A methodology to identify and prioritize organizational factors affecting implementation of value engineering

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A R T I C L E I N F O	A B S T R A C T
	The new millennium must be called the century to compete for survival. The increase interaction among international organizations has changed the world into a global village and firms have no choice but to develop a variety of instruments and equipments to compete with each other. Value engineering (VE) is one of the new techniques of management science emerged in using the power of organizational creativity and entrepreneurship programs. VE modifies the organizational activities, removes the non value-added activities and increases the current values of organizations. VE has been successfully implemented in many areas of management such as quality, productivity, project management, etc. The success of a VE program depends on many organizational factors such as the availability of resources, the strategy and the organization structure, the senior management support, the organizational culture and the communication and information systems. In this study, we identify and prioritize organization factors affecting the implementation of VE using ELECTRE III method.

1. Introduction

During the past two decades, there have been advances on new emerging theoretical managements, which are, in some events, in conflict with traditional theories. Increased competition, speed and flexibility have led many organizations to use the optimal resources for customer satisfaction and retention. There has been an evolution on competition techniques. It was started from price competition and then it was changed into quality-based competition and now the completion is on mainly based on customer value, innovation, creativity and value engineering (VE). The life cycle of products decrease and customers are not as loyal as they used to be since they prefer to take advantage of the recent advances of technology and new products. VE is believed to be one of the

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most effective approaches for the assessment of organizational activities. VE helps us separate the non-value-added activities from the value added activities and this could guide us to remove the unnecessary activities (Mudge, 1971, Parke, 1998). Society of American value engineering (SAVE) defines VE as the implementation of systematic and creative methods to reduce the unnecessary expenditures in an attempt to increase the quality of the products or services through a teamwork (Miller & Salzman, 1981). VE is also defined as a strong and, at the same time, simple method to improve design, quality, performance and other components of products such as increasing product's life cycle, reliability, etc. (Al-Yousefi & Hayden, 1995). According to Fong et al. (2001), VE is a systematic teamwork attempt to improve the quality and the service of products while a minimum level of cost is maintained. Kawakami et al. (1996) presented a knowledge acquisition method for conceptual design based on value engineering and axiomatic design theory. Echols and Neck (1998) studied the impact of behaviors and structure on corporate entrepreneurial success. Fang and Rogerson (1999) explained that there are a number of approaches such as labeling and grouping, etc to establish usable metrics for the quality management of the design process. They studied the use of importance levels with an adaptation of the value engineering technique for cost reduction. They also used a partial validation of their proposed method and identified the non-value-added processes that could be eliminated. Gandhinathan et al. (2004) presented a fuzzy approach to identify the non-value–added processes with an adaptation of quality function deployement (QFD) and VE. There are different evidences to believe that VE could reduce the cost of production. Cheah and Ting (2005) performed VE on construction projects located in Southeast Asia and reported significant cost reduction. Jogaratnam and Tse (2006) studied VE in Asian hotel industry. Ibusuki et al. (2007) proposed an approach for the product development process in auto industry where the primary objective was at the correct systematic approach of VE and target-costing in cost management.

VE and target-costing must be studied together. While the first one allows the identification of where the cost reduction can be found, the second one determines the target to be achieved for the long-term profitability plan of a company. The VE process normally involves three stages: concept, project and validation. Ibusuki et al. (2007) proposed an approach and validated the method in a case study of the engine-starter system of a vehicle. They reported that the proposed VE method could improve product cost, functionality and quality achievement, in accordance with customer needs and the company strategy. Gautam and Singh (2008) presented a mathematical model to capture the optimized design changes with cost implications. The primary of the method was on developing lean production through the maximization of customer's perceived value through design change. They examined their model on a case study of automotive vehicle development. Bowen et al. (2010) investigated value management (VM) practice by professional architects in South Africa and reported that VM was not widely used among the engineers in that region. However, they explained that wherever VM was used on projects, it could significantly reduce the cost in terms of both the project and the VM process itself.

There are also some works dedicated to the relationship between the corporations' belief and change. Björkman (1989) presented a model of factors that influence processes guiding the changes in organizational belief systems and reported that radical changes in organizational belief systems are affected by different factors such as organizational results, characteristics of the organizational environment, intra-organizational factors, and characteristics of the current organizational belief systems. Accountability and control were important issues affecting the corporations and Taylor (2003) discussed them in a comprehensive work.

In this paper, we present an empirical analysis to determine the important organizational factors influencing the success of firms on implementing VE. We first present the details of our proposed approach in section 2. Section 3 explains the details of the finding and finally conclusion remarks are given in the last section to summarize the contribution of the paper.

2. The proposed method

As we explained earlier, the primary concern of this paper is to find the most influencing organizational factors on the success of the implementation of VE. The study also uses multiple criteria decision making (MCDM) to prioritize the most important factors (Hwang & Yoon, 1981) and it is performed among university professors as well as experienced managers. There are 35 questions in our questionnaire and all people carefully replied to our questions. The results indicate that the following six items have been the most influencing factors,

    a. Management support

    b. Availability of necessary resources

    c. Strategy of the organization

    d.   Organizational structure

    e. Communications and information systems

    f. Organizational culture

Fig. 1 shows the details of the implementation of value engineering.
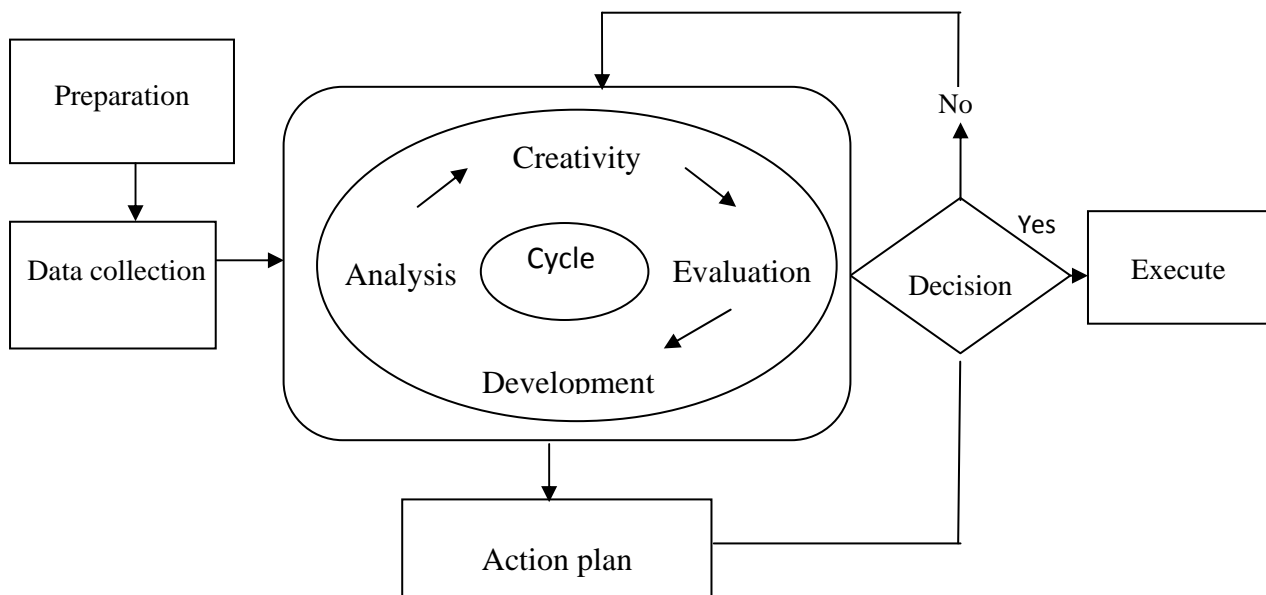

Fig. 1. The details of the implementation of value engineering

2.1 Management support

Implementation of value engineering in an organization requires accompanying procedures, policies, and management strategies. The first and the most important step is to build a strong commitment among middle and top level of management team. As long as there is no strong commitment among the management team, we cannot expect any creativity and innovation. According to Björkman (1989), one of the most effective ways to make the change on an organization is to train the most influencing management people. Training must be performed to absorb more resources to organization, determine the strength and the weakness of the market and make an improvement on organization.

2.2 Availability of necessary resources

Although we need a good support from the top management team to initiate VE project but practically the middle level management starts the VE job. The top managers normally just support the VE project on the early stages and the lower levels of management teams normally accomplish the works.

2.3 Strategy of the organization

All the necessary VE actions must be performed according to organizational strategies. In other words, business strategies need to support VE decisions to create value added actions. Organizations faced with rapid changes need entrepreneurial strategy formulation in order to achieve individual and organizational value engineering goals. According to Taylor (2003), the following actions could help entrepreneurial strategies,

- An increase on new emerging competitors

- Leaving skilled workers and acting as new competitors

- developing a sense of mistrust towards the traditional management practices

There are two major orientations for implementation strategy for entrepreneurship in an organization:

- Focus and attention to individual entrepreneurs in the organization called the organizational entrepreneurship.
- The second orientation of entrepreneurship within an organization is to create the structural changes, culture, entrepreneurial teams. This process eventually creates a common vision and understanding between managers and employees and it is called corporate entrepreneurship.

2.4 Organizational structure

The organizational structure plays an important role on the success of the firms. If there is any change on an organization, there must be a change on the structure of the organizations so that VE could be implemented. A dynamic structure could provide a better means to cope with market changes. The recent emphasis on strategic planning is to organize firms with dynamic and flexible structure with a minimum hierarchy. An entrepreneurial structure must have the following characteristics,

- A faster response to environmental changes
- An increase on long term actions
- More creativity
- Better services for customers
- A faster feedback
- Easier compatibility with market changes
- A quick response to employees' feedback

2.5 Communication and information systems

Communication is the exchange of the information from one to another and whenever a VE is executed in a firm there must be a strong relationship among all employers. Therefore, the following characteristics must exist in an organization to reach a successful VE outcome,

- Information sharing
- Clear communication
- Short communication
- Office automation
- Management information systems

The development and harmonization activities related to value engineering activities will have the following outcomes,

- There is a faster response for problems.
- There is an increase on useful information.
- There is a horizontal structure in organization.
- There is an internal satisfaction.
- There is a simple and comprehensive exchange of messages.
- Communication will be based on vision, mission and goals of the organization.

2.6 Organizational culture

Any organization normally has its own identity and the VE implementation requires a good attention to organizational culture. In order to have a good support on this issue we could consider the following,

- Innovation and risk vulnerability
- Listening to team members
- According to team members
- Ambitions

In order to make sure that organizational culture support VE project we must seek the following attributes on organizational culture.

- Are we supporting innovative ideas in organization?
- Are we supporting teamwork in organization?
- Is there a good level of trust among team members?
- Does organization consider human resource as the most valuable asset?
- Is there a good competition among team members?
- Do workers consider job as a hubby?
- Does anyone know about the exact definition of organization's missions?
- Does organization need a discipline to execute its duties and, at the same time, does it have the freedom of coping with changes?
- Is there any appreciation for workers' endeavor?
- Is there a learning process through all levels of organization?

Next, we prioritize the organizational factors affecting the implementation of value engineering.

3. Prioritizing the organizational factors

One of the primary concerns on the events where we face with multiple items affecting a decision is the prioritizing the attributes. There are literally various methods for ranking different alternatives (Hwang & Yoon, 1981). The proposed model of this paper uses logic-based decision support systems called ELECTRE III (Li, 1987). The implementation of the proposed model uses Likert scale to gather decision makers' opinions where one represents the minimum importance and nine means the maximum importance. Ten decision makers are asked to express their opinions about five attributes of quality (A1), productivity (A2), lean production (A3), product design (A4) and project

management (A5). Table 1 summarizes the average DM's opinions on each program in terms of five attributes.

Table 1
The mean of DMs' opinions on implementing six projects

Program	Attributes				
	A1	A2	A3	A4	A5
P1	7.3	8.3	5.0	5.0	3.4
P2	4.0	7.5	3.2	6.0	6.2
P3	5.5	3.0	6.0	6.6	6.6
P4	7.3	7.0	6.2	7.4	6.6
P5	5.0	4.0	8.7	7.4	5.0
P6	6.1	4.2	7.5	7.8	7.4

We have used analytical hierarchy procedure to measure the relative importance of each alternative (Hwang & Yoon, 1981). Table 2 summarizes the details of the ranking.

Table 2
The summary of the ranking for different alternatives

Program	Attributes					Rank
	A1	A2	A3	A4	A5	
A1	0.132	0.015	0.061	0.022	0.028	0.032
A2	0.194	0.090	0.085	0.089	0.085	0.108
A3	0.226	0.448	0.427	0.356	0.507	0.393
A4	0.258	0.179	0.213	0.178	0.127	0.191
A5	0.290	0.269	0.213	0.356	0.254	0.276

Next, we determine the threshold values for different attributes and the results are given in Table 3.

Table 3
 The threshold values for different attributes

Threshold	Attributes				
	A1	A2	A3	A4	A5
No difference(p)	1	1	1	1	1
Preference(q)	4	4	4	4	4
Rejection(v)	6	6	6	6	6

Table 4 summarizes the concordance matrix of six programs.

Table 4
The concordance matrix for six program

	P1	P2	P3	P4	P5	P6
P1	1	0.44	0.76	0.71	0.86	0.61
P2	1	1	1	0.97	0.97	0.93
P3	0.76	0.61	1	1	1	0.99
P4	0.72	0.61	1	1	1	1
P5	0.61	0.59	0.55	0.55	1	0.48
P6	0.61	0.61	0.61	0.61	1	1

Next step is to provide the credibility matrix which it is summarized in Table 5.

Table 5
The credibility matrix

	P1	P2	P3	P4	P5	P6
P1	1	0	0.76	0.71	0.86	0.61
P2	1	1	1	0.97	0.97	0.93
P3	0.76	0	1	1	1	0.99
P4	0.72	0	1	1	1	1
P5	0	0	0	0	1	0
P6	0	0	0	0	1	1

Finally, given the credibility matrix we can determine the priorities of different alternatives P1 to P6 and the results are summarized in Table. 6.

Table 6
Priority of various alternatives

	P1	P2	P3	P4	P5	P6
P1	I	-P	-P	-P	P	P
P2	P	I	P	P	P	P
P3	P	-P	I	I	P	P
P4	P	-P	I	I	P	P
P5	-P	-P	-P	-P	I	-P
P6	-P	-P	-P	-P	P	I

As we can observe from Table 6, P2 represents the highest priority. In other word, the availability of the resources plays a vital role for the implementation of VE projects in organizations. Alternatives P3 and P4 come the second priority. It means that the strategy and the structure of an organization play the second most important factors. The first alternative, management support ,P1 , comes the third in terms of priority. Finally, P5 and P6, communication and organizational structure, represent the lowest priority compared with other alternatives. In other word, communication and organizational structure are not as important as the other issues.

4. Conclusion

The implementation of value engineering is one of the most important cost reduction programs used in organization. There are various reasons motivating us to use value engineering such as increased competition and the need for fast and flexible organizations, efforts to reduce cost and increase product quality and service, activity specialization, diversity in customer needs and demands, changing customer needs, etc. There are different factors affecting the implementation of value engineering in any organization and we need to identify them very carefully. We have presented an empirical analysis to find the most important factors for the implementation of value engineering. We have determined six important factors and they are prioritized based on five criteria of quality, productivity, lean production, product design and project management using ELECTRE method. The results indicate that the availability of resources plays the most important factor. The strategy and the structure of an organization are the second most important factors and management support, communication and organizational structure are the least important factors.

References

Al-Yousefi, A & Hayden, W. (1995). Re-Engineering Through VM-TQM Integration: A Strategy for the Transformation. *Dayton (Ohio). SAVE Proceedings*, 286-289.

Björkman, I. (1989). Factors influencing processes of radical change in organizational belief systems. *Scandinavian Journal of Management*, 5(4), 251-271.

Bowen, P., Cattell, J. Edwards. P., & Jay, I. (2010). Value management practice by South African quantity surveyors. *Facilities*, 28(1/2), 46-63.

Cheah, C.Y. J., & Ting, S. K. (2005). Appraisal of value engineering in construction in Southeast Asia. *International Journal of Project Management*, 23(2), 151-158.

Echols, A. E. & Neck, C. P. (1998). The impact of behaviors and structure on corporate entrepreneurial success. *Journal of Managerial Psychology*, 13(1/2), 38-46.

Fang, W. H., & Rogerson, J. H. (1999). Value engineering for managing the design process. *International Journal of Quality & Reliability Management*, 16(1), 42 – 55.

Fong, P. S-W, Shen, Q., & Cheng, E. W. L. (2001). A framework for benchmarking the value management process. *Benchmarking: An International Journal*, 8(4), 306 – 316.

Gandhinathan, R., Raviswaran, N., & Suthakar, M. (2004). QFD- and VE-enabled target costing: a fuzzy approach. *International Journal of Quality & Reliability Management*; 21(9), 1003-1011.

Gautam, N., & Singh, N. (2008). Lean product development: Maximizing the customer perceived value through design change (redesign). *International Journal of Production Economics*, 114(1), 313-332.

Li, H-L. (1987). Solving discrete multicriteria decision problems based on logic-based decision support systems. *Decision Support Systems,* 3(2), 101-119.

Hwang, C. L., & Yoon, K., (1981). *Multiple Attribute Decision Making*. Springer, New York.

Ibusuki, U. & Paulo Carlos Kaminski, P. C. (2007). Product development process with focus on value engineering and target-costing: A case study in an automotive company. *International Journal of Production Economics*, 105(2), Issue 2, 459-474.

Jogaratnam, G., & Tse, E. C-Y. (2006). Entrepreneurial orientation and the structuring of organizations: Performance evidence from the Asian hotel industry. *International Journal of Contemporary Hospitality Management,* 18(6), 454-468.

Kawakami, H., Katai, O., Sawaragi, T., Konishi, T., & Iwai, S. (1996). Knowledge acquisition method for conceptual design based on value engineering and axiomatic design theory. *Artificial Intelligence in Engineering*, 10(3). 187-202.

Miller, E. A., & Salzman, G. S. (1981). Value engineering saves dam project. *International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts*, 18(2), 31-38.

Mudge, A. (1971). Value engineering: a systematic approach. McGraw-Hill, 1971.

Parker, D. E. (1998). *Value Engineering Theory*. The Lawrence D. Miles Value Foundation, Washington D.C.

Taylor, B. (2003). Board leadership: balancing entrepreneurship and strategy with accountability and control. *Journal of Corporate Governance*, 3(2), 3-5.