

Value Engineering as a Pragmatic Value Enhancing Tool for Public Sector Construction Projects

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Abstract—Value Engineering is a globally accepted methodical approach that enables the best balance between the quality, performance and reliability of a project while improving the “value” of goods, products and services. The concept of Value Engineering is applied within the construction industry of many countries to improve the output comparing to conventional practice. Most importantly, adopting conventional practice reasons for less value for the resources use for the construction projects. This is quiet high in public sector projects. Therefore, applying Value Engineering for public sector projects, will give better value for the resources use. Nevertheless, the applications of Value Engineering in public sector construction projects of Sri Lanka are rare. Therefore, this study aimed to identify the challenges that affect the implementation of Value Engineering for the public sector construction projects in Sri Lanka. In order to achieve the above aim, two objectives were implemented as (1) identify the significance of Value Engineering and the challenges affecting to the implementation of Value Engineering for the public sector construction projects in Sri Lanka, and (2) to develop a suitable framework to overcome the challenges affecting the implementation of Value Engineering in public sector construction projects. 23 challenges were identified through a comprehensive literature review and a questionnaire survey was conducted to identify the impact of those challenges and to find out suitable strategies to overcome them. There the data were collected from 71 construction industry professionals with Value Engineering knowledge. Then, the RII technique was adopted to rank the challenges based on the collected data. Eventually, based on the challenges and the proposed strategies a framework was developed for better adaptation of Value Engineering for the public sector construction projects in Sri Lanka.

Keywords— Value Engineering, Public Sector, Construction Projects, Challenges

I. INTRODUCTION

The construction industry plays an important role of Sri Lankan economy [1], accounting for the fourth largest sector, contributing 6-7% of GDP during the last decade [2]. Due to the post-conflict situation of the country and as a result of the end of the ethnic war in 2009, the economic activities have revived and resulted in an infrastructure boom [2]. Major government infrastructure projects like express ways, port city, etc. and rapidly expanding tourism industry have encouraged this boom [3]. As a developing country, public sector projects in the Sri Lankan construction industry face

numerous challenges such as failure to deliver within the budget, meet the quality requirements and deadlines [4]. Value Engineering (VE) is having the potential to come up with the most appropriate solutions to these issues by providing a balance in cost, schedule and scope via generating numerous innovative alternatives [4].

Value Engineering (VE) is a systematic technique that enables the best balance between the quality, performance and reliability of a project while reducing the overall cost [5]. The value can be defined as the ratio of function to cost (function/cost); therefore, the value can be increased either by reducing the cost or improving the function [6].

Guaranteeing the project value is one of the key problems faced by the construction industry [3]. Value Engineering is considered as an effective solution for this problem because it has the potential to enhance the value of the construction projects [7]. Value engineering has been established in many countries and has reduced the cost of construction projects since its first adoption in the 1950s [5], [8]. Even though the concept of Value Engineering was introduced to the Sri Lankan construction industry a while ago, it hasn't been effectively practiced in Sri Lanka [9]. Although there are some cases of applying Value Engineering for private sector constructions in Sri Lanka, it is very rare in relate to public sector projects [10]. This has been happened due to certain challenges and this research aimed to identify those challenges and to come up with a suitable framework to overcome them. Two objectives were implemented to achieve the above aim as (1) identify the significance of Value Engineering and the challenges affecting to the implementation of Value Engineering for the public sector construction projects in Sri Lanka, and (2) to develop a suitable framework to overcome the challenges affecting the implementation of Value Engineering in public sector construction projects.

II. LITERATURE REVIEW

A. Value Engineering

The idea of value engineering was first introduced by Lawrence D. Miles in 1940s during the World War II [11]. Due to the war, there were shortages of raw materials, and his intention was to perform the same function (without depleting

the final value / enhancing the final value) by replacing some materials with alternative materials [11]. There, he created a function-based methodology which was successful in enhancing the operational efficiency, decreasing the production time and reducing the cost [12]. Later this methodology was constantly used to boost the performance of the products and it is now known as 'Value Engineering' [13].

Value Engineering can be considered as a method which is aimed to find the best and optimum functional balance in between a product's cost, reliability and performance [10]. It is not only a cost-cutting technique, but also focuses the value enhancement of the project [14]. This means that various cost control mechanisms are used for the project at the minimum practicable cost without compromising the value and aim of the project [14].

B. Value Engineering within the Construction Industry

Time, cost and quality are the three main parameters of a construction project [4]. Implementation of Value Engineering helps to reduce project costs up to 26%, upgrades operational performance up to 40% - 50%, and boosts product quality up to 30% - 50% [15]. Value engineering methodologies can be adopted at any point in a project's life cycle, but the most significant advantages can be achieved by applying during the initial stages [5]. Fig. 1 illustrates the saving potential of Value Engineering according to the time of application.

As it portraits in Fig. 1, early implementation of Value Engineering reduces the total cost while executing the projects in a more coordinated manner and preventing any significant changes right from the beginning [12].

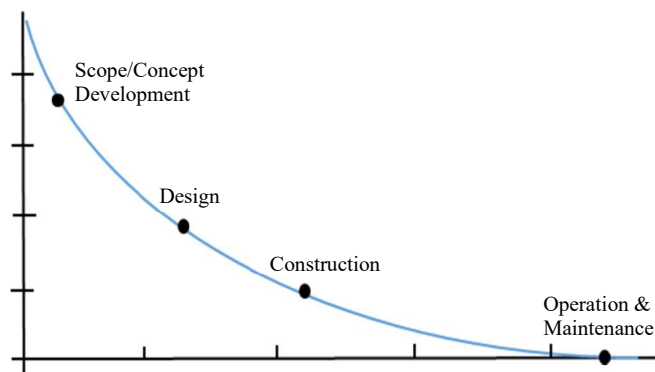


Fig. 1. Saving potential of Value Engineering according to the time of application [16].

C. Significance of Value Engineering in Construction

TABLE I. BENEFITS OF VALUE ENGINEERING

Benefits	Sources
Cost optimization: Make the most effective use of money and reduce unnecessary cost including capital, maintenance, and operational.	[7], [17], [18]
Save time	[18], [19]
Reduce resource wastage	[18], [20]
Minimize the occurrence of conflicts	[21]
Reduce risks	[20], [17]
Improve the level of quality	[21], [19], [17]
Increase client's satisfaction	[20], [17]
Identify and understand the specific needs and expectations of the customers	[21]
Energy efficiency	[7], [22]
Reduce environmental pollution	[17], [21]
Promote renewable resource usage	[21]
Performance optimization	[22], [17]
Increase reliability	[21]
Minimize conflicts	[20], [17]
Save natural resources	[21]
Reduce manpower	[17]
Reuse of land and materials	[17], [21]
Improve the internal communication and co-operation	[21], [17]

Value Engineering brings number of advantages to the construction industry including enhancing the project value, effectiveness, reducing the project duration, communication, and collaboration between stakeholders, etc. [16]. Major benefits of Value Engineering for the construction industry have been pointed out in Table I.

III. METHODOLOGY

The selected research approach for this study was comprised of three segments: a comprehensive literature survey, expert interviews and a questionnaire survey. Initially a comprehensive literature survey was conducted to identify the challenges in implementing value engineering for construction projects. Then based on the identified challenges, a questionnaire was prepared and further developed through five expert interviews. As the next step, the developed questionnaire was distributed among the selected sample for the study. The identified challenges are listed within Table II.

TABLE II. CHALLENGES TO IMPLEMENT VALUE ENGINEERING FOR CONSTRUCTION PROJECTS

Challenges	Sources
Lack of awareness of VE	[4], [23]
Difficult to get started first	[4], [24]
Lack of expertise among industry professionals about VE	[25], [4], [26]
Lack of guidance and construction framework for practical applications	[25], [27]
Difficulty to implement VE under cost-oriented procurement systems	[4], [27]
Lack of support from the company management	[23], [28]
Less familiarity about the culture of VE among public firms	[15], [24]
Unwillingness to take risks and implement innovative and creative alternatives	[28], [24]
Dislike to implement VE	[15]
Lack of teamwork spirit and proper coordination among VE team members	[4]
Inflexible provisions in legislations	[23], [27]
Lack of policies to promote VE	[26], [29]
Lack of standards/certificates	[29]
Lack of incentives from the government to encourage VE	[23], [24]
Client's lack of knowledge about VE concept and techniques	[26], [27], [29]
Lack of support from clients	[15], [24], [26]
Lack of support from the government	[23], [28], [27]
Misbelief that VE is not suitable for developing countries like Sri Lanka	[15], [24]
VE is not aligned with the concepts used in countries like Sri Lanka	[15]
Misbelief that VE is not worthy	[15], [24]
VE is too complicated	[4]
Misbelief that high initial implementation cost is for VE	[4], [25], [28]
Misbelief that when the project is developed by the top designers, VE is not necessary	[4], [25], [24]

The targeted population for this questionnaire survey was construction industry professionals with Value Engineering knowledge. The questionnaire was distributed among the 90 professionals within the Sri Lankan construction industry and 71 were responded. The sample included project managers, engineers, quantity surveyors, and architects. All the identified challenges had mentioned within the questionnaire and the respondents were requested to rank the given challenges using a five-point likert scale. Then the collected data were analyzed using the Relative Important Index (RII). The following formula was used to analyze the collected data statistically.

$$\text{Relative Important Index (RII)} = \frac{\sum W}{A \times N} \quad (1)$$

W = Weightage which is given to each variable by the respondent

A = Highest weight (5)

N = Total number of people who participated as the respondents for the questionnaire survey

Based on the findings of the analysis, a framework was developed to overcome the challenges in applying value engineering for public sector construction projects in Sri Lanka.

IV. RESULTS AND DISCUSSION

A. RII analysis results for the challenges in applying Value Engineering for the public sector construction projects in Sri Lanka.

TABLE III. RII VALUES OF THE CHALLENGES TO IMPLEMENT VALUE ENGINEERING FOR THE PUBLIC SECTOR CONSTRUCTION PROJECTS IN SRI LANKA

Challenges	RII	Rank
Lack of expertise among industry professionals about VE	0.904	1
Misbelief that high initial implementation cost is for VE	0.896	2
Misbelief that VE is not necessary when the project is developed by the top designers	0.890	3
Client's lack of knowledge about VE concept and techniques	0.885	4
Lack of incentives from the government to encourage VE	0.882	5
Lack of support from clients	0.879	6
Difficulty to implement VE under cost-oriented procurement systems	0.862	7
Lack of guidance and construction framework for practical applications	0.862	8
Lack of teamwork spirit and proper coordination among team members	0.856	9
Lack of support from the government	0.834	10
Lack of support from the company management	0.825	11
Lack of standards/certificates	0.823	12
Misbelief that VE is not suitable for developing countries like Sri Lanka	0.800	13
Lack of awareness of VE	0.794	14
Lack of policies to promote VE	0.780	15
Difficult to get started at first	0.772	16
Unwillingness to take risks and implement innovative and creative alternatives	0.755	17
Misbelief that VE is not worthy	0.713	18
Less familiarity about the culture of VE among public firms	0.659	19
VE is too complicated	0.648	20
Inflexible provisions in legislations	0.642	21
Dislike to implement VE	0.586	22
VE is not aligned with the concepts used in countries like Sri Lanka	0.524	23

Table I illustrates the Relative Important Index (RII) values of the challenges that affect the implementation of Value Engineering for the public sector construction projects in Sri Lanka.

B. Strategies to overcome the challenges

In order to overcome the above-mentioned challenges, the respondents were asked to suggest suitable strategies. Therefore, the respondents had proposed following strategies.

- Conducting value engineering awareness programs for construction industry related professionals.
- Add the value engineering as a module for construction related courses and degree programs.
- Provide information to the client over the Value Engineering proposal, including the advantages to the client.

- Conduct Value Engineering workshops to educate construction professionals over the correct method of implementation.
- Encourage and give rewards to the organizations and professionals who already practice Value Engineering for construction projects.
- Promote Value Engineering concept for construction projects by the government.
- Introduce a suitable Value Engineering procedure guidelines and handbook.
- Encourage the use of the Value Engineering approach at the initial stage of a project.

C. Development of the framework

The framework was developed based on the literature findings and the data collected through the questionnaire survey. The framework illustrates the factors that encourage the application of Value Engineering, challenges in applying Value Engineering for the public sector construction projects in Sri Lanka, and strategies to overcome the challenges. Fig. 2. represents the developed framework to implement Value Engineering for the public sector construction projects in Sri Lanka.

V. CONCLUSIONS

This study attempted to develop a suitable framework to adopt Value Engineering for the public sector construction projects in Sri Lanka. Prior to develop the framework, the significance of value engineering and the challenges in applying Value Engineering for the public sector construction projects were identified. The identified challenges were analyzed based on the data collected through questionnaire survey. According to the results of RII analysis, it was found that there are several notable challenges as lack of expertise among industry professionals about VE, misbelief that high initial implementation cost is for VE, misbelief that VE is not necessary when the project is developed by the top designers, client's lack of knowledge about VE concept and techniques, lack of incentives from the government to encourage VE, lack of support from clients, difficulty to implement VE under cost-oriented procurement systems, lack of guidance and construction framework for practical applications, lack of teamwork spirit and proper coordination among team members and eventually lack of support from the government. Most importantly, eight strategies were proposed by the respondents to overcome the above identified challenges. Based on the strategies, a framework was developed and applying it will strengthen the adaptation of Value Engineering for the public sector construction projects in Sri Lanka. This will eventually lead to the enhancement of quality, reduce time and cost of public sector construction projects. Therefore, being a third world developing country this is something really essential that needs to have a vigilant attention.

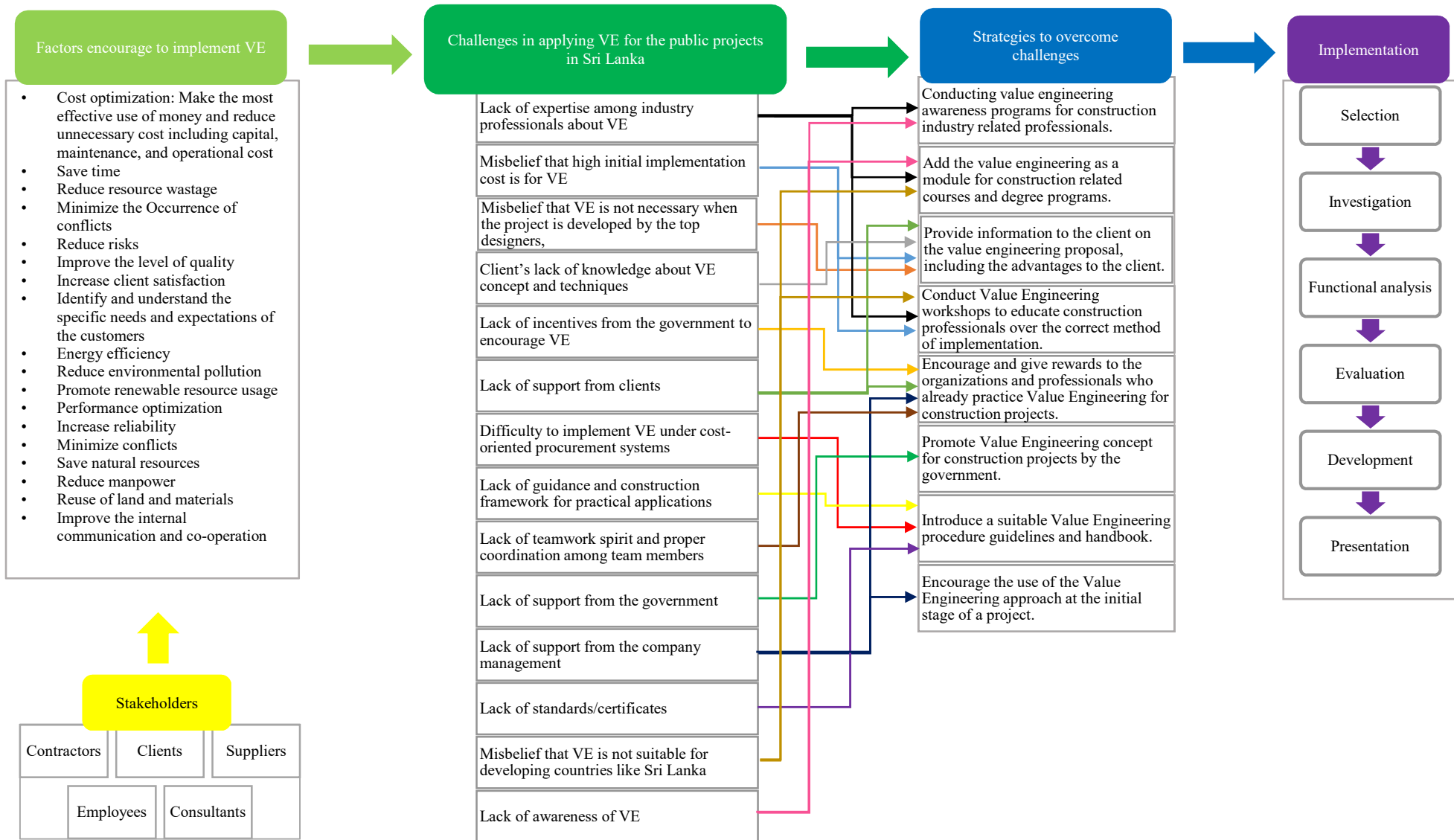


Fig. 2. Framework to implement Value Engineering for the public sector construction projects in Sri Lanka

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