Design and Suggestion a Model by Use Value Engineering to Evaluate the Risk Engineering of Cost Reduction and Quality Increasing for Development of Effective Management of Project

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ABSTRACT: This study was conducted to compare the true concept of value engineering with what practitioners perceive as value engineering and its application in the construction industry. The present paper aims to introduce a new generated C# code provides guidelines for establishing and managing a value engineering program and defines the procedure for the application of value and risk engineering techniques within Company. This code is capable and applicable to public buildings service projects under the technical direction of the regional design and construction divisions. To validate and verify the generated code a case study was investigated. This comparison is established through the research of various books, technical papers and publications for determining and outlining the formal concept of value engineering. The obtained results of the generated code in this study shows good and acceptable agreement with previous have done. Value engineering has potential to explore the opportunities it can bring to the engineer in meeting the changing needs of clients with particular emphasis on the critical design phase.
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INTRODUCTION

Value Engineering (VE) is a methodology that focuses on the function of a product or service to improve value without sacrificing quality or reliability. It involves assembling a cross section of multi-disciplined professionals and enabling them to work together, each bringing a unique perspective and expertise to the assignment. It is a systematic method to improve the "value" of goods or products and services by using an examination of function. Value, as defined, is the ratio of function to cost can be increased by either improving the function or reducing the cost. It is a primary tenet of value engineering that basic functions be preserved and not be reduced as a consequence of pursuing value improvements. This method is sometimes taught within the project management or industrial engineering body of knowledge as a technique in which the value of a system's outputs is optimized by crafting a mix of performance (function) and costs. In most cases this practice identifies and removes unnecessary expenditures, thereby increasing the value for the manufacturer and/or their customers. This methodology relies heavily on team-building principles that focus on effective communicating, careful listening and understanding, the generation of creative solutions and efficient decision making. The main steps of value engineering job plan phases are as below and table (1), shows value engineering stages.

- **Selection:** select project
- **Investigation:** Investigated project analyze function and cost
- **Speculation:** Speculate on alternatives
- **Evaluation:** Evaluate alternatives
- **Development:** Develop alternatives
- **Presentation:** Present alternatives
- **Implementation:** Implement alternatives
- **Audit:** Audit results

Table (1). Stages in value engineering

Information	An information gathering process that focuses attention on the client's business drivers for the project. Particular importance is given to the use of facilitated workshops.	**Define and understand the nature of the problem.**
Speculation	Creative-thinking techniques are utilized to generate alternative ways to provide the business drivers identified in stage 1.	**Generate alternative ideas as to how the problem may be solved.**
Evaluation	The solutions generated are evaluated in terms of their feasibility and cost. Ideas are combined and consolidated to produce a list of perhaps five or six that are worthy of further consideration.	**Evaluate the feasibility of the ideas so generated.**
Development	The surviving ideas are developed in detail, ensuring that all of the interfaces with the client's business are taken into account.	**Fully develop and test the ideas judged to be the most suitable.**
Recommendation/ implementation	The most suitable solution is identified and a formal recommendation made to the client for implementation	

Value Improvement procedures are recognized worldwide as a highly profitable means to achieve increased profits, client satisfaction, and improved quality. Its application through the Value Method uses powerful, creative, value based decision-making processes that have been used and improved upon worldwide for over 60-years with tremendous success. Businesses and government agencies using the process save costs, and/or increase profits, by as much as billions of dollars every year. These results were often achieved while increasing product quality, usefulness, customer satisfaction, and other increases in essential product component requirement fulfillment. Most of these benefits are provided through the use of "value studies" using highly qualified facilitation services, and team members from the business sponsoring the study. Clients require more than technical expertise and problem solving they expect customer service and value for money (Anderson, 2001). It is the opinion of Zimmerman and Hart (1982), that the best place for value engineering effort is in the planning and design stages. The reason being that if changes can be found at these stages the major cost saving being realized by the client will not have to be shared with the contractor. Consulting engineers will find that the value engineering enhances the capabilities of their firm to the benefit of present and future clients, providing an additional valuable service that gives them a competitive edge over firms who do not (Brahtz, 1978). Many analysts have portrayed the construction industry to be uncompetitive and insufficient with up to 40% of the effort expended in developing capital works being wasted, adding value to the client, depending both the respect between and the profit and reputation of professionals, contractors and clients alike and exacerbating the adversarial conditions so prevalent in the construction industry (Gallo et al., 2002). Construction is a project based industry with each project typically being unique. It has many problems with its structure and fragmented nature that have combined to inhibit its performance (Banwell, 1964; Latham, 1994; Egan, 1998). Poor design and documentation can be responsible for up to 12% of project costs (Tilley et al., 2002). According to Hegan (1993), value engineering is a creative and disciplined process which seeks to offer a reliable cost saving opportunity to client without quality detriment or performance. The power of the value engineering technique is rooted in its objective and disciplined methodology.

Watson (2005), described the term "engineering" as being derived from the Latin ingeniousus meaning to be skilled. Sperling (2001), adds the relation of value with function and cost and contends improving value means enhancing function, reducing cost or both. Kelly and Male (1993) described value engineering as a philosophy supported by technique rather than a absolute method or set of rules. A basic concept of value engineering is that each element of cost must add commensurate user function (Miles, 1961(a) and (b)).

METHODOLOGY

Value engineering is a systematic procedure directed towards the achievement of required functions at least cost. Unlike value management, it aims to provide an optimal answer to a design problem.

Value engineering progresses from an initial solution to provide function-oriented alternatives generated in an unconstrained, creative environment.

Value engineering uses rational logic (a unique "how" - "why" questioning technique) and the analysis of function to identify relationships that increase value. It is considered a quantitative method similar to the scientific method, which focuses on hypothesis-conclusion approaches to test relationships, and operations research, which uses model building to identify predictive relationships. As a pilot study, the questionnaire was initially distributed among a small sample of the distribution database to provide feedback to the various questions. The questionnaire was modified to eliminate wordings that were confusing or provided dual definitions prior to the full study. The final version of the survey questionnaire was distributed to members of a consultant engineering regional construction industry in a distribution database that was created to provide an equal distribution among the various members of the construction industry. To get the mentioned aim a GUI C# computer code was generated to survey and investigate the established questionnaire to obtain a reliable and confirmed response. The interfacing software has developed on base of the project management and construction of civil engineering data. This code is capable of reading of excel sheet data from database, performing calculations of value index for management purpose analyses, and preparing a data input file for other provided section in the code. The capability of the generated code was increased then in order to perform graph analysis and calculation of other requested parameters. The major part of the study is development of software that can perform the above mentioned tasks of a management construction engineering problem since the data can be used in upper management decision level. One of the main properties of this software is modeling section that can do mathematical model for the designed purposes. This code provides a graphical user interface (GUI) in order to link the constructed databases. From this point of view generated code can be regarded as moderate scale management software. This code is capable to monitor the project, edit data section and etc which is given in figures1, 2. Figure3 shows the flowchart of the proposed methodology which the code has designed on base of it respectively.

As mentioned above, the first part of the questionnaire established the respondents' general knowledge of the concept of value engineering by asking various questions concerning their experiences with the value engineering process. Furthermore, the questionnaire also dealt with respondents' concept of a successful value engineering review by asking specific questions relative to their experiences with success and failure in the elimination of unnecessary costs within a project. The fourth section of the questionnaire was designed to establish the respondents' opinions on what they felt were the various obstructions to implementing a successful value engineering process. By refer to the proposed methodology flowchart the tables (1), (2) and (3) were obtained and computed for selected possible products of this study, which defined the desire characteristics within the construction industry and the sizes and types of projects.

Figure1. Start screen of generated code (left) and Modeling section and its components (right)

The current perception and application of value engineering was established through a survey questionnaire sent to various members of the construction industry which asked detailed questions on the participants' knowledge and experience with value engineering. According to achieved results in mentioned tables, at the first beauty value index and particle weight percentage versus beauty value index percentage was drawn as shown figure4. It shows that beauty value index percentage is increased by decreasing the particle weight percentage.

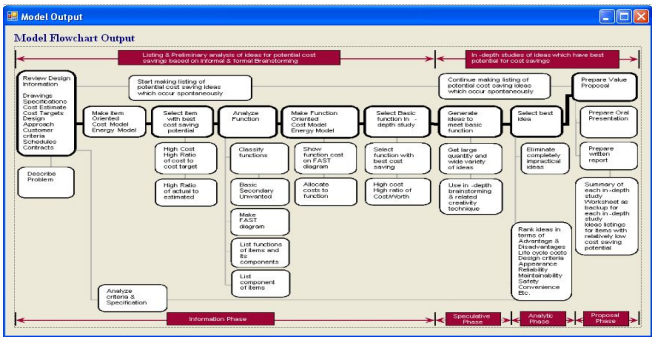

Figure2. Model output screen of the generated code

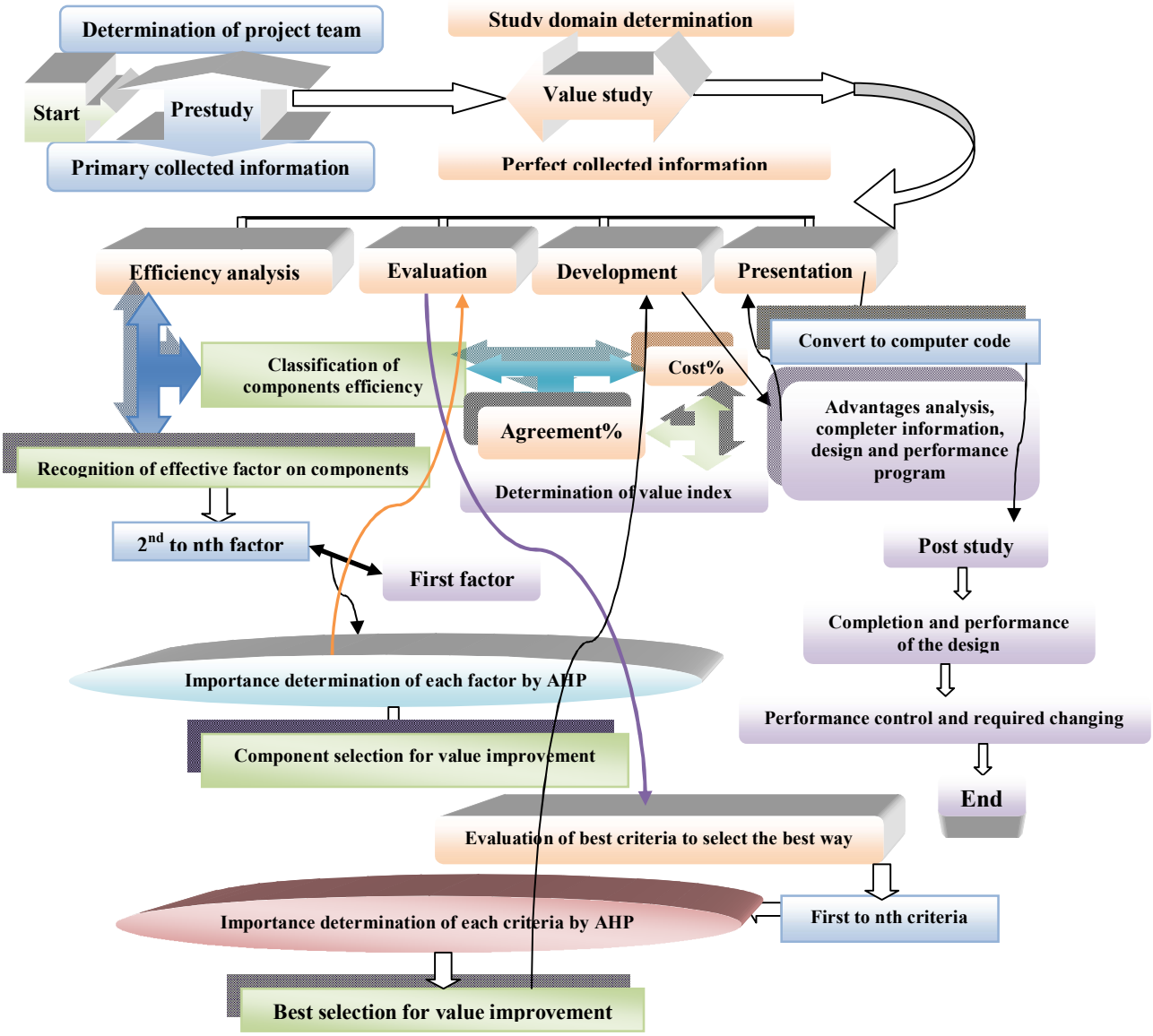

Figure3. Detailed flowchart of the study

Figure5 shows the relation between beauty value index percentage, beauty value and particle weight percentage. The contour map of the three mentioned variables was plotted as pointed in figure6 and the probability analysis of these variables are estimated and computed in figure7 respectively. To validate and modify the generated GUI a 3D image of variables are computed and plotted in figure8.

Table (1). Computed Beauty Value Index of each product in building façade

Beauty Value Index	product
0.617	A
0.454	B
1.222	C
1.398	D
1.826	E
1.653	F
2.734	G

Table (2). Computed the percentage of Beauty Value Index of each product in building façade

Beauty Value Index%	Product
0.062	A
0.046	B
0.123	C
0.141	D
0.184	E
0.167	F
0.276	G

Table (3). Computed the weight percentage of each product in building façade

Weight%	Product
24%	A
34%	B
12%	C
14%	D
8%	E
3%	F
5%	G

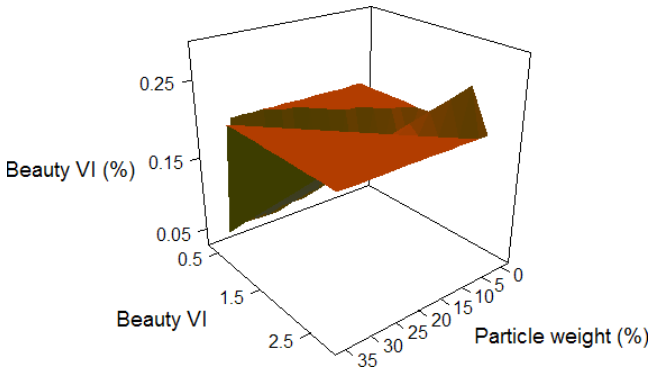

Figure4. Variation of Beauty VI, Beauty VI (%) and Particle weight (%)

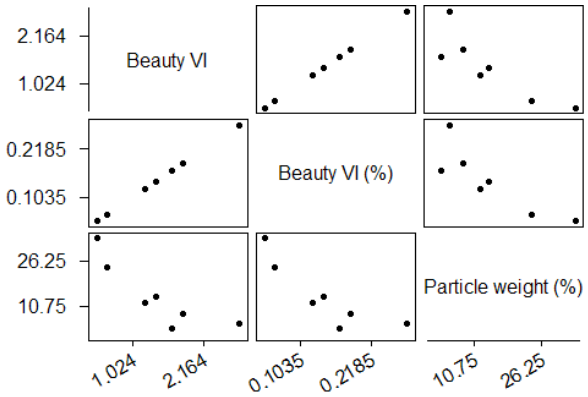

Figure5. Box plot of Beauty VI, Beauty VI (%) and Particle weight (%)

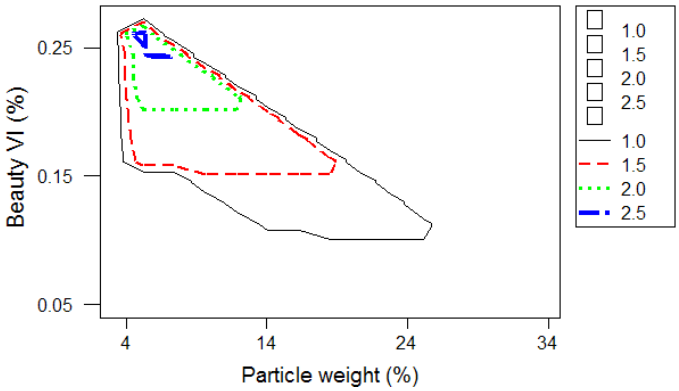

Figure6. Contour map of Beauty VI on base of Beauty VI (%) and Particle weight

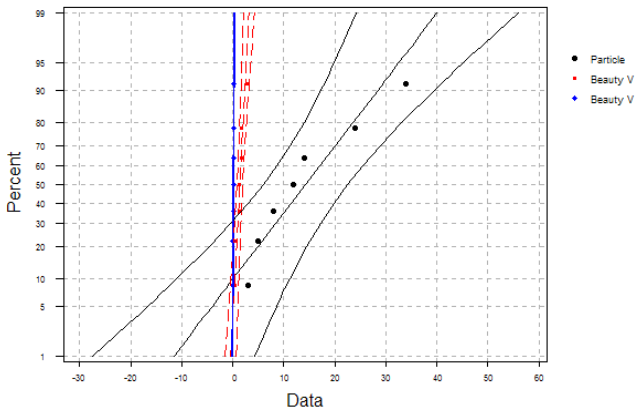

Figure7. Normal Probability plot of Particle weight and Beauty VI on base of Beauty VI (%)

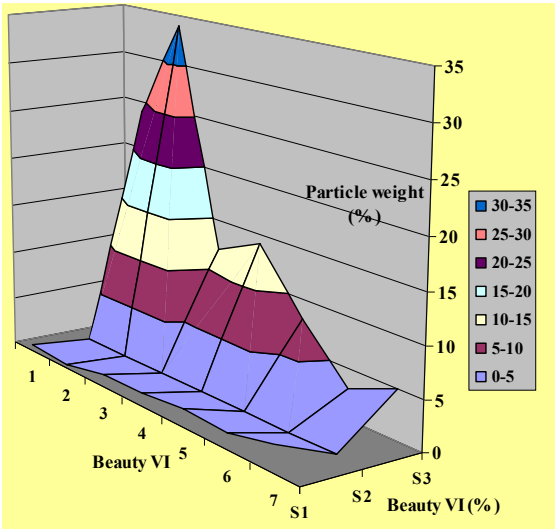

Figure8. 3D variation of Beauty VI and Beauty VI (%) versus Particle weight (%)

CONCLUSION

Value management is an important tool in the exercise of defining the client's actual requirements. It should be implemented in the earliest stages of the project process to allow it to have maximum impact on the outcome of the project. The five stages of a value management exercise are information, speculation, evaluation, development, and recommendation/implementation. The process formalises the essential client requirements and retains the correct focus throughout the project lifecycle.

This study questionnaire established that the respondents recognized that they participated in value engineering studies. The independent facilitator is a critical part of successful value engineering since the facilitator has no previous agenda concerning the project and maintains the focus of the group. Furthermore, it was concluded that the respondents who stated that they participated in value engineering studies actually participated in reviews of the design plans for cost saving alternatives which where established to meet a project budget.

The respondents understood that the early stages of a project (conceptual or 35% design) were the critical time in which a value engineering study should take place. The early stages of the project permit changes to the individual functions of the project without having to redesign, which will result in additional costs and time. However, the respondents' experience with value engineering studies indicated that value engineering studies are performed farther into the

design process. Therefore, the participants seemed to be more into the cost savings thought process in which they are reviewing completed designs and making suggestions on how to perform a function in a more cost effective way. This was further established when the respondents provided examples in which value engineering was applied to their projects along with what they believed to be the greatest cause of unnecessary costs within a project that value engineering will eliminate.

While the term value engineering is often used, the true concept of value engineering is not understood by the majority of today's construction industry members. Furthermore, the performance of value engineering studies with an independent facilitator in the private construction industry is rare and the industry is confusing cost saving measures with value engineering.

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