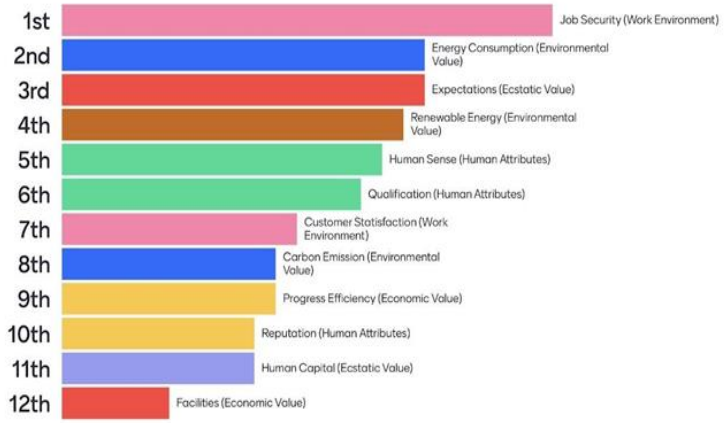

Figure 1: Non-monetary attributes

4.1 Significant Factors Affecting Non-Monetary Attributes

Evaluation for non-monetary attributes utilises a wide variety of measurement units to assess. Table 3 listed the attributes contributing factors. The significant factors that affect non-monetary attributes are needed to value these non-monetary attributes. This is because the factors are elements that will affect the value of the non-monetary attributes.

Table 3: Factors That Affecting Non-Monetary Attributes

Attributes	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Element in Sustainability
S1 - Job Security	Economic (5.36)	Political Stability (4.45)	Competency (5.09)	Industrial Demand (5.09)	-	
S2 - Expectation	Product Review (4.45)	Product Promotion (5.00)	Experiences (4.90)	Aesthetic Element in Construction (5.00)	-	
S3 - Safety and Health	Work Environment (4.90)	Job Safety and Health (5.18)	Workplace Procedures (5.18)	Act and Policies Enforcement (5.27)	-	Social
S4 - Qualification	Over Qualified (4.00)	Under Qualified (3.63)	Relevancy of the Qualification (5.09)	-	-	
S5 -	Job Delivery	Job Quality	Scheduling	-	-	

Customer Satisfaction	(5.27)	(5.54)	(5.54)			
S6 -Progress Efficiency	Funding (5.09)	Scheduling of Projects (5.36)	Force Majeure (4.81)	Natural Disaster (5.27)	-	
S7 - Reputation	Expectation-Third Perspective (4.54)	Decision Making (5.09)	Rules and Responsibility (5.00)	Performance (5.36)	-	
E1 - Energy Consumption	Social Awareness (4.81)	Advance Technologies (5.00)	Political Stability (4.54)	Act and Policies Enforcement (5.09)	-	
E2 - Carbon Emission	Corporate Awareness (5.09)	Social Awareness (5.00)	Ignorance (4.27)	Act and Policies Enforcement (5.18)	Government Incentive (5.27)	Environment
E3 - Renewable Energy	Social Awareness (5.18)	Overall Cost (5.36)	Advance Technologies (5.45)	Client Requirement (5.45)	Government Incentive (5.45)	

5.0 CONCLUSION

There a lot of non-monetary attributes we have extracted 36 and 10 are chosen which are job security, expectation, safety and health, qualification, customer satisfaction, progress efficiency, reputation, energy consumption, carbon emission, renewable energy. Each attribute is assumed to be affected by multiple factors. This factor is important in determining the sub value in the final calculation of these non-monetary attributes. Based on the validated factors, it is shown that there are some that are more significant than others. This is due to the contribution of the factors towards the end value of the attributes.

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