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Using of Value Engineering in Main Road Construction

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Abstract: This research summarizes a study that was performed on the construction Main Road in Iran related to the use of technique Value Engineering (VE), its applicability and acceptance in the performance of today's constructed Main Road. Also, the data were collected from project Main Road constructed. This study achieved to the model Value Engineering in Main Road Construction (VEMRC) which cause decrease time, decrease cost and increase quality in projects it has been. That yielded equal $VEMRC = 3.836 - 0.2099T - 0.0000033396C + 0.334Q$ responses. The major findings concerning reduce cost, reduce time and increase quality for use technique Value Engineering, analytical technique usage from software R also usage from method liner regression. The results indicate that technique VE is very useful in construction Main Road. The study shows that usage VE in construction Main Road are more experienced and educated, they inclined to work in stage design also they are more likely to use VE in all stages projects.

Key words: Improve project, cost, value, quality, time

INTRODUCTION

The Value Engineering (VE) success can be achieved in a variety of ways including initial/life cycle cost Savings, improved performance, increased revenues and enhanced image (Pucetas, 1998). The VE is the systematic review of a project, product, or process to improve performance, quality and/or life-cycle cost by an independent multidisciplinary team of specialists (NCHRP Synthesis 352, 2005). The VE is known as a managerial method and useful tool for cost management in the production process and it has been widely applied in the various kinds of productive activities including the field of public works (Ando, 2005).

The application of methodologies for the Value Management in such an industrial environment as the automotive one, characterized by a product that presents a high number of functions and components, is a complex process that involves all the company since the contents introduced by these methodologies have an high strategic relevance, it's been assumed that the approach could even be imperfect, because of not considering all the sub-systems of a car, provided the chance of implementation was very high (Darnir *et al.*, 1999).

The VE increases value by reducing cost while retaining performance and customer satisfaction

Practitioners know this and can show managers and executives repeated and presumably Compelling examples of success (Charles, 1999).

The VE process incorporates to the extent possible, the value of the major stakeholders, these generally include the designer, construction engineer, maintenance engineer, contractor, state and federal approval agencies, local agencies and the public has been formally recognized as an acceptable review process in transportation development (AASHTO, 2003). The application of Value Engineering (VE) in the construction industry has been observed in a number of countries around the world and is recognized as one of the most effective methodologies for achieving best-value-for-money (Shen and Liu, 2003). Since, its introduction, the development of Value Engineering in construction has put the VE study objective far beyond its original intention, which was seeking substitutes for materials in shortage. It is now also being used to facilitate strategic decisions, to enhance communication and consensus among stakeholders and to define the project scope (Barton, 2000). Since, overhead costs, general and administrative expenses and profit are usually added to costs as a percentage of direct transport project costs, it is imperative that estimate accuracy being with precise estimate of the materials and labor hours required to the job (Peter, 2001).

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The VE is understood to increase customer satisfaction and value to investments. In enhanced assessment is seen that VE can be used also in improving the value and optimizing the life cycle cost of a process and its practices (Pasi *et al.*, 1999). The VE is a professionally applied, function oriented, creative and systematic team approach, used to analyze and improve value in construction-a powerful methodology for solving problems and/or reducing cost while improving performance and quality requirements (Pasi *et al.*, 1999). Value Engineers are trained in saving money while improving the value of products or services and hence improving the shareholders' value of large corporations (Krishan *et al.*, 1996).

This research applies VE for a local high-grade Main Road project. Present work started with the VE definition and finished with model VE (reduce cost, reduce time and increase quality) of improvement project in implementation. The aim of the study is to verify the effect of VE as a valid approach for Main Road improvement projects and to develop the VE technique in this procedure.

MATERIALS AND METHODS

Time cost and quality: The time, cost, quality triangle is commonly used in Value Management workshops as a Tool to elicit from the client their value criteria. The Facilitator commonly asks for team Consensus on the position of the dot that indicates the team's relative value criteria in Terms of the three variables, time, cost and quality. Invariably this discussion commences With client stating all are important and therefore, the dot should be in the centre. It is only after protracted discussion that the position of the dot tends to move. Figure 1 illustrates a time cost quality triangle for a proposed new court project. The dot indicates the result Of a discussion in which the team agreed that quality is more important than cost and that Time is not important in the context of a replacement for an existing court. In this study, it is proposed to take three variables of cost, time and quality

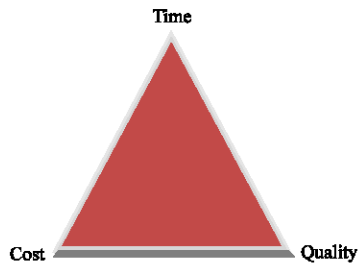


Fig. 1: Example time, cost, quality triangle

and discuss them in relation to VE with the intention of decide a method of measuring the client's value system (John and Steven, 2001).

Data collection: The data for this research were gathered through main road which constructed in Iran country to number 30 projects from year 2003 until 2009 and base total project for length kilometer (KM) and for time month (M) optioned (Appendix). Also the questionnaire includes Value Engineering (VE) and quality that by consultant and employer and contractor to them answered. All this data will be stored and analyzed by using software R. The main purpose of using "R" to analyze the data is to create a result for achieve to model Value Engineering. After fitting a multiple regression model on data which value engineering as a dependent (response) variable and the dependent (explanatory) variables includes time, cost, quality the regression model is significance at the level of 95 percent with the p-value = 5.322e-09. The multiple R-square for this model is = 0.79 which means 79% of variance of value explained by these variable.

The parameters which can be included in the model with the significance level of 95 and p-value = 5.322e-09 < 0.05. Therefore final model achieved in following shown.

Multiple linear regression method: The results of analysis are obtained as shown in following. Analysis, the Value Engineering prediction model for Main Road Construction according following equation:

$$VEMRC = 3.836 - 0.2099T - 0.0000033396C + 0.334 Q$$

Where:

Time = T

C = Cost

Q = Quality

The model has an R-square of 0.79, which means that 79 % of the variation in the number of VE has been explained the regression line. The t-test also indicates that the model is significant and can be used for the prediction of the number of VE in Main Road Construction. This study developed model value engineering in main road construction which might bring about a decrease in construction cost and time and an increase in project quality. But the other variable cannot be included in the model (since their p-value are greater than 0.05).

RESULTS AND DISCUSSION

Relationship between VE and cost, time, quality: Fig. 2 the relationship between Value Engineering and

Table 1: Use of value engineering techniques with method brain storming in construct highways

Year	Total offers	Total admission	Percent acceptance	Saving (\$)	Offer quality (Savings per unit)
1997	-	333	-	31,069,777	93.303
1998	376	329	87.5%	38,400,000	116.717
1999	335	286	85.37%	35,020,000	122.448
2000	354	269	75.99%	40,655,000	151.134
2001	359	299	83.29%	66,305,000	221.756
2002	416	347	83.41%	61,101,000	176.084
2003	330	288	87.27%	54,140,000	187.986
2004	310	255	82.26	40,129,000	157.369
Sum	2408	2406	-	366,819,777	-
Average	354	296	83.59%	45,852,472	153.349

Source: (FHWA. 2002)

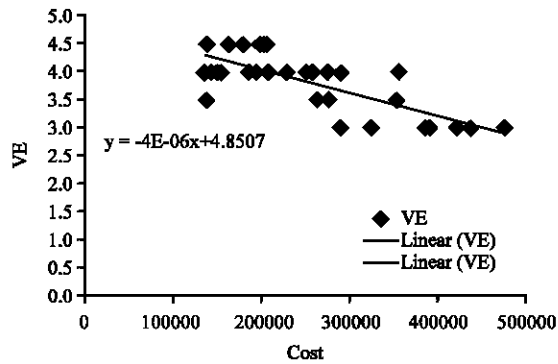


Fig. 2: The usage linearity between VE and cost

cost shows that with reducing costs value Engineering increased and Considering the linear equation $Y = -0.000004X + 4.8507$ shown that with Reducing the costs value construction in projects linear form of increased and in Fig. 3 relationship between Value Engineering and time shows that with reducing time, Value Engineering increased also in Fig. 4 VE versus Time equal: $Y = -1.3042X + 6.9652$ shown that with Reducing the time value construction in projects increased. And in Fig. 3 shows that with increase quality, Value Engineering increased and this equation $Y = 0.1205X + 3.2922$ Confirming, meaning in per KM reduce cost and time In according previously research (Table 1) more than twenty paper studied in more them usage technique VE for reduce cost and time also increase quality according to recommendation engineering experiences and project manager to method brain storming presented but this model (VEMRC) to accuracy control analyzed and this model for other project responses.

For example, statistics and results presented proposed change to the method VE in office Federal Highway Association (FHWA, 2002) in recent years in Table 1 is shown below that usage VE during years 1997 until 2004 to method brain storming growing trend and had a good and compared with model achieved which in

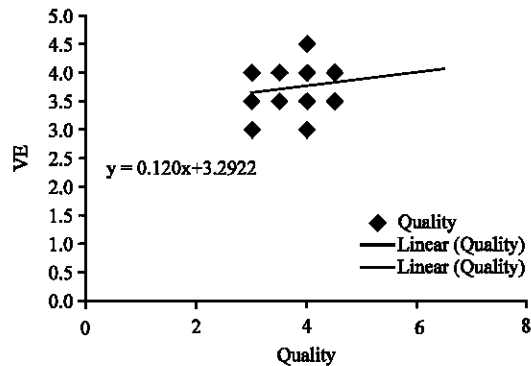


Fig. 3: The usage linearity between VE and quality

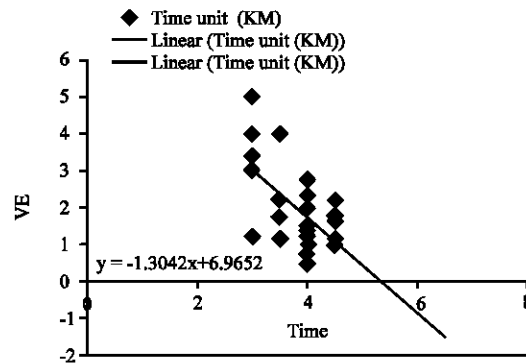


Fig. 4: The usage linearity between VE and time

this model reduce time and cost also is increase quality in projects whereas, in evaluation project by FHWA more focus on cost reduction.

Reasons for Use VE: Usage of VE Project complexity is the most influential in construction Main road. Also strong influencing factors (cost, time and quality) affecting usage. The characteristics of the data collected for effect of VE in construction main road. The results show that the cost related process is the most important in the project then quality in finally time. The achieved

high value in construction projects main reason usage VE is projects also with utilization and with use of this technique employers can more money save.

CONCLUSIONS

The model in this study can in the evaluates the projects performance of VE study. By reduced cost, reduce time and increase quality which in this model for per KM using of technique VE that achieved: $VEMRC = 3.836 - 0.2099T - 0.0000033396C + 0.334 Q$. Therefore, this model tested for another project and can be used for other projects also in this research Linearity between VE with cost, time and quality as separately calculated and shown. To evaluate the effects of a VE study needs to consider not only the final economy but also the reciprocation relationship between VE with time, relationship between VE with quality and then study reciprocation between the expeditor and the project participants.

However, VE, Main Road projects are reviewed and opportunities for better, less expensive means of completing the projects are analyzed. The intention is to improve project quality and productivity, foster innovation, optimize design elements and ensure overall economical costs. The goal of a VE study is to achieve performs excellence. Its objectives are to improve quality, minimize total ownership costs and decrease construction time.

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