

Value Engineering in Construction Industry of Pakistan

by

Syed Kamran Ahsan Gilani

A Thesis
of
Master of Science



Submitted to the
National Institute of Transportation
School of Civil and Environmental Engineering
National University of Sciences and Technology
Islamabad

In partial fulfilment of the requirements
for the degree of

Master of Science in Civil Engineering

2012

*This is to certify that the
thesis entitled*

Value Engineering in Construction Industry of Pakistan



Submitted by

Syed Kamran Ahsan Gilani

Has been accepted towards the partial fulfilment

of

the requirements

for

Master of Science in Civil Engineering

Dr. Rafiq Muhammad Choudhry, Ph.D

Department of Construction Engineering and Management

National Institute of Transportation

School of Civil and Environmental Engineering

National University of Sciences and Technology, Islamabad

**DEDICATED
TO
MY PARENTS, TEACHERS
AND
COLLEAGUES**

ACKNOWLEDGEMENTS

I am thankful to ALMIGHTY ALLAH, who gave the opportunity and enabled me to complete my Master's Degree. I am extremely grateful to my family for their sincere prayers and support during the entire length of my course and research work.

My heartfelt thanks and sincere gratitude to my thesis supervisor, Dr Rafiq Muhammad Choudhry for his guidance, valuable time and encouragement during my research work. I am also extremely grateful to the Committee members, Dr. Hamza Gibrael, Dr. Muhammad Babar Khan and Lecturer Zia ud Din for their sincere guidance.

ABSTRACT

Value Engineering is an excellent decision making tool for project management. In construction, value engineering is used, either to increase function at same cost or result in reduction of initial and life cycle cost of a project. It is a multi disciplinary approach with a systematic way of brain storming to focus on function rather than uses of intent of construction. Value engineering has become mandatory in many developed and developing countries alike, once the cost of a project exceeds a certain threshold value. Value Engineering is specially desirable and useful for multi-story high-rise buildings or mega projects involving scores of stakeholders, since such projects require project management to perform at its optimum. Value Engineering proves as a valuable asset of project management on such mega projects, clarifying the scope of project since its inception while safeguarding interests of all stakeholders and encouraging a balance between time, cost and quality. The construction industry of Pakistan is a fast developing sector contributing substantially to national gross domestic product (GDP). The research was aimed at assessing general awareness of value engineering, the extent to which it is practiced, its utility for Pakistan and its hold back factors in the industry. A questionnaire was designed to get responses from respondents working in the industry. An introduction to Value Engineering was made part of questionnaire. A three pronged approach was adopted; i.e. phone calls/e-mails, postal survey and personal visits to gather the maximum responses. A total of 142 respondents, mostly from major cities and mega builders, consultants and clients were involved in the study. Their responses were analyzed using SPSS and descriptive statistics were produced. The technique of the Relative Importance Index was adopted to weigh the opinion of respondents. Results revealed that the level of awareness of value engineering in Pakistan is 'low,' the practice of value engineering is also 'low,' while utility of this technique for the country is 'high'. Further analysis revealed that 98% of the respondents want to implement value engineering on their projects while 97 % desire a certified person in value engineering to review their design. Ninety- nine percent of the respondents desire that both value engineering study and value engineering change proposals (which are prepared by the contractor) be incorporated in the contract. Further usefulness of this technique is

evident from the value engineering workshop conducted at Nespak Headquarters Lahore for review of a design for a Saudi German Hospital at Abha, KSA which resulted in initial and life cycle cost savings of 20 % of the total cost. Additional discussion on this is given in this study. The research recommends a more collaborative effort towards promotion of value engineering technique in the construction industry in an effort to increase value for money invested.

Table of Contents

Acknowledgements	iv
Abstract.....	v
Table of Contents.....	vii
List of Figures	ix
List of Tables.....	x
1 INTRODUCTION	1
1.1 GENERAL	1
1.2 SIGNIFICANCE OF STUDY	3
1.3 OBJECTIVES	4
1.4 ORGANIZATION OF THESIS.....	4
2 LITERATURE REVIEW	6
2.1 INTRODUCTION	6
2.2 HISTORY OF VALUE ENGINEERING	6
2.3 TRADITIONAL COST CONTROL METHOD	8
2.4 BRIEF ON VALUE ENGINEERING	8
2.5 VALUE ENGINEERING IN CONSTRUCTION INDUSTRY	10
2.6 FACTORS THAT ENCOURAGE THE APPLICATION OF	
VE IN CONSTRUCTION INDUSTRY.....	15
2.7 HOW VALUE ENGINEERING IS DONE.....	17
2.8 WHEN TO APPLY VALUE ENGINEERING	20
2.9 A WORD ON FUNCTION ANALYSIS TECHNIQUE	24
2.10 WHY DESIGNERS CAN NOT DO VE.....	25
2.11 MISUNDERSTANDINGS ABOUT VE.....	26
2.12 SUMMARY	28
3 METHODOLOGY	29
3.1 INTRODUCTION	29
3.2 QUESTIONNAIRE DEVELOPMENT	31
3.3 SAMPLING	31
3.4 DATA COLLECTION	32
3.5 DATA ANALYSIS STRATEGY	34
3.6 RELATIVE IMPORTANCE INDEX FOR INTERPRETATION OF RESULTS ...	34
3.7 LIMITATIONS	35
3.8 SUMMARY	36

4 RESULTS AND DATA ANALYSIS	37
4.1 GENERAL INFORMATION.....	37
4.2 ASSESSING GENERAL AWARENESS OF VE.....	39
4.3 ASSESSING CURRENT STATE OF VE & UTILITY FOR PAKISTAN.....	41
4.4 ASSESSING FACTORS HINDERING IMPLEMENTATION OF VE	43
4.5 ASSESSING MISCELLANEOUS RESPONSES.....	45
4.6 INTERPRETATION OF RESULTS FROM DESCRIPTIVE STATISTICS.....	48
5 DISCUSSION	49
5.1 INTRODUCTION.....	49
5.2 DISCUSSION ON GENERAL INFORMATION OF RESPONDENTS	50
5.3 DISCUSSION ON GENERAL AWARENESS ON VALUE ENGINEERING	51
5.4 DISCUSSION ON ASSESSING STATE OF PRACTICE AND UTILITY FOR PAKISTAN.....	52
5.5 DISCUSSION ON ASSESSING HOLD BACK FACTORS OF VE	
FOR PAKISTAN.....	53
5.6 A REFERENCE OF A SUCCESSFUL VE WORKSHOP.....	54
5.7 SUMMARY	55
6 CONCLUSION & RECOMMENDATIONS	56
6.1 INTRODUCTION.....	56
6.2 CONCLUSION	57
6.3 SUGGESTED GUIDELINES IN REGARDS TO VE	57
6.4 RECOMMENDATIONS	59
References	61
Appendix 1: QUESTIONNAIRE SURVEY	64

List of Figures

Figure 2-1:	Conventional vs VE approach.....	10
Figure 2-2:	Life Cycle Costs for typical Residential and Office Building.....	13
Figure 2-3:	Seven most significant factors responsible for Savings Actions	14
Figure 2-4:	Three Phases Of VE	18
Figure 2-5:	Seven Phases of the VE Job Plan	19
Figure 2-6:	Major decision makers influence on Facility Costs.....	22
Figure 2-7:	Potential savings from VE applications.....	23
Figure 3-1:	Research Methodology Flow Chart.....	30
Figure 4-1:	Bar chart showing designation of respondents.....	38
Figure 4-2:	Bar chart showing project locations	39
Figure 4-3:	Respondents desire to implement VE on projects	46
Figure 4-4:	If respondents recommend a VE certified person in design team	46
Figure 4-5:	If respondents recommend VE study clause and carrying out VECp in contract....	47

List of Tables

Table 2-1:	Typical VE Study Process.....	20
Table 2-2:	Examples of Functions	24
Table 2-3:	Comparison between putting & performing Value Engineering	28
Table 4-1:	Type of firms responding to questionnaire.....	38
Table 4-2:	Frequency of respondents aware of VE.....	39
Table 4-3:	Where did respondents learn about Value Engineering	40
Table 4-4:	Perception about VE by respondents and analysis	41
Table 4-5:	No of respondents ever applied VE	42
Table 4-6:	Data showing Number of Projects on which Respondents Applied VE	42
Table 4-7:	Factors assessing utility of VE for Pakistan and analysis	43
Table 4-8:	Factors that hinder implementation of VE and analysis of data.....	44

INTRODUCTION

1.1 GENERAL

VE (Value Engineering)/VM (Value Management) has been applied in different countries, regardless of whether countries are developed or developing with different degree of success. VE/VM focuses on value rather than cost and seeks to achieve an optimal balance between time, cost and quality (Kelly, Male et al.2004) as it provides a method of integration in the building process that no other management structure in construction can provide (Kelly and Male 1991). It also explores the functional requirements of a project and seeks overall optimization accordingly (Shen 1995). In the developed countries like the United Kingdom, United States and Australia, the success of applying value management to construction projects is very high. In fact its applications have been backed by laws in some of the developed countries (Olanrewaju and Khairuddin,2007).

Value Engineering can be defined as the process of relating the functions, the quality, and the cost of the project in the determination of optimum solutions for the project (Dell'Isola 1988). It is a process whereby team efforts are made to understand the functions of a system in order to realize the essential functions of that system at the lowest possible life cycle cost (Yonker 2003). Although value engineering has its origin in the manufacturing industry, its methodology has been well developed for use in the construction industry (Dell'Isola 1988).

A VM study generally encompasses three stages: pre-workshop, workshop and post workshop. The workshop stage is normally conducted in a structured and disciplined

procedure with six phases, namely: information, function analysis, creation, evaluation, development and presentation (SAVE International 2007). VM studies are normally conducted at the early stages of construction projects by the key stake holders of the projects. Successful VM studies in construction should clarify the clients objectives, improve communication with stake holders, and stimulate creativity through the interaction of participants of the VM study (Lin and Shen 2006).

Value Engineering can be said as a pro-active, creative problem solving tool which is a strategic approach to achieving maximum value in a project consistent with the organizations broad business goals. It is a structured team approach to problem solving and reducing costs that can be applied during the objective setting, concept, design and construction stages and the ongoing management of buildings (SAVE, 2006). A Value Engineering exercise aims to achieve optimum value by providing the necessary functions at the least cost without affect to required quality and performance.

The benefits of applying Value Engineering are achieving better value of money in satisfying the customer's need, saving in project cost by elimination of unnecessary cost, better understanding of project's objectives, enhancing the function of the project, improved teamwork among the construction professional, and enhanced creativity through interaction of different professionals and external experts in the construction field.

Value Engineering remains a topic least understood by stake holders in the Construction Industry of Pakistan. Often one gets to hear terms, "but we already do it", "what's the big difference" and alike. Now, what Value Engineering does or strives to do, is only fruitful when practiced in a correct fashion i.e.; the most common methodology worldwide is employing value engineering through independent value engineering consultants, since if practiced by their own design team, they might have inherent vested interests in following a particular design. Moreover, most design departments these days,

are becoming too pre occupied or lethargic to introduce and take up new concepts. They tend to follow a particular theme, a set pattern, or similar kind of solutions in all their designs. Unlike that, Value Engineering practicing people keep a watch on all latest and non-traditional solutions to any kind of need arising. Abreast with knowledge on latest trends of market, knowledge on available products and coupled with sufficient knowledge to produce a most cost effective solution considering life cycle costs is probably the sole reason our Construction Industry needs to switch over to using services of Independent Value Engineering Consultants.

The objectives of research were simple i.e.; firstly to assess degree of understanding of Value Engineering, further to evaluate current state of Value Engineering carried out on construction projects, and finally to assess the irritants which bar promulgation of this useful technique from being adopted in our Construction Industry. During interviews with clients, owners, and Project Managers, it was also endeavored to know if they placed a Value Engineering Clause in their Contracts and whether or not they invited Value Engineering Change Proposals with price sharing with Contractors.

With all industries striving to form standardization in their procedures, the Construction Industry is no exception. FIDIC 99 has categorically advocated Value Engineering Clause in Contract Documents. With our stake holders, likely to keep pace with changing trends in Construction Industry worldwide, they must understand and practice this useful technique as practiced elsewhere world over.

1.2 SIGNIFICANCE OF STUDY

Traditionally, construction projects in Pakistan have been developed by generating a program of needs, or hiring consultants to develop necessary design and drawings and then commencement of construction project by contractors. This may satisfy manager's requirements to control cash flows and timely completion of various project activities;

however there is no program to implement any kind of value assurance or quality control to any of the processes of construction activity. Value Engineering /Value Management fills that gap.

Construction engineering management is an emerging trend in construction industry of Pakistan. At present, general project management techniques i.e., standard project management processes and tools targeting project management body of knowledge, are not fully utilized in construction projects in the industry. The research focuses on clarifying the value engineering concepts and practicality in the construction industry of Pakistan. Furthermore, the research aims to rationalize and recommend the involvement of value engineering consultants in construction projects.

1.3 OBJECTIVES

Value Engineering has a tremendous success rate worldwide and is being widely practiced. It is pertinent to know, what is the level of awareness of this technique in Pakistan, what is the prevalent perception about it and if it is non-prevalent here, then why this excellent project management tool couldn't flourish in Pakistan's construction industry. With these factors in background, the major research objectives include;

- a. Assess the degree of understanding of Value Engineering among the stake holders of Pakistan Construction Industry.
- b. Assess the current state of Value Engineering practices on Construction Projects and its utility for Pakistan.
- c. Identify critical delay factors for implementation of Value Engineering techniques.

1.4 ORGANIZATION OF THESIS

This Thesis has been organized into six chapters. Chapter 1 is 'Introduction.' It explains in general, the concept of Value Engineering, why the need was felt for this

study, the importance of the study for Construction Industry of Pakistan and the Objectives behind this study.

Chapter 2 is ‘Literature Review.’ It explains the secondary data related to study in a logical sequence. It explains to readers, the history of Value Engineering, especially emphasizing the role of value engineering in construction industry, how value engineering is done and thereafter a few misunderstandings about the value engineering technique.

Chapter 3 is ‘Methodology’ of research. It explains how the research was conducted to obtain our primary data, how the questionnaire was developed keeping our objectives in view, how the sample size was determined, and who were our target respondents and the rationale for their selection. Finally, it explains how the collected data was analyzed to produce results.

Chapter 4 is ‘Results and Data Analysis.’ After giving a general overview of the technique, it provides graphical presentation as well as tables concerning compilation of our data. It concludes with interpretation of analyzed data for our objectives.

Chapter 5 is ‘Discussion.’ It discusses in detail how our objectives were achieved from using our analyzed data. It explains how our collected and analyzed data was interpreted to produce the results which interpret achievement of our objectives.

Finally, Chapter 6 is ‘Conclusions and Recommendations.’ This discusses the results from our study and how they affect the construction industry of Pakistan in general and provides recommendations addressing future studies that can be taken for further research purposes. A few suggested guidelines are also made part of this chapter which are postulated by the author from our primary and secondary data and represent the opinion of author on the subject.

LITERATURE REVIEW

2.1 INTRODUCTION

Projects procured on a low bid basis may save an owner a small amount on up front design costs but can lead to significantly higher construction costs and higher operating and maintenance costs (ACEC,2004 P6). The term Engineering is described by Watson (2005) as being derived from the Latin *ingeniousus* meaning to be skilled, the word Value being relative. Sperling (2001:46) adds $Value = Function / Cost$ and contends ‘improving value means enhancing function or reducing cost or both.’ Kelly and Male (1993) describe Value Engineering as a philosophy supported by technique rather than absolute method or set of rules. A basic concept of Value Engineering is that each element of cost must add commensurate user function (Miles 1968).

Value Engineering - which has been the subject of much study and consideration and has been defined in many ways - is an organized approach to identifying and eliminating unnecessary costs which urges a complete analysis of a use of a service or a product rather than simply its engineering attributes (Watson 2005). Value Engineering also plays a significant role in pulling together a complete construction team making them more effective and more efficient - a benefit which cannot be over looked (Boorman 2009).

2.2 HISTORY OF VALUE ENGINEERING

The concept of Value Engineering can be traced back to the World War II era. Mr. Lawrence D Miles is generally credited with being the inventor of the Value Engineering technique. Mr. Miles was an employee of General Electric, who was, at that time

providing defense related stores to the American Army. Due to their enhanced demand, General Electric was facing problems in meeting the supply requirements. Miles thought and analyzed the problem. He realized that users are always satisfied with the functionality of what they get, not use alone. Things should always satisfy the basic function for why they are procured while secondary functions are an added advantage to users. This became the back bone of what came to be known as 'value methodology.' Mr. Miles understood that products are purchased for what they can do – either through the work they perform or the pleasing aesthetic qualities they provide. Using this as his basic philosophy, he focused on understanding the function of the component being manufactured. He questioned whether the design could be improved or if a different material or concept could achieve the function.

Acknowledged as 'the father of value analysis' by Fletcher and McClintock (2004:554) and Wixon (1999), Lawrence D Miles conceived the concept to overcome scarcity of materials during World War II while he was employed as an engineer with General Electric in the early 1940's (Davis, 2004). Value Engineering is not cost reduction, reduction of quantities, cheaper materials or lower standards; nor is it quality control or a design review. It is the analysis of function focusing on the elimination or modification of elements that add cost without contributing to the function required (Jergeas and Revay, 1999).

Later, the U.S. Army as well as Navy actively took up the concept. Thus, slowly and gradually the idea refined its shape. From the Manufacturing sector, Value Methodology travelled to the Construction Industry. Thus, the legacy of Mr. Miles lives on today. Value Methodology, is known today as an important Project Management tool that is used to optimize the value of a project or product.

VE/VM is defined as an organized, systematic, and multidisciplinary team process,

which analyze the functions a project is required to perform for the purpose of achieving best value for money invested (Olanrewaju and Khairuddin, 2007).

2.3 TRADITIONAL COST CONTROL METHOD

Basically, the traditional cost control method is defined as the control of the cost of project that includes the collection, measurement of the project cost and reporting the weekly progress. The main objectives of this method are as follows :

- a. To achieve the optimum profit by finishing the project on time as scheduled, or earlier, without affecting the required quality.
- b. To obtain a report at every stage of the construction progress to compare with the target profit or to identify the risk of loss.

Although this approach seems to have been working satisfactorily, much improvement can still be made. These are some of the disadvantages of this cost control method:

- a. Nobody in the design process has the authority to comment on the efficiency of design or even to make suggestions on the improvement of design.
- b. It is not function oriented.
- c. It does not include a group of participants with opportunity to contribute.
- d. Seldom includes the client.
- e. Seldom includes the external group of professionals to evaluate.
- f. Seldom considers Life Cycle Cost implications of the chosen design.
- g. It doesn't have decision making tools and techniques like Value Management uses with its Job Plan methodology.

2.4 BRIEF ON VALUE ENGINEERING

A Value Engineering (VE) study is the formal application of value methodology to

a project in order to improve its value. The application is also referred to as value engineering (VE), value analysis, value planning or value management (VM). VE/VM focuses on value rather than cost and seeks to achieve an optimal balance between time, cost and quality (Kelly, Male et al. 2004).

Traditionally, construction projects have been developed by a set of needs. This is done by using in house persons to develop the project's basic requirements and outside consultants to make design and contract documents. Projects so procured and built, usually satisfy manager requirements to control flow of cash and progress of construction, but leaves very little room for adding value to the project. It also fails to identify a dedicated parameter to check against quality control. Value Methodology is the solution to that problem.

A central feature of Value Engineering/Value Methodology is to get all stake holders very clear about the project. At the end of a formal value methodology session, all stake holders will understand all aspects related to design and function. As these are well discussed and agreed upon, it brings quality control to what is eventually designed and built. As already discussed, value engineering focuses on functions. Mathematically,

$$\text{Value} = \text{Function} / \text{Cost}$$

Where, functions are the expectation of users,

While, cost is what the user is ready to pay.

From the above you can see that either increasing function, or decreasing cost, results in increased value of a product. Value Methodology, thus can be described as a formal application of knowledge of value study on a project in order to maximize its value. It is done by a dedicated team of experts whose energies are coordinated and controlled by a Value Specialist. Hence, through focusing on functions and not design alone, through considering Life Cycle Cost and not initial cost alone, this team arrives at a

solution that brings best value for the client. VE generates these cost improvements without sacrificing needed performance levels. A wide range of companies and establishments have used VE effectively to achieve their continuous goal of improving decision making.

Hence, the traditional approach is that of individual efforts of client, designer, Project Manager, engineer and Builder while the Value Engineering approach is a dedicated effort of a team which brings concerns of all on board and brings out a solution to provide required functions that are acceptable to all.

2.5 VALUE ENGINEERING IN CONSTRUCTION INDUSTRY

Value Analysis (the technique designed to improve value without sacrificing function) was introduced into construction by U.S. Military around 1963 where its success lead it to be taken up by other agencies and departments (Cheah and Ting 2005). Around the same time in the early 1960's Alphonse Dell'Isola is accredited with introducing the value engineering concept into the American Construction Industry (Fong and Shen 2000). To understand the Conventional versus Value Engineering approach, see Figure 2.1.

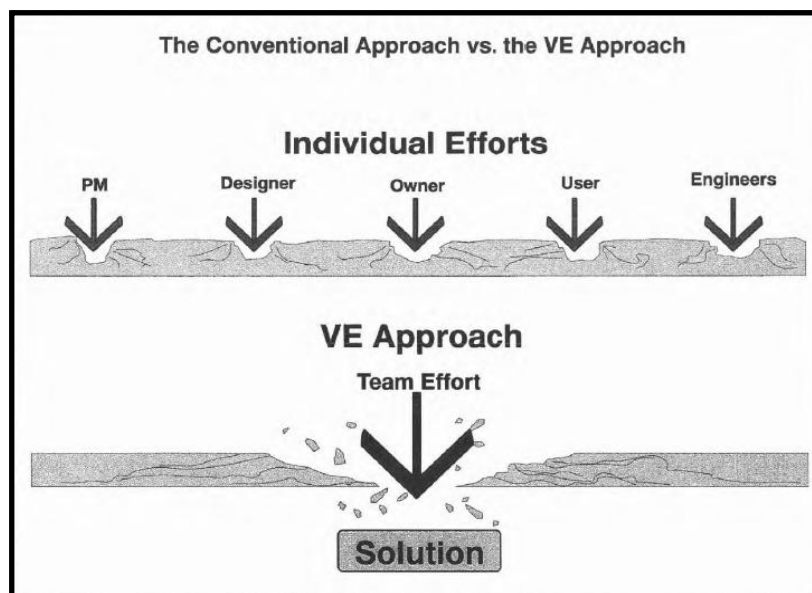


Figure 2-1: Conventional vs VE approach

Adapted from (Dell'Isola 1982)

Value engineering as applied in the construction industry, is a combination of heuristic and scientific techniques used to analyze either a building system, building material, or a construction method. Using systematic investigative techniques, proposed design and construction methods for a project are evaluated to identify any methods or features that could possibly be eliminated or modified to achieve the lowest possible life cycle cost (Dell Isola, Value Engineering practical applications).

Value Engineering can be applied at any stage during the life of a project, however it is proven that the earlier it is applied, the most beneficial would it be. Since, value engineering focuses on functions and not cost alone, it strives to get a balance between time, cost and quality for a project. Value Engineering has been applied at many countries worldwide, regardless developed or developing, with varying success rates. However, generally, value studies have resulted in at least 10% reduction in construction cost worldwide. Most facility owners would identify long term profitability as their main objective. They would also quickly point out that high quality and competitively priced facilities, products or services are essential to achieve this goal. Of course, these must be produced economically in quantities consistent with demand. The coordination and communication necessary to accomplish these complex and seemingly conflicting tasks are often difficult to achieve. To keep pace with the ever changing business climate, companies must better utilize their most important resource - their people. This has been demonstrated through the recent quality revolution experienced in companies in many advanced countries.

Management has learned that once personnel are involved in decision making process and committed to a goal, significant improvements can be realized. The quality revolution has demonstrated that waste and inefficiency are unacceptable anywhere within the organization. Also, companies have learned that they must offer users products and

services that satisfy their needs in a timely and responsive manner. Responsible decision makers have realized that they must better meet owners / users needs at optimum value (Dell Isola, Value Engineering practical applications).

VE can play a critical role in managing value to meet these goals. It can provide the networking required for improving coordination and communication. In other words, VE facilitates management of both value and costs. Using the VE methodology will result in improved profit, and it will continue to pay dividends for years to come. How much importance do we give to the most important aspect in the life of a building i.e., its design? It can be depicted through the following Figure 2.2 - merely a 1 % expenditure on design shows that the element most important is most neglected;

The VE technique can be used to achieve a number of objectives. It can solve problems; save money; reduce time; and improve quality, reliability, maintainability, and performance. VE can also make contributions to improve human factors, such as attitudes, creativity and team work.

The main objective of VE is to improve value and VE techniques can overcome many of the roadblocks to achieve good value. Unnecessary costs that lead to poor value are generally caused by one or more of the following:

- a. Lack of information
- b. Lack of ideas
- c. Temporary circumstances
- d. Honest wrong beliefs
- e. Habits and attitudes
- f. Changes in owner requirements
- g. Lack of communication and coordination
- h. Outdated standards and specifications

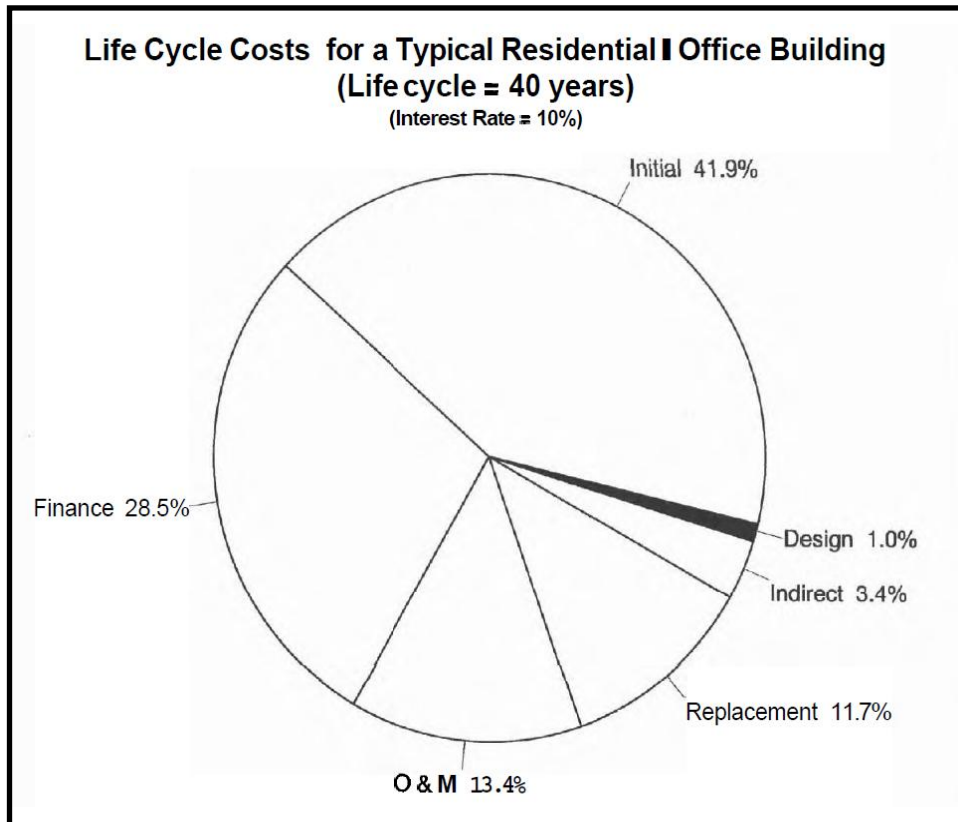


Figure 2-2: Life Cycle Costs for typical Residential and Office Building
 Adapted from (Dell'Isola 1982)

Each reason for poor value provides an opportunity for improved decision making and an area where value engineering effort is appropriate. In the developed countries like the United Kingdom, United States and Australia, the success of applying value management to construction projects is very high. In-fact, its applications have been backed by laws in some of the developed countries (Olanrewaju and Khairuddin,2007). In the U.S., Society of American Value Engineers (SAVE International) is entrusted with training professionals to carry out value study of projects. SAVE International, has its local chapters worldwide. In Japan too, value study for projects is an active program. In fact, in few countries, Value Engineering is mandatory once the cost of a project exceeds a certain threshold limit. In India too, an active Value Engineering program is running since 1977.

The use of Value Engineering in United States expanded widely in 1993 with the

introduction of two bills making the process mandatory on all government programs (Fong and Shen 2000). In 1996 President Clinton signed into law an act obliging all executive agencies to establish value engineering procedures - the estimated savings from 1996 alone were forecast at \$ 2.19 B (Elias, 1998).

In the United States, to ensure that the active involvement of designers in the value engineering, their design fee (which is based on the estimated contract amount) is generally not reduced in line with any reduction in the contract amount resulting from a value engineering study (USGSA 1992). The seven most significant factors responsible for savings actions are illustrated as per Figure 2.3.

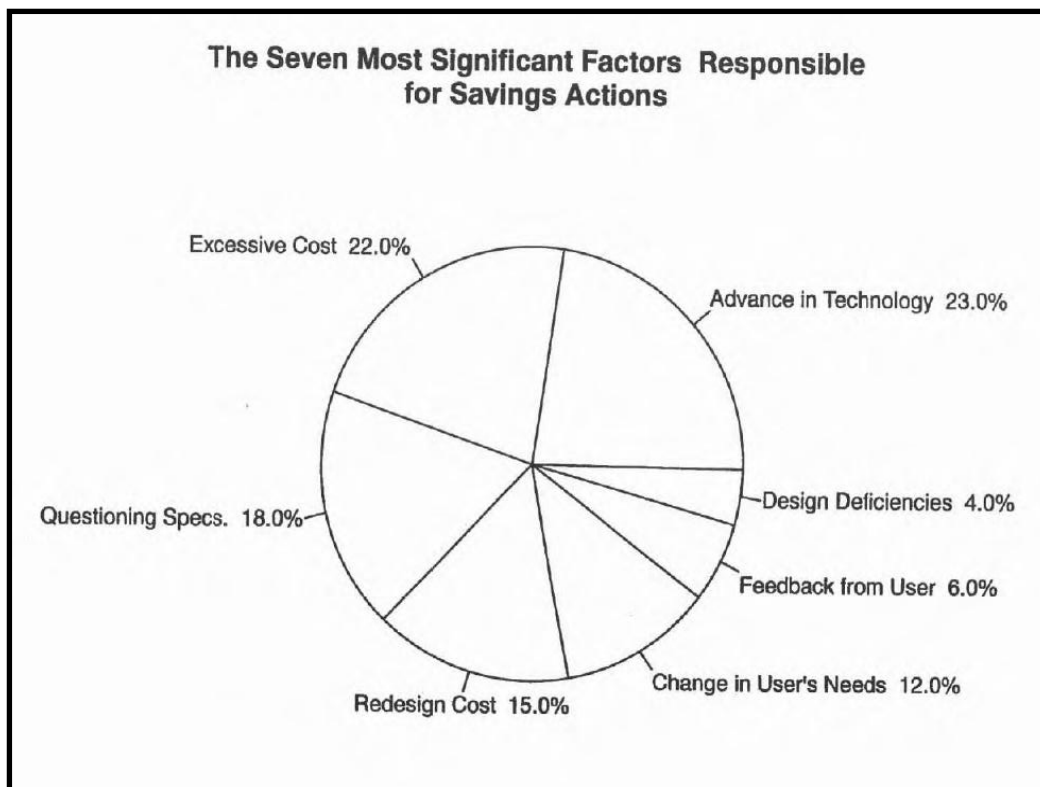


Figure 2-3:Seven most significant factors responsible for Savings Actions

Adapted From (Dell'Isola 1982)

It clearly depicts that if we want to get better value in construction activity, we will have to cut off the excessive cost owing to redesigning, we will have to get feedback from users and we will have to adopt advancement in technology. All such actions refer to performing Value Engineering for construction.

2.6 FACTORS THAT ENCOURAGE THE APPLICATION OF VE IN CONSTRUCTION INDUSTRY

- a. To achieve optimum value of money in satisfying the customer's needs :

The decision to build, refurbish or extend premises or facilities involve a huge investment of time, effort and money. The need to use Value Engineering to achieve construction customer requirements and reach the optimum value for money is the first step in understanding the use of Value Engineering for the construction customer, their consultants and contractors.

- b. Elimination of un necessary cost :

The traditional cost planning approach has its defects and every design contains a certain amount of unnecessary cost which does not contribute to required functions in the proposed project. In order to minimize this unnecessary cost, value engineering should be applied.

- c. Enhance the function of a project

Value Engineering has the general aim of giving the client, value for money. But it focuses upon functions and finds alternative ways in which these functions can be performed. It will question the part of cost which does not contribute to required function for example, the unnecessary cost for supporting or unwanted functions that are wasting money.

- d. Reduce the cost of a project without adversely affecting the quality or performance of the project:

Value Engineering is an effective process which has led to millions of dollars in project cost savings by selecting the right decision to perform while maintaining or improving the quality or responsiveness to client's priorities.

- e. Improved team working :

Another major consideration is that value engineering is a team oriented approach which ensures effective pooling of expertise. Besides improving design efficiency, all professionals can contribute to generate the ideas for solutions to the problems.

- f. Encourages creative thinking :

One of the strong aspects of value engineering is that it is a tool that encourages creative thinking since one of the stages of value engineering job plan is the speculation or creative stage to develop a large amount of ideas for performing the function selected for study.

- g. Better understanding of project objectives:

For a construction project, it is necessary to identify and understand what the priorities of the project's objectives are. Either to reduce the project cost, finish the project within the contract period or maintain or enhance the quality or performance of the premises or structure. This will be achieved with the existence of an opportunity for the client to formally participate in key design and planning decisions during a value engineering session.

- h. Identifies the projects constraints or problems:

Besides these, a further benefit is that when implementing a value engineering study, it is possible to identify project constraints or problems and to develop

strategies to manage those problems that happen at any stage in the construction process from the feasibility to the construction stage.

i. To arrive at a more effective design:

One of the benefits of implementing value engineering is better understanding of the customer's specific needs, in simple clear terms. This enables the value engineering team to consider all options, alternatives or innovative ideas to produce a more effective design to achieve the optimum value for money in satisfying the customer's requirements. In addition, all professionals are allowed to make suggestions to create solutions for the more effective design.

j. Existence of a Value Engineering manual:

Since 1947, the application of Value Engineering has greatly increased around the world and it still continues to expand. A 'value engineering manual/standard' has been introduced by SAVE International Professional Certification Board that defines the common terminologies, it includes the standardized job plan, methodology, typical profiles of the value manager, value specialist, duties of a value management team and glossary etc. The manual can be used by value engineering team to perform value engineering study for any construction project (John Bryant, 1998).

2.7 HOW VALUE ENGINEERING IS DONE

Value Engineering is done in three steps i.e., pre-study, VE Work shop and post study activities (as shown in the following Figure 2.4). Each has specific activities in order to complete a Value Study for a particular project. The essence of value study being the function analysis phase, this is what differentiates it from typical design reviews or cutting cost of an over budgeted project.

The pre-study phase consists of coordination, data preparation, team selection and

modelling activities. This phase is basically the preparatory phase during which a team is selected appropriately keeping in view the task at hand.

The VE Workshop phase is the essence of a value study. The typical steps of the VE workshop consist of Information, Function Analysis, Idea generation, Evaluation, Development and Presentation. During this phase, detailed information is gathered about project, functions/desires of client are listed and then starts the heart of VE, the function analysis.

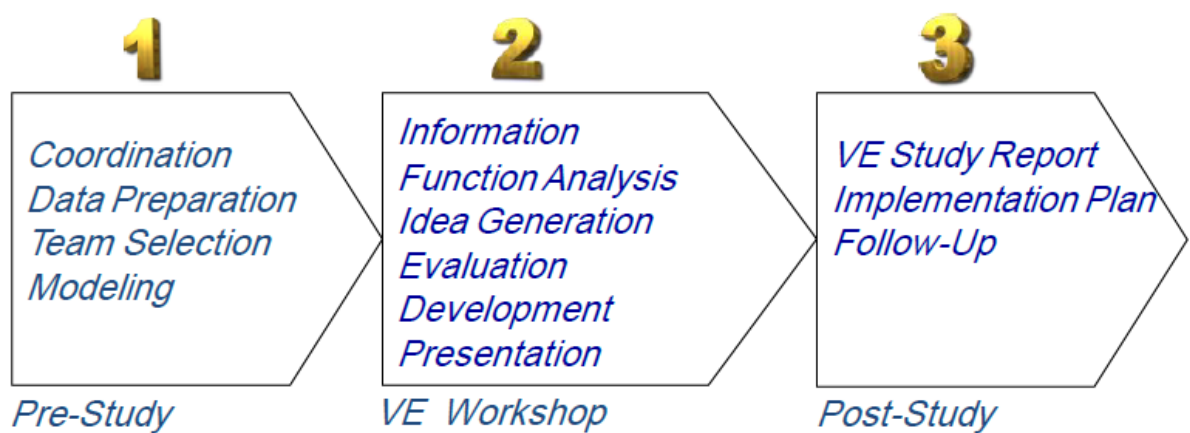


Figure 2-4: Three Phases Of VE

During this activity, functions and not uses of intent of construction are studied. Each activity is broken down to an active verb and a measurable noun. For example, one function of a house is to ‘shelter inhabitants.’ Now if that be the function we are building for, what else can accommodate that function. Then comes the brain storming session, the generating of ideas for required basic and secondary functions, followed by life cycle and maintenance costing of each. During Evaluation and Development Phases, only the few, practical and most pertinent solutions are selected and presented.

Thus, the Value study, due to function analysis and brain storming techniques, brings a solution to the problem at hand, that is acceptable to all stake holders. It defines very clearly, the scope of the project, hence striking a balance between time, cost and

quality, the prime focus of Project Management.

Function Analysis incorporates the customer's perspective and establishes the value they place on each function to determine precisely where cost reduction can be achieved. Dell'Isola (1982) points out that traditional cost reduction efforts concentrate on making the same item, only cheaper. Function Analysis involves thinking why an item is necessary. Being function oriented rather than item oriented leads to a more creative solution to users needs.

It is acknowledged by many studying in the field of value engineering that projects which undergo function analysis and whole life costing studies, frequently see cost savings in the region of 10-30 %. In context with the construction industry, that can amount to 10-25 % of the country's total GDP. This is a major area where significant rationalization can be achieved. The Value Engineering Job Plan (as shown in Figure 2.5) and its phases may be illustrated in the figure ahead :

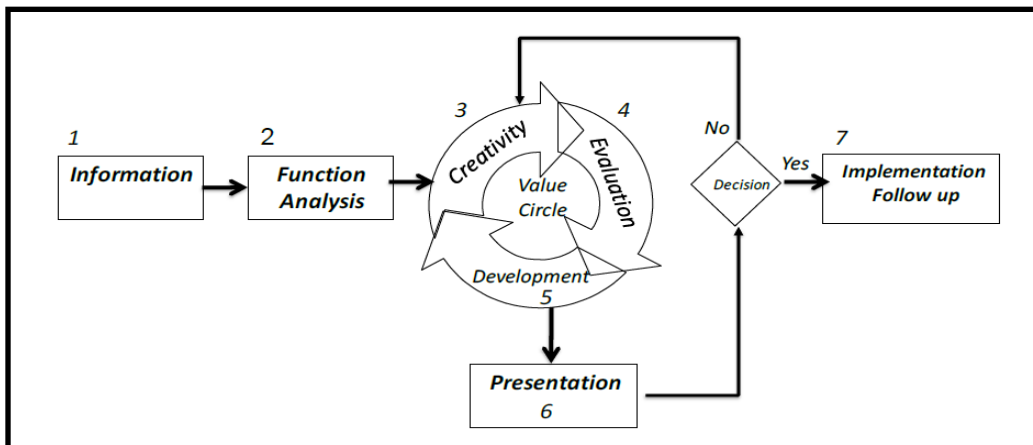


Figure 2-5: Seven Phases of the VE Job Plan

Adapted from (Al-Yousefi)

Let us now understand how the complete process of initiation and performance of Value Engineering for a construction project takes place. The same is as illustrated in the following Table 2.1. The table shows a logical sequence of Value Engineering Performance and actions of various stake holders i.e., participants and milestones.

Table 2-1: Typical VE Study Process

I. Pre Study Phase				
Owner	VE Consultant	Owner	Design Consultant	VE Consultant
Incorporate scope of service in VE contract Advertise VE procurement	Identify team members Submit team qualifications and cost proposal	Select VE consultant	Provide design data Approve VE changes	Schedule VE study Prepare models Distribute data
II. Study Phase				
Team coordinator	Design consultant	VE team	Owner	Design Consultant
Assemble and lead VE study team	Brief VE team Review VE ideas Attend VE team briefing	Conduct VE study Prepare VE proposals Present VE proposals	Brief VE team Review VE ideas Attend VE study presentation	Comment on Teams presentation
III. Post Study Phase				
Team Coordinator	Design Consultant	Owner	Design Consultant	Team Coordinator
Prepare draft report	Comment on each VE proposal	Review VE report	Implement approved VE changes	Prepare final report (optional)
		Review designer comments		
		Approve or disapprove each VE proposal		

2.8 WHEN TO APPLY VALUE ENGINEERING

A great idea for adding value to a project is not so great when it requires the whole team to back up and start over again (Kirk et al, 2002 : 6). VE should be performed as early as possible – before commitment of funds, approval of systems, services, or designs – to maximize results. The potential for savings, as illustrated in Figure 2.7 ‘Potential savings from VE application,’ is much greater the earlier VE is applied. When VE is

applied later, two things increase: the investment required to bring any changes, and the resistance to change.

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 savings being realized by the client will not have to be shared with the contractor. Consulting engineers will find that 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).

The Figure 2.6 'Major decision makers influence, on facility costs,' shows whose decisions have the most influence over the expenditure of funds during the life cycle of a facility. The owner and consultant are the major decision makers. To ensure optimal results, it is essential to involve owner and consultant in the VE process. Regarding total cost of a facility, the consultant fee represents the smallest expenditure of all the initial costs. Consultants' decisions influence about 50 % of the facility's total costs. Therefore the optimal results can be expected when resources are set aside for VE early in the design process, focusing on owner and consultant impact.

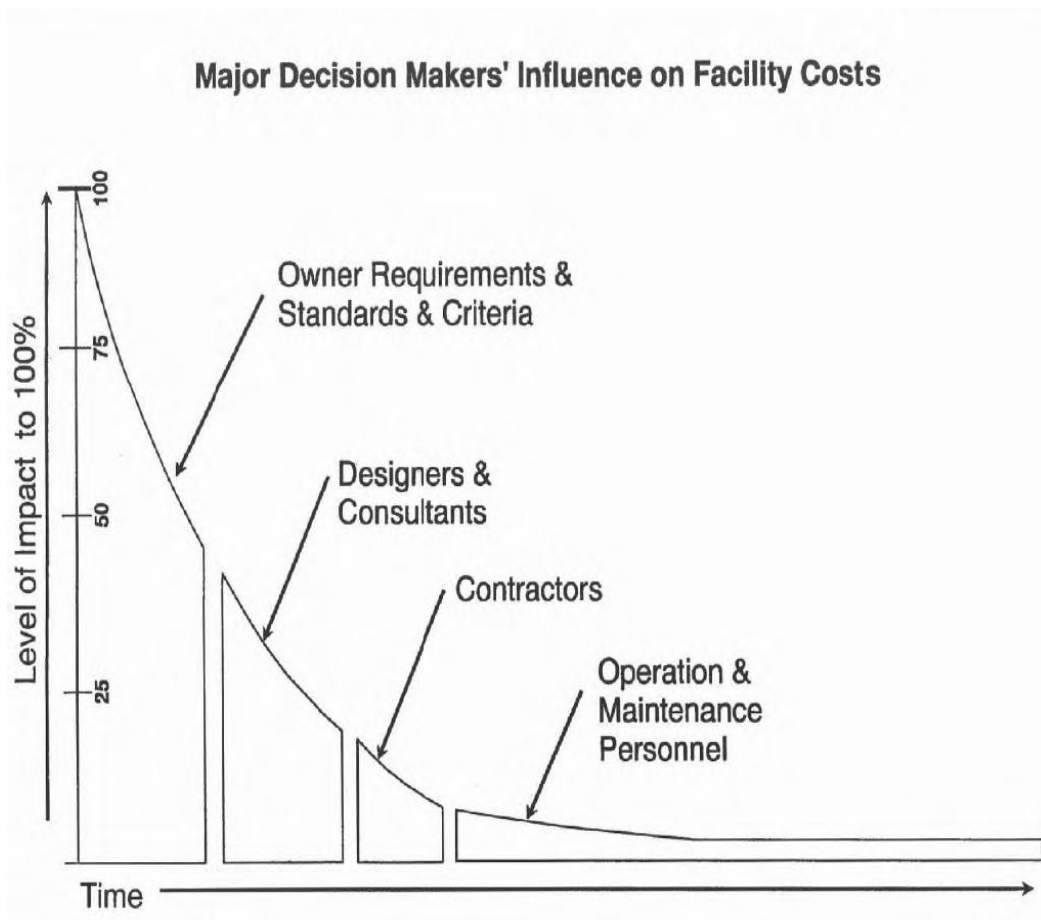


Figure 2-6: Major decision makers influence on Facility Costs

Adapted from (Dell'Isola 1982)

Owners who delight in squeezing design fees invariably promote poor value design decisions. Prudent expenditure during design to improve design decisions can return significant initial and follow on cost and quality improvements (Alphonse Dell Isola, Value Engineering Practical Applications).

It is known through experience that maximum potential of savings from a VE study can only be achieved when it is done in the initial Planning and Analysis stage of a project. It doesn't mean that VE study remains useless in an advanced stage of a project even though the cost of implementing any change as a result of VE study increases as the

design advances. One must balance the cost of the VE study with the potential for implemented savings when a project advances ahead of planning stage, hence maximum benefit of a VE study can be accrued once it is undertaken in the initial planning and analysis stage of a project. The same is illustrated as per Figure 2.7:

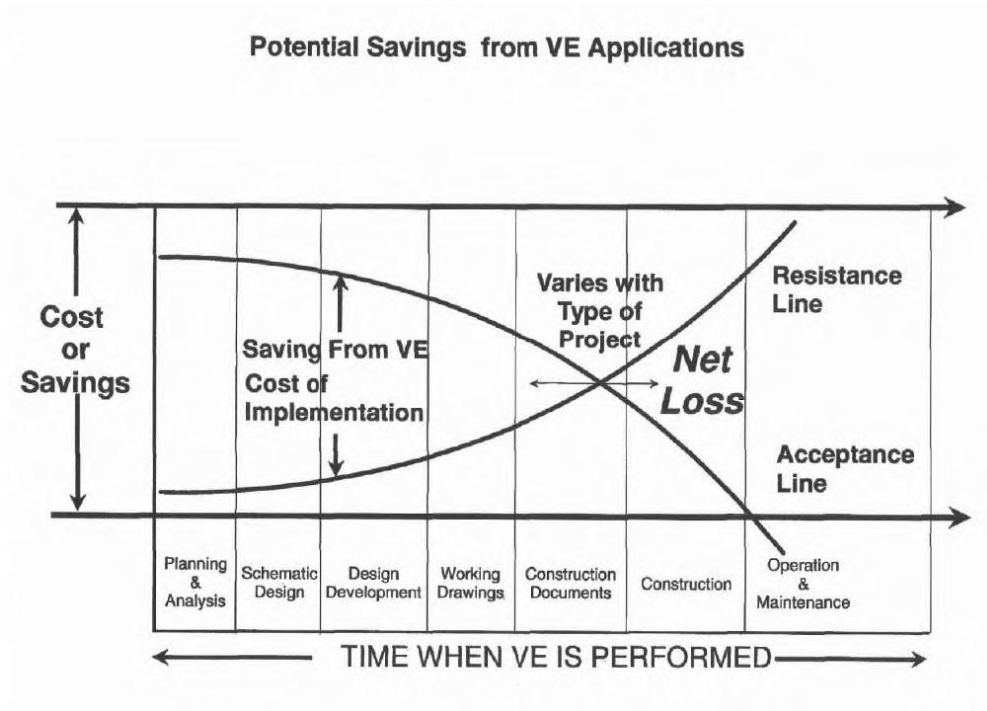


Figure 2-7: Potential savings from VE applications

Adapted from (Dell'Isola 1982)

The Value Engineering study can almost be undertaken at any stage during the life of a project. However, it is known that the earlier it is undertaken, the more beneficial it would be. In an ideal situation, the first VE Study (VE 1) should be undertaken at design and concept planning stage to review project goals, functions, facility configuration and site adaptation. The second VE Study (VE 2) should preferably be undertaken at 15-30% of design stage to review selected building systems and system computations. The third VE Study (VE 3) is applied at about 80-85% of design to review selected material schedules, hardware schedules, equipment schedules, standards, and specifications, and make sure that VE Proposals of VE 2 are properly implemented.

2.9 A WORD ON FUNCTION ANALYSIS TECHNIQUE

The acknowledged foundation of the Value Engineering methodology and the key activity that distinguishes the value engineering methodology from other problem-solving or improvement practices is function analysis (SAVE 2007). Function Analysis, an essential feature of the value management methodology is considered to be a promising method of expressing client requirements by providing the precise description of client requirements in a structured framework thereby enabling a clear definition and identification of client/user objectives and necessary functions (Shen et al 2004).

The technique of stating function using the verb-noun abridgement forces conciseness, assists in reading a problem to its fundamentals and ensures only one function is defined at a time. It also aids in distinction between basic and secondary functions and leads to a broad level of disassociation from previous any solutions that is necessary for an effective study (Dell'Isola, 1982).

Function, is the original intent or purpose that a product, process or service is expected to perform. It is expressed in a two word active verb - measurable noun structure. Few of the examples of this abridgement of active verb - measurable noun abridgement can are shown in Table 2-2.

Table 2-2: Examples of Functions

Products	Design Construction	Services
Furnish Power	Furnish Space	Establish Criteria
Contain Liquid	Vary Shape	Validate Action
Protect User	Reduce Creep	Communicate Information
Reduce Effort	Support Roof	Translate Information
Control Temperature	Support Load	Receive Results
Vary Capacitance	Establish Grade	Verify Compliance

2.10 WHY DESIGNERS CAN NOT DO VE

Designers do not do VE because they are not trained in the techniques nor paid to do it as part of their design process. VE entails carrying out function analysis and it entails calculating Life Cycle Cost.

Though, a general perception prevails in our country that designers carry out in house value engineering. But in fact, what they are carrying out is either alternate design reviews or a sort of in house peer review, to bring variety to their work.

Designers never work on the philosophy behind Value Methodology. Even an in house VE effort does not prove to be very useful because in house VE is often done by their own design team. The original design team has their own vested interests in preparation of the design, and mere critique by members of own team negates the essence of Value Methodology. It is for this reason, Value Study stresses getting the study done through Independent Value Engineering consultants, who cannot have bias views towards the interests of either party. Their motto is to bring about best value for money to be invested. Often the reaction of designers to a value engineering study is that,

- a. either, the client is questioning his/her professional capability
- b. unusual expertise or proprietary information may be exposed to competitors
- c. time will be wasted in responding to poorly thought out suggestions and
- d. the project will be delayed

A successful value engineering program must recognize and address these concerns. 'The additional effort' as pointed out, is not a reflection on the designers professional capability, but it is an attempt to improve the design results using a different approach. It is an effort to bring new and innovative approaches to bear on details of the design problems with a view to achieving basic functions at lowest cost.

2.11 MISUNDERSTANDINGS ABOUT VE

One would think that any process that advocates economy would be readily adopted. This has not being the case for Value Engineering. (Jergeas and Revay 1999: PM 12.2). Value Engineering is not simply about money....its about value (Kirk et al 2005:5). The lack of knowledge and awareness about Value Engineering is a major cause for its limited application (Cheah and Ting, 2005:153).

Dell'Isola mentioned that the misconception about Value Management/Value Engineering is a major problem in implementing it. He mentioned some of these misconceptions as follows:

- a. Value Engineering is only a cost cutting tool and does not consider quality.
- b. Value Engineering is an unprofessional effort and it tends to cast doubt on the integrity and capability of original designer.
- c. Value Engineering is what the quantity surveyor does instinctively.

Fong (1999) claims value management as one of today's most misunderstood management concepts. A major misunderstanding about value engineering is that it is something that is used to fix mistakes. Thus once conducting a value study is mentioned, resistance and defensive behavior are a natural result. They explain that value method is something that everybody can and should use in their every day work applications.

One should understand that it is a highly effective decision making process and is time tested. Few people often perform all the functions in value methodology, and hence that results in poor decisions. It is very important thus, for people to understand the process and its potential benefits so they can be incorporated and avoid poor decisions.

Often one hears terms like, 'there is no time for value study.' Time for value study and adjustments for its results can be scheduled at the beginning of the project. Very few projects are so confined that time for a value study (typically less than 5 days) cannot be

accommodated. Due to increased decision making process, value studies can actually reduce a projects design and/or construction time.

Few claim that ‘there is no money for value engineering.’ Since the added value of the improved product usually exceeds the cost of performing the value study, the study pays for itself. Unfortunately, design funds are normally used to pay for the value study, even though it is the construction, where savings actually accrue. There is also, always a tremendous inertia against change. Thus, once a value study requirement is felt, a common view comes up that ‘everyone has already agreed to this concept.’ Whereas using the value method with an independent team at a specified time, ensures everyone takes the time to measure the value of the initial concept against other, perhaps better alternatives and methods.

The most common statement made by Engineering Designers is, ‘we already do value engineering.’ They are engineers, and they do their work very hard to give their clients the best value, however, engineering designers rarely perform value engineering on their projects. This statement, actually stems from a misunderstanding of the difference between the concept of designer putting value in their engineering and act of performing value engineering (Kinnan 97).

Table 2.2 clarifies some of the differences between putting value into engineering and performing value engineering:

Table 2-3: Comparison between putting & performing Value Engineering

Item	Putting Value in Your Engineering	Performing Value Engineering
Task	Solve the problem.	Make sure the right problem is being solved.
Team Priorities	Meet project objectives, safety criteria, budget, schedule, etc. Look for value mismatches in spare time.	Find value mismatches and investigate alternatives that increase value.
Team Makeup	Technical expertise for meeting project objectives.	Independent Team used to provide objectivity and fresh look. Client, stakeholder are included in the value study team.
Process	Value mismatches may be hidden.	Proven process makes value mismatches more apparent.
Constraints	Constraints, perceptions and traditional methods are given to the engineering team and may or may not be challenged.	Constraints, perceptions and traditional methods are revisited with input from clients, owners and stakeholders.
Accountability	Results are anecdotal.	Results are measured against goals.

2.12 SUMMARY

The Literature Review has presented the available data which points out the utility of the Value Engineering technique. The available data clearly signifies its importance. It clarified how Value Engineering emerged from Industrial Sector, how it started being practiced in the construction industry, how Value Engineering is done, what constitutes a Value Engineering workshop and to know why there are very basic misconceptions about Value Engineering. It also clarifies the basic difference between putting value into engineering and actually performing value engineering.

METHODOLOGY

3.1 INTRODUCTION

The findings of Literature Review provided an overview of Value Engineering in the construction industry. A thorough literature review does not give much information on the application of value engineering in Pakistan's construction industry. So, the best way to obtain information about the current degree of understanding, usage of value engineering and also the factors that hinder its employment in our construction industry is a questionnaire survey. This kind of information obtained through the questionnaire survey shall constitute our Primary Data.

This research combines literature review and questionnaire survey. The questionnaire for survey was formulated keeping our objectives of study in view. It had to assess the general awareness of VE, the extent to which it is practiced and the hold back factors of VE in our Industry. The questionnaire survey was circulated among Construction Industry stake holders which included developers, consultants, contractors as well as officials of Government statutory bodies and persons linked with academics.

A three pronged approach was adopted to circulate our questionnaire to get maximum response. It included e-mails, postal survey, and physical visits to construction sites. This approach was adopted so that all major projects in major cities could be covered. If our research had to represent views of Industry, our sample size should cover a larger area, hence besides physical visits, e-mails and postal survey were too, included.

For research through literature, maximum use of latest research available on web was made use of. A continuous contact was kept with SAVE International, (Society of

American Value Engineers), a premier organization which conducts training and promotes academic literature on Value Engineering worldwide. As a result, they even kept the questionnaire for survey on their official web site for one month so that maximum international responses and views could also be generated.

In order to assess general awareness, the extent to which practiced and hold back factors of VE, the respondents opinions were measured on a Likert Scale of 5 continuum points. The data thus obtained through e-mails, postal survey, physical visits, interviews with renowned industry professionals and academicians, were analyzed using SPSS Software to produce Descriptive Statistics. The Research Methodology followed can be explained through the following Flow chart in Figure 3.1:

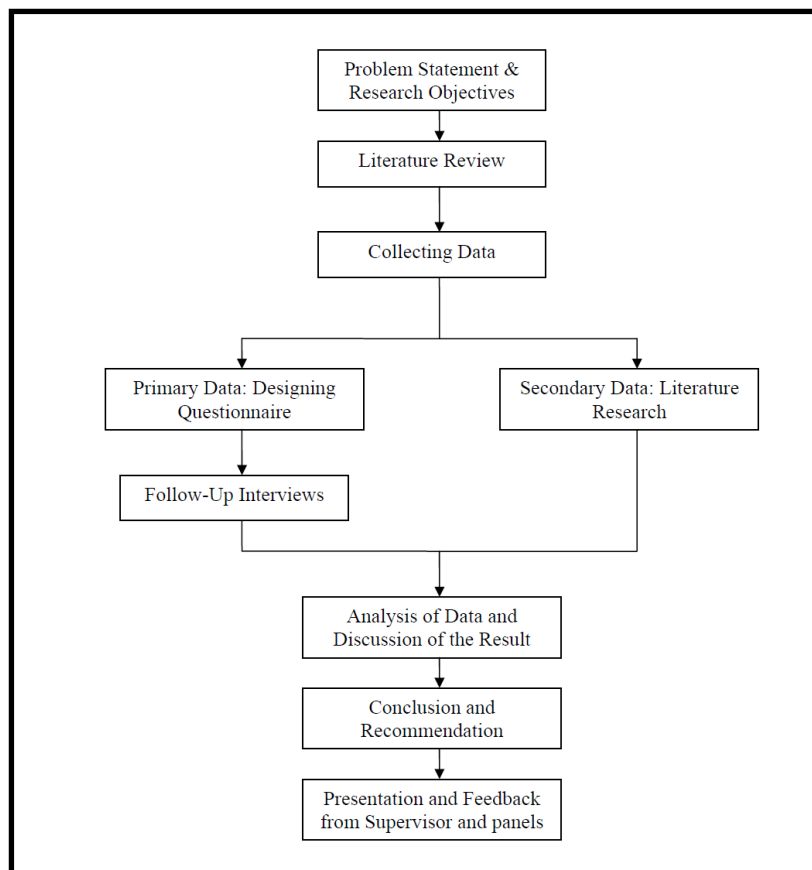


Figure 3-1: Research Methodology Flow Chart

3.2 QUESTIONNAIRE DEVELOPMENT

The questionnaire was developed keeping prime focus on the objectives of our study. The initial part of the questionnaire was made as an introduction to value engineering technique, hence due to our questionnaire, an education on very basic definition and explanation of this technique could also be imparted. After initial general response of name, designation and firm etc, questions were asked to get user responses for assessing general perception about Value Engineering, state of practice, hindrance factors, while questions related to value engineering being part of their contract clauses, and if they desire inclusion of such contract clauses or otherwise, were also asked.

The questionnaire was a blend of ordinal responses, i.e., on a Likert scale of 5 continuum points, and nominal responses i.e., either in yes/no. A copy of the Questionnaire made to conduct this research is attached as Appendix I.

3.3 SAMPLING

To calculate our sample size following formulas have been made use of (Franklin and Walker 2003). Firstly, the initial sample size can be calculated as:

$$n_1 = \frac{z^2 \hat{p}(1 - \hat{p})}{e^2} \quad (3.1)$$

where,

n_1 = initial sample size,

z = a value corresponding to a desired level of confidence,

\hat{p} = estimated proportion of simple random sample,

e = desired margin of error

Now, adjusted sample size would be:

$$n_2 = n_1 \left(\frac{N}{N + n_1} \right) \quad (3.2)$$

where,

N = size of the population.

And adjusting the sample size for effect of sample design,

$$n_3 = \text{deff} \times n_2 \quad (3.3)$$

where,

$\text{deff} = 1$ for simple random sampling designs,

And finally adjusting for response rate to determine the final sample size can be expressed as:

$$n = \frac{n_3}{r} \quad (3.4)$$

where,

r = expected response rate.

Thus, for our sample size, we use judgment to keep population of our stake holders as 2500 (though actual number may vary, but value engineering being a relatively new field, known and practiced by very selective, hence following population size assumed and research focused to major cities of country only).

Keeping margin of error, $e = 0.10$

Therefore, $z = 1.96$

SRS will be used (random sampling designs). Since there is no advance estimate of \hat{p} , hence 0.5 is assumed which yields maximum sample size.

A response rate of 65 % is expected so $r = 0.65$. Thus, our sample size is calculated as under:

- a. Using Equation: 3.1 the initial sample size $n_1 = 96$
- b. Using Equation: 3.2 the adjusted sample size $n_2 = 92$
- c. Using Equation: 3.3 the sample size for effective sample design $n_3 = 92$
- d. Using Equation: 3.4 the final sample size $n = 142$

3.4 DATA COLLECTION

The data collection remained a challenging task. Value Engineering was assessed to be a topic not very well understood by majority of stake holders. It is for this reason, an

introduction to value engineering was made first part of our questionnaire, hence respondents, can understand its definition, and can accordingly respond if they practice this or a similar technique.

Our target population had to be in major cities of Pakistan, and target respondents, were to be well known names in Industry, since this technique was assessed to be known and practiced by very few. Mostly the data was collected from Rawalpindi/Islamabad, Lahore and Karachi.

Multi-story mega buildings projects were specially targeted since a multi-story building presents huge challenges for stake holders. A complex blend of simultaneous activities and co-ordinations required presents a huge challenge for Project Management. That is the setting which Value Engineering could be most useful, being an important project management tool for decision making.

It was for this reason, to name a few, mega multi-story building projects like centaurus towers, state life building, NFRD complex, FFC towers in Islamabad/Rawalpindi and EOBI hotel, MCB towers, Tricon plaza in Lahore were visited.

Mega builders and consultants in major cities were also visited / contacted. To name a few, these included, Bahria Town, NHA, Nespak, Meinhardt, Alghurair Giga, Locii Inc, Izhar Builders and Descon. Efforts were made to get as many responses through personal interviews with management as possible.

A three pronged approach was adopted to get maximum user responses. This included, physical visits, e-mails/ phone calls and postal means. The cities of Rawalpindi/Islamabad and Lahore were physically visited while from Karachi. Mostly the responses were obtained either through e-mails/phone calls or through postal means. Hence, as per our calculation for sample size, a total of 142 responses were collected to

conduct this research.

3.5 DATA ANALYSIS STRATEGY

Once data was collected, it was analyzed to produce descriptive statistics. The results were based duly from inference drawn through descriptive statistics using SPSS (Statistics Package for Social Sciences). Since the questionnaire was such that data obtained was a very basic data comprising of factors which reveal respondents perception on Value Engineering, its usefulness for Pakistan and hold back factors, application of inferential statistics to our obtained data was not deemed necessary. Because Value Engineering, is a relatively very new concept for our industry, most respondents had their own understanding of the concept and thus a huge variation was received among user responses, thus invalidating test of reliability of data. It was for this reason, tests of inferential statistics were also not deemed necessary for our data and our results were based on descriptive statistics alone.

3.6 RELATIVE IMPORTANCE INDEX FOR INTERPRETATION OF RESULTS

The data that was obtained from Questionnaires was analyzed using Relative Importance Index (RII).

The formula for relative importance index is as under;

$$\text{Average Index (AI)} = \frac{\sum a_i x_i}{\sum x_i} \quad (3.5)$$

where,

a_i = constraint describing the weight given to response

x_i = constraint describing the frequency of the response for $i = 1,2,3,4,5$ and illustrated as follows:

x_1 = Frequency of “strongly disagree” response corresponding to: $a_1 = 1$

x_2 = Frequency of “disagree” response corresponding to: $a_2 = 2$

x_3 = Frequency of “neutral” response corresponding to: $a_3 = 3$

x_4 = Frequency of “agree” response corresponding to: $a_4 = 4$

x_5 = Frequency of “strongly agree” response corresponding to: $a_5 = 5$

Where the classification of rating scale is as follows:

Strongly disagree :	$1.0 \leq \text{Average Index} < 1.5$
Disagree :	$1.5 \leq \text{Average Index} < 2.5$
Neutral :	$2.5 \leq \text{Average Index} < 3.5$
Agree :	$3.5 \leq \text{Average Index} < 4.5$
Strongly Agree :	$4.5 \leq \text{Average Index} \leq 5.0$

3.7 LIMITATIONS

Value Engineering remains a relatively new concept for our construction industry. Stake holders generally did not know the actual concept. They mostly thought that merely making alternative design proposals by designers is called Value Engineering or that it merely means cutting down the cost of an over budgeted project. Hence, wherever possible, the idea or spirit behind Value Engineering was explained in detail to them. It was explained to stake holders that the idea behind Value Engineering revolves on the concept of functions and not cost alone. It has to be done by a multi-disciplinary team who do brain-storming to evaluate functions desired from the construction, calculate life cycle costing and hence reach consensus which delivers the best value for money. Now, this all explanation could only be done physically, hence where ever respondents replied to questionnaire through e-mails and postal survey, such clarity of mind was found missing. Though the questionnaire was prepared, with first section dedicated to explaining in simple terms, the idea behind Value Engineering, the respondents still replied as their own understanding of the concept.

A major limitation was faced by the fact that we have very few Value Engineering Specialists present in our Industry. There is no society which brings them and their work

on one platform, hence it is very difficult to reach them and get their views. It may not be fully understood unless one physically practices it or attends a Value Engineering workshop. Value Engineering and its methodology is difficult to understand by merely reading through research publications. In order to convince respondents on its utility one has to understand how it works and what it does. VE is basically a practice, which may not be forced, but can be adopted through motivation once fully convinced that it works. Without ever having practiced or formal training under any Value Specialist, explaining about it had to remain absurd or rather crude to respondents. Hence, mostly the views obtained by respondents depict their understanding of the concept, the best to which one could explain it to them and what they understood out of it.

3.8 SUMMARY

The Research Methodology was to carry out a survey through questionnaire to get respondents views on Value Engineering for attainment of our research objectives. From Literature Review, we knew that Value Engineering is practiced mostly on mega projects. Hence our target respondents, and target projects had to be big names in our Construction Industry. It was for this reason, mostly the data pertains to that taken for, four major cities of Pakistan and selected projects were also mega projects and high rise buildings. An SRS method i.e Simple Random Sampling Technique was employed to get respondents views. Using the formula for sample size, we calculated a required 142 respondents views for our survey for which a three pronged approach of using e-mails/phone calls, postal survey means and finally personal visits on sites were adhered to. Later, the data was analyzed on SPSS to produce descriptive statistics. For inferring results from obtained data, the technique employed was that of Relative Importance Index/ Average Index. This technique was employed since it is more reliable than average or pure mean.

RESULTS AND DATA ANALYSIS

4.1 GENERAL INFORMATION

The research was conducted through Literature Review and Questionnaire Survey. The questionnaire was designed specifically to meet the objectives of this study, i.e., first to assess the general awareness on VE in our construction industry, second to assess current state of VE and utility for Pakistan from stake holders point of view, and third to assess factors, which in stake holders view, hold back any VE practice to be conducted here.

All information comprising of secondary data was gathered through extensive literature review, while primary data through interviews/questionnaire survey from industry professionals. Since, it is a relatively new subject for our Industry, it was envisaged necessary that that our target group should only be well known names in Industry. It is for this reason, the research was mostly restricted to major cities of Country i.e. Rawalpindi/Islamabad, Lahore and Karachi. The data from Rwp/Isb and Lahore was mostly personally collected, while data from Karachi was obtained through postal survey and e-mails.

This research pertains to data collected from 142 respondents. Mostly the contracting firms, responded, followed by Engineering/Architect Consultants and then a few Clients as well as academicians responses are also made part of research.

The type of firms responding to our Questionnaire is as given in Table 4.1. It can be seen from the table that mostly the Developers/Contractors responded to our Questionnaire followed by Engineering/Architect Consultants.

Table 4-1: Type of firms responding to questionnaire

Type of Firm	Frequency	Percent	Valid Percent	Cumulative Percent
Engineering/Architect Consultants	52	36.6	36.6	36.6
Developers/Contractors	60	42.3	42.3	78.9
Owner/Client	21	14.8	14.8	93.7
Others	9	6.3	6.3	100.0
Total	142	100.0	100.0	

Once we mention Designation, mostly Engineers responded to our questionnaire. This, followed by PM/CM’s at sites while few Architects as well as Academicians responded too. Few CEO’s and Directors of firms also gave their views which means that our results are truly indicative of our construction industry in general. As for cities, to which these respondents belong, mostly the data pertains to that collected from Karachi, followed by Rawalpindi/Islamabad and then Lahore. The same is represented in the Bar charts below as per Figure 4.1 and 4.2

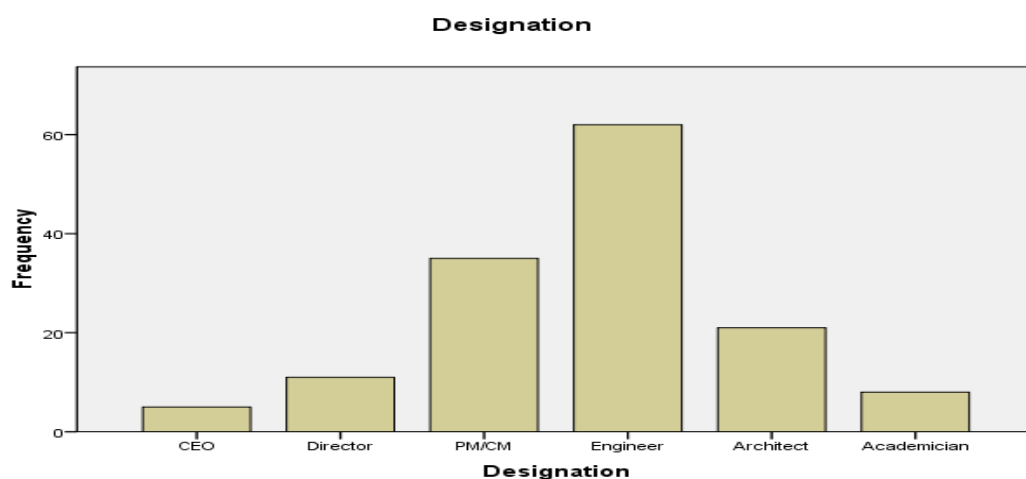


Figure 4-1: Bar chart showing designation of respondents

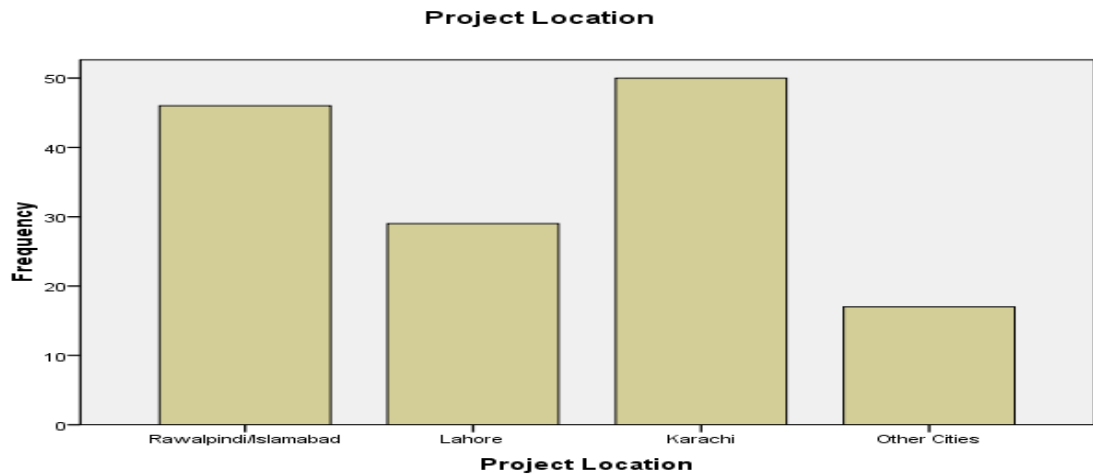


Figure 4-2: Bar chart showing project locations

4.2 ASSESSING GENERAL AWARENESS OF VE

An interesting phenomenon was observed once we assessed general awareness on VE in the industry. Most of the respondents said they were aware of technique of Value Engineering i.e., 82 %, though mostly came to know it through colleagues / friends. Now, merely knowing about VE is never sufficient to let one practice this technique. Tables below i.e., Table 4.2, shows the level of awareness and source of having learned VE by respondents.

Table 4-2: Frequency of respondents aware of VE

If Aware of VE	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	117	82.4	82.4	82.4
No	25	17.6	17.6	100.0
Total	142	100.0	100.0	

Table 4-3: Where did respondents learn about Value Engineering

Where learnt about VE	Frequency	Percent	Valid Percent	Cumulative Percent
Professional Seminars	13	9.2	9.2	9.2
Professional Publications/Journals	26	18.3	18.3	27.5
Colleagues/Friends	51	35.9	35.9	63.4
Already Applied	18	12.7	12.7	76.1
Read as Course/Subject	9	6.3	6.3	82.4
Do not Know/Not Applicable	24	16.9	16.9	99.3
Misc	1	.7	.7	100.0
Total	142	100.0	100.0	

An interesting analysis came up once factors on perception on VE were analyzed regarding respondents answers on the Likert Scale. They collectively view that VE is a mere cost cutting technique. They also agreed that it increases functions and life cycle cost, as well as agree that VE decreases life cycle cost. This shows the level of unawareness that prevails among stake holders in general. VE is never meant for merely cutting down cost of an over budgeted design, nor does it increase Life Cycle Cost (LCC) of a project. In fact, working out LCC during VE study, bars it from being labelled as merely a cost cutting technique. Hence, perception on VE remained just about ‘low’ among our construction Industry stake holders. This is as depicted in the Table 4.4.

Table 4-4: Perception about VE by respondents and analysis

Perception on VE	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Index	Result
Merely cost cutting technique	7	10	35	43	47	3.8	Agree
Increases functions at same cost	1	7	29	73	32	3.9	Agree
Increases functions and life cycle cost	5	4	26	44	63	4.1	Agree
Decreases life cycle cost	2	4	55	42	39	3.8	Agree
Average Total	2.6%	4.4%	25.5%	35.6%	31.9%	3.9	Agree

4.3 ASSESSING CURRENT STATE OF VE & UTILITY FOR PAKISTAN

Here too, some interesting facts and figures came up. Once asked about having applied VE on construction projects, half of the respondents replied in affirmative (50%), This can also be seen as per Table 4.4, while the size of projects they applied mostly remained between 1 and 5 (as per shown in the following Table).

Only later, it was revealed, that mostly, our stake holders regard making alternative design proposals by designers, as VE or an in house review of design from constructability point of view, is also being termed as Value Engineering. This, however, is not true. Value Engineering can only be fruitful once practiced in correct fashion, i.e., a formal value study workshop by independent value consultants, doing function analysis, doing brainstorming, conducting LCC and hence reaching the most pertinent design.

The data pertaining to respondents ever having applied VE/VM on construction projects and the number of projects they have applied it, can be found as per Table 4.5 and following Table 4.6:

Table 4-5: No of respondents ever applied VE

Ever applied VE/VM on construction project	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	71	50.0	50.0	50.0
No	71	50.0	50.0	100.0
Total	142	100.0	100.0	

Table 4-6: Data showing Number of Projects on which Respondents Applied VE

Approx applied on number of projects	Frequency	Percent	Valid Percent	Cumulative Percent
1 to 5	48	33.8	33.8	33.8
5 to 10	19	13.4	13.4	47.2
10 to 15	2	1.4	1.4	48.6
Above 15	2	1.4	1.4	50.0
None	71	50.0	50.0	100.0
Total	142	100.0	100.0	

Once we analyzed data pertaining to factors which assessed utility of VE for Pakistan, a mixed response was observed. Though respondents in general, agreed to its utility and scope for Pakistan, they never the less also remained neutral, as a whole. One commented ‘why going for a VE consultant once own designer can also do the same.’ This primarily is also the reason that stake holders are not well conversant with the concept behind value study. If they just regard design changes, and not consider function analysis or LCC, they would not find any utility in a Value Study and would remain neutral as the case came up. As an over all trend, respondents remained ‘neutral’ to the utility of VE in Pakistan. This was also surprising. Maybe we need to vigorously promote

the idea. In our neighbouring India, an active Value Engineering program along with local chapter of SAVE International exists, since 1977, where as, in Pakistan, most have not even heard of it. Thus, as an overall trend, the current state of VE in Pakistan is almost ‘nonexistent.’ Table 4.5 shows the Factors assessing utility of VE for Pakistan as given by our respondents.

Table 4-7: Factors assessing utility of VE for Pakistan and analysis

Factors that assess utility of VE for Pakistan	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Index	Results
Far fetched idea for Pakistan and has no scope	9	86	35	11	01	2.4	Disagree
Why increase time and cost going to VE consultant once own designer can do it	8	56	51	27	0	2.7	Neutral
With advancement in Project Management tools, has a certain scope for our construction industry	2	1	19	67	53	4.2	Agree
Certainly makes a difference to the way we conceive and execute a project	1	1	26	64	50	4.2	Agree
Average Total	3.5%	25.4%	23.1%	29.8%	18.3%	3.4	Neutral

4.4 ASSESSING FACTORS HINDERING IMPLEMENTATION OF VE

There were eight factors which were kept in front of respondents and their views

were recorded and analyzed. Mostly, respondents agreed to all factors listed. Here too, an interesting analysis came up. Respondents think that VE is too expensive to carry out. However, Value Engineering is probably the only project management tool that is proven to always save cost and is not at all expensive to employ when comparing it to the benefit it gives. This also points out the wrong perception prevailing about VE among stakeholders of Industry.

Remaining factors are very evident. We need to have an active VE program, starting from its knowledge, developing guide lines, and then training professionals in this field. Once, none of this infrastructure exists in here, all these factors were agreed upon by respondents as responsible for hindering non employment of Value Engineering in our Industry. These can be as seen in following Table 4.8 :

Table 4-8: Factors that hinder implementation of VE and analysis of data

Factors that hinder the implementation of VE	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Index	Results
Lack of local guidelines and info about VE/VM	0	1	33	53	55	4.1	Agree
Lack of knowledge and practice in VE/VM	0	0	31	52	59	4.2	Agree
Interruption to normal work schedule	1	6	43	67	25	3.8	Agree
Too expensive to carryout VE	1	11	66	35	29	3.6	Agree
Conflict of objectives	1	2	50	57	32	3.8	Agree

by different project stake holders							
Not suitable for low cost projects	3	6	52	51	30	3.7	Agree
Lack of trained professional in VE/VM	0	2	23	62	55	4.2	Agree
Lack of training opportunities in VE/VM	0	2	16	67	57	4.3	Agree
Average Total	0.5%	2.6%	27.6%	39.1%	30.2%	4	Agree

4.5 ASSESSING MISCELLANEOUS RESPONSES

As far as desire to implement this project management tool is concerned, very encouraging results were obtained. Almost 98% respondents said they were convinced that they would want to implement value engineering on their projects. Almost 97% said, they would want a VE certified person as part of their design team, hence Value Study remains a priority area since inception of the project. Almost 98% respondents desire that Value Study clause should be part of PEC documents (100 % response said that VECP, at present, is not part of their contract documents and VECP's are not invited by contractors), and being treated as null and void, while almost 99% desire that both Value Engineering Study (client/consultant specific) and VECP (contractor specific) should be part of contract clauses. The same results are graphically represented as per Figures 4.3, 4.4 and 4.5:

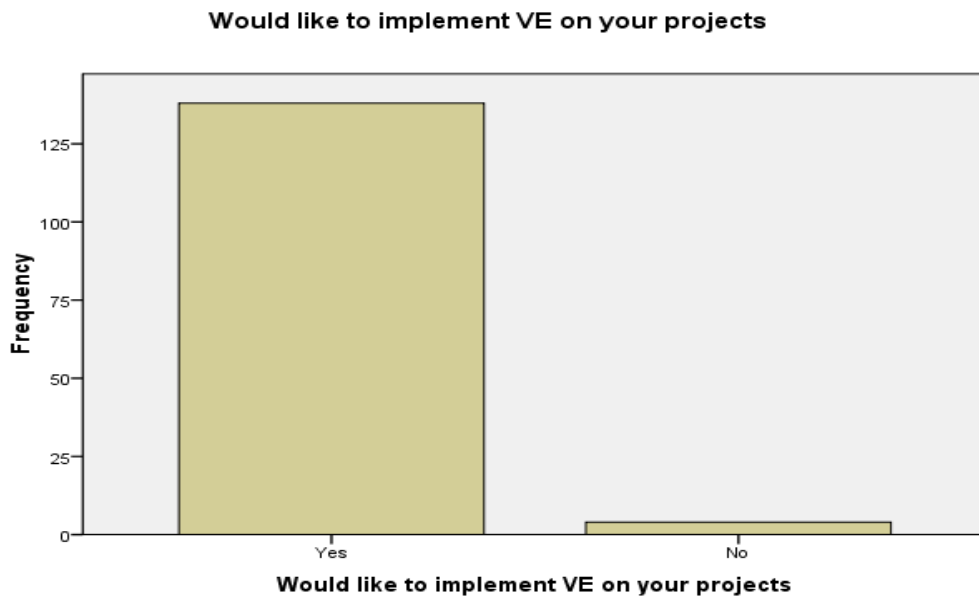


Figure 4-3: Respondents desire to implement VE on projects



Figure 4-4: If respondents recommend a VE certified person in design team

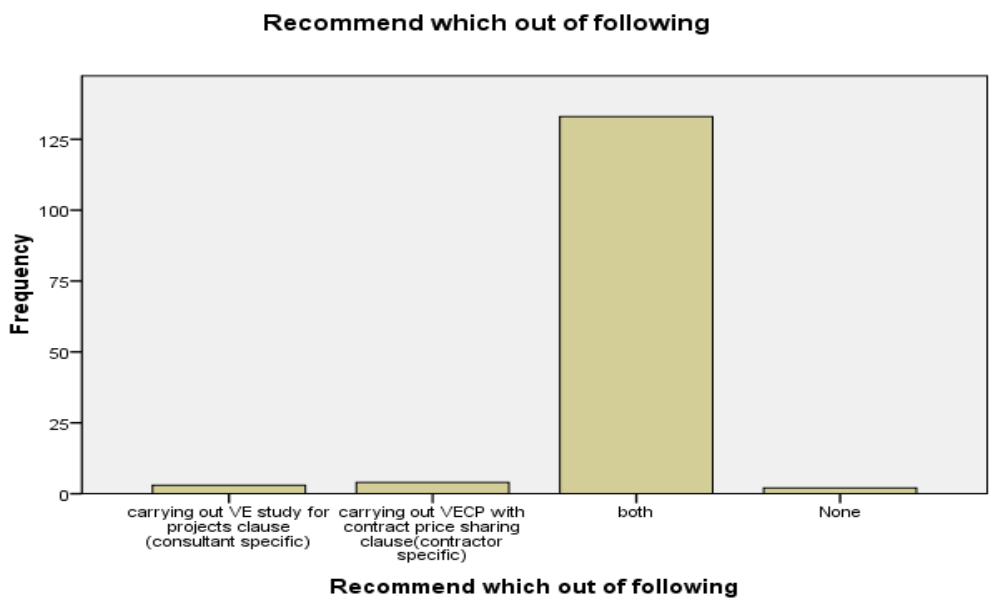
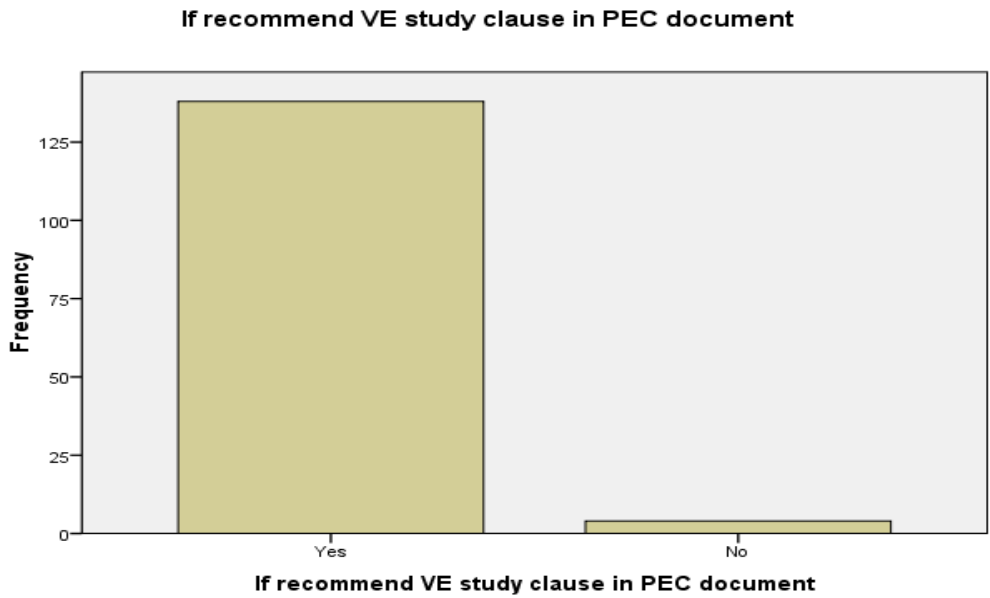


Figure 4-5: If respondents recommend VE study clause and carrying out VECP in contract

4.6 INTERPRETATION OF RESULTS FROM DESCRIPTIVE STATISTICS

For this study, it was envisaged that descriptive statistics along with Relative Importance Index fairly provide us with the clear indication of our objectives.

- a. As far as level of awareness of value engineering is concerned, it may be regarded as 'low'.
- b. As far as level of implementation of Value Engineering is concerned, it may also be considered as 'low'.
- c. As far as utility for Pakistan is concerned, it is assessed that it is now 'high' for our construction industry.
- d. As part of miscellaneous responses generated, 98% respondents said they would want to implement value engineering on their projects while 97 % said they would want a VE certified person as part of their design team. Almost 99 % respondents desire that both value engineering study and value engineering change proposals should be part of contract clauses. These clearly indicate that utility of VE for Pakistan is high.

DISCUSSION

5.1 INTRODUCTION

Unfortunately, a study on the present topic has never been carried out before in Pakistan. Hence, we do not have any reference study findings to compare our study results with. However, a thorough review of existing Literature Review makes a firm base, on which we can compare our findings and infer the direction in which our results point out. The same can be taken as reference using which we can give our recommendations and future actions to be undertaken in this field.

Prior to discussing the results and achievement of our objectives, we must review a few facts established through our secondary data i.e. the literature review. These can be enumerated as follows:

- a. Value Engineering is a project management tool which is a known and accepted way of achieving optimum value world over. Hence, its importance in the field of construction cannot be denied.
- b. There are misunderstandings about Value Engineering partly due to lack of awareness of this excellent value enhancing technique.
- c. Value Engineering is only fruitful, if practiced in a correct fashion i.e., employing independent value engineering consultants for design review during initial stages of the project. Indeed, it is difficult for in house designers to do it because of lack of training in VE, conflict of interest, and/or experience in calculating life cycle cost, an important activity in completion of value study of a project.

- d. Merely reading through value engineering literature is never sufficient to understand the mechanics involved and practice of value engineering. SAVE International, is a premier organization known world over for training professionals in conduct of value study. Other forms of acquiring knowledge is through professional seminars, or actually attending a value engineering workshop.
- e. A Value Engineering study, almost always results in either increasing value, reducing cost, or increasing value at the same cost. However, it always incorporates a reduction to the life cycle cost of the project.
- f. Though, value engineering, is now a known method for enhancing value and is mandatory among many developed and developing countries alike; however, it requires more motivation to perform than promulgation through rules and regulations. The statutory bodies for its promulgation, enforce it through laws but its real enforcement can only be ensured once stake holders are fully convinced of its utility and conducting a value study is promoted focused on getting best value of money spent.

With this knowledge base established, we are now in a better position to analyze our results and discuss how have they been able to achieve our objectives of study.

5.2 DISCUSSION ON GENERAL INFORMATION OF RESPONDENTS

A sample size of 142 is considered to be good enough to represent our population i.e., the construction industry of Pakistan. About 18 CEO's/Directors, 35 PM/CM's, plus 60 Engineers were part of the study. The presence of CEO's and Directors/PM's indicate that our study is valid and it can be taken as representative of our Construction Industry in general.

As for project locations, the data mostly pertains to the four mega cities of Pakistan

i.e., Karachi, Lahore and the twin cities of Rawalpindi and Islamabad. Value Engineering is a relatively new field and would rather be practiced in major cities and mega projects only. Hence, we deduce that our study, mostly based in major cities and mega projects, in general represents the Industry.

5.3 DISCUSSION ON GENERAL AWARENESS ON VALUE ENGINEERING

Though 82% of respondents said they were aware of Value Engineering, but then, it comes out as an experience through personal visits to sites and personal interviews that such a high number of stake holders are not aware of the value study technique. This 82%, in-fact represents the total sample size who collectively know about value engineering and together with those who have misconceived ideas about what value engineering really is.

Once we discuss the source of knowledge of Value Engineering, we find out that 51% of respondents have learned it through friends/colleagues while merely 12% have already applied it earlier and thus have learned about it. 18% and 9% respectively have learned it through Journals/Publications and Professional seminars.

Thus, this together presents a good picture of awareness of Value Engineering. However, once we see results of various questions about perception on Value Engineering, we find that respondents collectively agree (Relative Importance Index technique employed) that it is merely a cost cutting technique. They also agree that it increases function and life cycle cost. These statements cast doubt on their perception and awareness of Value Engineering. The prime focus of a value engineering study is that it is taken up to perform required functions in another manner. It is never undertaken as a merely cost cutting technique. Neither it increases LCC (life cycle cost), in-fact a purpose of value study is reduction of LCC.

Thus keeping both factors in front i.e., majority respondents having merely heard about it from colleagues/friends and their agreeing that it increases LCC and that it is

merely cost cutting technique, we can draw inference that the perception of value engineering remains that it is merely a cost cutting technique and that though, Value Engineering increases function, it also increases Life Cycle cost. Our drawn inference is more so pertinent, once we analyze having asked if they think, VE is somewhat practiced by designers by giving various options, and the majority affirmed that. This, on the contrary, may be regarded as alternative design review but not value engineering.

5.4 DISCUSSION ON ASSESSING STATE OF PRACTICE AND UTILITY FOR PAKISTAN

Once established that a wrong perception about value engineering exists among the majority of our respondents, the state of practice i.e., what they practice and claim value engineering also becomes doubtful.

This becomes more pertinent once we analyze their responses. Though 50% respondents claim they have practiced value engineering on their projects, and out of that 50% applied it on between 1 and 5 projects, probably what the majority claim to have practiced is not Value Engineering in its true sense.

Thus based on reasons of their ill knowledge of value engineering, we can safely assume that state of practice of Value Engineering is “low.” As for utility for Pakistan is concerned, the majority remained agreed on all questions we asked regarding utility of Value Engineering for Pakistan. They remained disagreed regarding VE being a far fetched idea for Pakistan and they remained ‘neutral’ to being asked why go to VE consultant when their own designer can do it. However, they agreed once asked for if the scope of VE in Pakistan is high. Collectively, their views remained ‘neutral’.

Thus, once we analyzed the result of having asked them if they would like to employ VE on their projects, a majority replied in affirmative. We can thus safely assume that the Utility of VE for Pakistan is ‘High.’

5.5 DISCUSSION ON ASSESSING HOLD BACK FACTORS OF VE FOR PAKISTAN

The hold back factors of employment of VE were assessed based on eight factors. All stake holders remained agreed on all points related to hold back factors. However, keeping in view, the prevalent misunderstandings about Value Engineering and state of practice, it was also endeavoured to know, why this excellent technique could not develop in here. During post questionnaire filling interviews with few key consultants, the following analysis came up which is discussed as follows.

In Pakistan, Project Management as a specialization in the industry and the role of the Project Manager as a lead in organizing a construction project is yet to evolve as an industry practice. This situation is similar to other developing countries. There are several reasons for this situation in Pakistan. Key among them include:

- a. Lack of awareness on the part of project owners/sponsors regarding the advantages of professional management.
- b. Absence of large scale projects which would necessitate the prominence of PM.
- c. Less developed construction techniques, standards and specifications along with poor accountability and implementation of the same.
- d. Nascent advent of Project Management as a specialization in the Pakistani universities and industry.

Under the above circumstances, by all accounts, Project Management and its related techniques/processes are virtually absent from the Pakistani industry. Value Engineering and its full independent application is consequently also not present as a commonly used practice. In the private sector, which generally participates in the buildings sector, an architect is engaged to lead the design/construction process. Most architects have small practices and do not have the capacity/capability to utilize any

Project Management techniques including the induction of an independent VE consultant. There are no consultants with specialized VE experience in Pakistan.

Essentially the role of a Project Manager is often confused and reduced to site supervision and or construction manager, if and when it is utilized. The Public Sector, which generally undertakes infrastructure projects, also does not engage a PM to initiate a project and instead typically engages a design consultant. The situation with regard to Project Management applications including independent VE is again the same.

It is important to realize that in addition to lack of understanding it is difficult to expect a design consultant to engage an independent VE consultant. In such a situation the VE exercise, if at all undertaken by another design consultant, loses independence and assumes a conflict of professional egos and interest with the client acting as an arbitrator - a role which although a competent PM can carry out but the client is ill equipped for. The bottom line, therefore, is that unless the specialized role of PM does not become a well accepted practice in the Pakistani industry, the utilization of VE as a time, resource and cost optimization technique and an independent specialization has little prospect unless the owner employs the VE directly to protect his interests.

5.6 A REFERENCE OF A SUCCESSFUL VE WORKSHOP

A value engineering workshop was conducted at NESPAK Headquarters Lahore for review of design of Saudi German Hospital at Abha KSA. NESPAK were supervisory consultants for this project. The Value Engineering team generated some 127 ideas, out of which 34 proposals were developed for change representing ten million Saudi Riyals in potential initial savings and approximately fourteen million Saudi Riyals in present worth of annual cost savings. In addition, 53 design suggestions were provided which clarify/improve design or increase cost. For owner's additional consideration, a deferred cost reduction of ten million Saudi Riyals was suggested.

The Hospital Building covered an area of 40,000 square meters prior to VE study. Construction of about 4,000 square meters was deferred, leaving behind 36,000 square meters. The pre VE cost, as estimated by the VE team, amounted to 106.600 Million Saudi Riyals. Facilities worth an amount of 10.370 Million Saudi Riyals were deferred. Initial savings achieved through VE study were 10.000 Million Saudi Riyals (9.4 %), whereas Life Cycle Savings were estimated at 13.634 Million Saudi Riyals. Thus, the combined savings of both, VE and deferred/cancelled construction was 20.370 Million Saudi Riyals, hence reducing the Interim Project Cost to 86.230 Million Saudi Riyals, i.e. an overall saving of approx 20% achieved.

Such is the importance of a Value Engineering Study for projects, which almost always results in either decreased cost or increase in functions. We too, need to vigorously promote this concept in order to increase value for the money invested.

5.7 SUMMARY

In the discussion chapter, the results of analyzed data were discussed. It was explained how we determined our objectives for our research. It was explained that Value Engineering is a concept which is widely misunderstood among our stake holders. We analyzed our results of study i.e., primary data while equating with secondary data. While assessing the degree of understanding of value engineering among stake holders, we assessed it to be low. Assessing the current state of value engineering practice in the construction industry, we termed it very low. While utility for Pakistan, keeping in view its benefits, can rightly be termed as high. As far as critical delay factors are concerned, it was analyzed that unless Project Management develops to its optimum in here, Value Engineering may remain dormant unless project owners utilize it.

CONCLUSION & RECOMMENDATIONS

6.1 INTRODUCTION

Poor design and documentation can be responsible for up to 12% of project costs (Tilley et al 2000). The reduction in quality is in direct relation to reductions in design fees and there has also been a corresponding increase in project time, cost over runs disputes and delays. As a major stake holder in the industry, 'it is essential that engineering profession address this situation with a view to ensuring that the building and construction industry returns to a mindset of efficient performance' (Gallo et al 2002 p3).

Value Engineering is a concept which a majority of our Construction Industry stake holders are unaware of. They have been found to have varying misconceptions about VE. Some regard preparation of various options with pros and cons by designer for client as Value Engineering while others feel VE in fact is done to reduce cost and functions - a typical mind set of remedial measures to overcome an over budget design. Most think that this technique has no scope in our Construction Industry and hence there is no need to incorporate a requirement to carry out a value study for projects in contract clauses.

The underlying reason for this unawareness is due to many factors. Like many other fields, our Construction Industry is run with very little regard to standardization. Construction tycoons are used to rely on their experiences and habitual thinking instead of harnessing their most important resource - their people. VE refines an idea through rigorous and systematic process to increase value and optimize life cycle cost of a facility. LCC being the most buzz word these days, our Construction Industry is not endeavouring enough to save on cost of the client over operation and maintenance of a built facility over

its life time.

6.2 CONCLUSION

The research was aimed at assessing the degree of understanding of Value Engineering, current state of practice, its utility for Pakistan and its hold back factors. The collected data was analyzed and it was concluded that the degree of understanding of Value Engineering is 'low,' based on the findings that the majority regard VE either as a mere cost cutting technique or something that increases life cycle cost. The current state of practice of VE is also 'low' based on findings that the majority term VE as preparation of alternative design proposals. While discussing hold back factors for employment of VE in Pakistan, it was concluded that Project Management has yet not developed to its optimum in the Industry. The PM on behalf of the Client, desires Value Study, for which PM is trained but the Client is ill equipped for. Unless Project Management develops to its optimum in the Industry, Value Engineering has little prospect of developing as cost and value optimizer in our construction industry unless the Owner hires VE directly to protect his interest.

As far as miscellaneous responses generated are concerned, 98% respondents said they would want to implement value engineering on their projects while 97% said they would want a VE certified person as part of their design team. Almost 99% respondents desire that both value engineering study and value engineering change proposals should be part of contract clauses. All such indicators point that utility of VE for Pakistan is high.

6.3 SUGGESTED GUIDELINES IN REGARDS TO VE

Few of the suggested guidelines emerging as a result of this research are postulated as follows:

- a. The owner must want VE done to REMOVE the burden of time and cost on a project. VE solves problems of over-budget, lost time due to high bid openings,

redesign, high cost change orders, lost time due to change orders. If the owner has no problems and doesn't care about cost or schedule he will see no benefit to doing VE.

- b. We need to actively pursue awareness of this useful technique. A seminar/conference inviting the existing Value specialists in the country highlighting this technique; would indeed be a step in right direction.
- c. For a start, we can do VE in-house. The best is to use a separate in-house team of employees for that specific purpose. This eliminates interrupting the designers by taking the job off their drawing boards. They can keep working. Besides the owner is making his/her own design review and the VE recommendations can be returned to the designers at the same time the owner returns their comments. Very little additional time is lost during the "study" using this process. Of course some time is lost implementing the owner's and VE team recommendations. Designer's normal attitude is to defend their work. That is why a separate team is recommended, so that you can keep the VE study time shorter and more productive. If we give everyone on the staff VE training we can then rotate who is on the VE team so they review each other's work all the time and the defensiveness breaks down. It will be a form of PEER review.
- d. For construction contractors the owner should include the VE incentive clause in their contracts and share savings 50/50 with them if they turn in cost savings ideas. Designers would remember what was changed and apply these as "lessons learned" to their next design. The motivation is not to pay twice for the same idea. Wouldn't owners rather deal with cost saving credit change orders than all those claims for extra's?

- e. There is no organization of Value Engineers/Society within Pakistan. In fact there is no Pakistani chapter of SAVE (Society of American Value Engineers), a pioneer organization which gives training and certifications for Value Specialists. There exists a need to gather information on existing value specialists within the country and represent their services/work through a society. A Pakistani chapter of SAVE International, would indeed pave a way to make our Construction Industry realize importance of value studies and get benefits from their work.
- f. If one cannot afford the time for a 40 hour work shop, its fee and travel expenses, then joining Miles Value Foundation online e-learning program is recommended. It can be taken in Pakistan by employees wanting to further their knowledge. The web link is [www.valuefoundation .org/Educate-E-Learning.htm](http://www.valuefoundation.org/Educate-E-Learning.htm)

6.4 RECOMMENDATIONS

This research has merely touched very basic aspects of Value Engineering. The idea was to find level of awareness and the extent to which practiced. Once established that this excellent value enhancing technique is virtually missing in the industry, we need to raise the level of awareness for its implementation with motivation. There are numerous areas of VE which requires further research. Existing case studies of VE Workshops of projects abroad can be studied in comparison to similar local projects where VE was not conducted to find out what have we been missing. Similarly, research could also be conducted to create a data base for VE Workshops conducted for projects within country and their accrued benefits.

Government statutory bodies alike PEC, be asked to include Value Studies as mandatory in contracts. FIDIC, since the 99 edition onwards, advocates carrying out Value Study for projects. However, the same is not reflected in our contract documents. Even if present, it was found that it is being treated as null & void. Success stories/case studies of

Value Engineering Workshops where they resulted in huge cost decrease with functions increased should serve as indicator that if we want to give the client, best value for his money, Value Engineering shall prove to be a major factor for that.

It helps if authorities support VE concept, but we cannot regulate or make motivation or creativity a requirement. Hence, spreading awareness about VE and its utility is probably the best option to ensure its implementation by Industry stake holders.

References

- Cheah, C, J, Y., Ting, S, K. (2005) “Appraisal of value engineering in construction in south east asia.” *International Journal of Project Management.*, 23, 151-158.
- Chung, B., Syacharani, S., David, H., Kwak, Y. (2009) “Applying Process Simulation Technique to Value Engineering Model”. *IEEE Transactions on Engineering Management*, 56 (3), 549-559.
- Davis, K. (2004) “Finding Value in the Value Engineering Process”. SAVE International Conference Proceedings.
- Elias, S. (1998). “Value Engineering: A powerful productivity tool”. 22nd ICC&IE Conference on Computers and Industrial Engineering.
- Fletcher, T., McClintock, S. (2004). “Integrating Value Management into the Quality Management framework”. Annual Quality Congress Proceedings Ontario Canada.
- Franklin, S., Walker, C. (2003). *Survey Methods and Practices*, Published by authority of the minister responsible for Statistics Canada, 2010.
- Fong, P., Shen, Q. (2000). “Is the HongKong Construction Industry ready for Value Management”. *International Journal of Project Management*, 18(5), 317-326.
- Idrus, A., Abdullatif, O., Khamedi, M., Abdurrahim, M. (2010) “ The implementation of Value Engineering among Malaysian consultants.” 9th Annual Conference & Meeting of Management in Construction Researchers Association.
- Isola, A. D. (1982). *Value Engineering Practical applications for Design ,construction*, RS Means Inc, Kingston, MA, USA.
- Jeffrey, R., Swiggum, K., Shapiro, J., Alaydrus, A. (1994) “Constructability related to TQM, Value Engineering and Cost benefits”. *Journal of Performance of Constructed Facilities*, 8(1).

- John, K. (2000) “Does value management have a place in project management”. SAVE International conference proceedings.
- Kelly, J., Male, S. (2002). “What is of Value to your customer”. SAVE International Conference, Denver, Colorado.
- Kirk, S., Turk, R., Hobbs, R. (2004). “Value based team design decision making”. SAVE International Conference proceedings.
- Kinnan, M., (1997) “But we already do it and other misunderstandings”. SAVE International Conference proceedings.
- Miles, L. (1977). “Earliest History of Value Analysis”. Technical Report by The Lawrence D Miles Value Engineering Reference Centre Collection
< <http://digital.library.wisc.edu/1793/4960> > [Accessed on 15 Jan 2012].
- Sameul, M., (1997) “Whats the difference”. SAVE International conference proceedings.
- Sano, A. (2000) “ Proposal of new approach in in-house VE.” SAVE International Conference Proceedings.
- SAVE International. (2007). “Value standard and body of knowledge”.< <http://www.value-eng.org/>> [Accessed on 1 Jan 2012].
- Theresa, L., (2000) “Maximizing value & minimizing waste”. Technical Research Paper of Lean Construction Institute . <<http://www.leanconstruction.org/>> [Accessed on 1 Feb 2012].
- Timothy, L., (2000) “Use Vs Function, flipping the switch”. SAVE International conference Proceedings.
- US General Accounting Office. “Information on the use of Value Engineering”. A Technical Report < <http://www.gao.gov/new.items/d03590r.pdf>> [Accessed on 20 Jan 2012].
- US.General Services Administration Public Buildings Service (USGSA). (1992). “Value Engineering Program Guide For Design & Construction”. A Technical Report <

http://www.gsa.gov/graphics/pbs/New_VEPG_Volume_I_R2Q-iK_0Z5RDZ-i34K-pR.pdf>

[Accessed on 30 Mar 2012].

Watson, G. (2005). "Putting Value back into Engineering". ASQ World Conference on Quality and Improvement Proceedings, Seattle.

Yousefi, A. (2010) "Value engineering application benefits in sustainable construction".

Technical Paper Project Management Institute-Arabian Gulf Chapter (PMI-AGC)<<http://www.pmiagc.com/techdocs/The%20paper%20%20Value%20Engineering%20application%20benefits%20in%20Sustainable%20Construction.pdf>>[Accessed on 15 Feb 2012].

Zimmerman, W., Hart, G. (1982). "*Value Engineering, A Practical Guide for Owners, Designers and Contractors*". Van Nostrand Reinhold Company, USA.

Appendix A: QUESTIONNAIRE SURVEY

MSc RESEARCH QUESTIONNAIRE : APPLICATION OF VALUE ENGINEERING IN CONSTRUCTION INDUSTRY OF PAKISTAN

Section I: A brief overview of VE for construction projects

Value Engineering is an excellent decision making technique that invites brain storming and focusing on functions of a particular intent of construction activity rather than use alone. It is undertaken by a multi disciplinary team usually managed by a Value Specialist, a person who is trained and acknowledged to be holding expertise to conduct a value engineering workshop. A VE workshop results in formulation of a Job Plan, which usually achieves a trade off between time, cost, and quality; hence meeting clients requirements with minimum initial and life cycle cost while maximum deliverables.

Value Engineering technique exists elsewhere in developed and developing world since 3-4 decades, however the term is relatively new for our construction industry. May it be undertaken to cut cost, increase functions or reduce life cycle cost of a construction project; the technique has a wide scope of use and practice in our Construction Industry.

Section : II Respondent Information(will not be published and will only be referenced for research analysis)

-Name of Respondent :

-Designation (CEO/Director/PM/CM/Architect/Engineer/Academician/Others)

-Phone Number:

Section : III Firm/Project characteristics(will not be published and will only be referenced for research analysis)

-Type of firm (Engineering Consultants/Architect

Consultants/Developers/Contractors/Academician/Clients/Other):

-Location:

-Project name & location (if applicable):

-Project gross area/approx cost (if applicable):

Section : IV Perception on Value Engineering

(Objective: To assess general awareness on VE)

a. Are you aware of VE technique on construction projects:

- yes :

- no :

b. Where did you learn about technique of VE:

- professional seminars :

- publications/journals etc :

- colleagues/friends:

- Already applied:

-read as a course/subject:

- others(please specify):

c. In your opinion, is VE/VM:

(please give your opinions on a scale of 1-5, with 1 being Strongly Disagree(SD),

2 Dsagree(D), 3 Neutral(N), 4 Agree(A), 5 Strongly Agree(SA);

1SD 2D 3N 4A 5SA

Merely cost cutting technique					
Increases functions at same cost					
Increases functions & life cycle costs					
Decreases Life Cycle Cost					

- Others (please specify) :

d. After having understood VE/VM concept, do you feel, at your organizational level it is somewhat practiced by:

- designers, by giving various cost effective options to clients :

- not practiced at all :

Section V : Current state of VE/VM

(Objective: To assess current state of VE/VM on projects)

a. Have you ever applied VE/VM on construction project:

- yes:

- no ;

b. If applied, approx on how many projects have you applied it:

- 1 to 5 :

- 5 to 10 :

- 10 to 15 :

- Above 15 :

- None :

c. What were the type of projects on which VE was applied:

Alike;

- Public/private :

- Traditional Architect/Engineer contract:

- Design/construction manager contract:

-Professional construction management contract :

- Design build(turnkey) contract :

d. In your opinion, is VE/VM;

(please give your answer on a scale of 1 to 5, with 1 being Strongly Disagree, 2 Disagree, 3

Neutral, 4 Agree, 5 Strongly Agree

A far fetched idea for a country like Pakistan and has no scope					
Why increase time & cost going to a VE consultant when own designer can easily do the same					
With advancements in project management tools, has a certain scope in construction industry of Pakistan					
Certainly makes a difference to the way we conceive and execute a project					

- Others (please specify):

Section VI: Hindrance to Value Engineering on project

(Objective: to assess factors hindering implementation of VE on projects)

a. In your view, what are the factors which hinder implementation of VE/VM technique

(please give views on a scale of 1 to 5, with 1 being Strongly Disagree, 2 Disagree, 3 Neutral, 4 Agree, 5 Strongly Agree)

Lack of local guidelines and info about VE/VM					
Lack of knowledge and practice in VE/VM					
Interruption to normal work schedule					
Too expensive to carryout VE					
Conflict of objectives by different project stake holders					
Not suitable for low cost projects					

Lack of trained professional in VE/VM					
Lack of training opportunities in VE/VM					

- Others (please specify) :

b. While considering hindrance to VE/VM, which factor would you weigh more;

- Commitment of leadership/management :

OR

- Non conducive environment for teamwork at a project :

c. If you were certain that VE indeed makes a difference, by giving more options to owners, cutting cost of project, increasing functions, taking into account life cycle and maintenance costs, hence helping in decision making and increasing value; which should be a prime concern for planners in an energy deficient country alike ours,

would you, like to implement it, despite the fact that it might increase increase considerable time, design cost and resources for project ;

- Yes :

OR

- No :

Section VII : Scope of VE study, VECP(Value Engineering Change Proposals)and contract sharing clause in our construction contracts

(Objective: to assess if stake holders feel VE study, VECP and contract price sharing clauses have a scope in our construction industry)

a. Do you have a VECP(value engineering change proposal)clause in your contract document;

- yes

- no

b. Do you have contract price sharing clause with contractor(owing to approved VECP) in contract clauses;

- yes

- no

c. Do you recommend addition of a VE certified personnel in your design team hence VE remains a priority area right from conceptualization/designing of project:

- yes:

- no :

d. With a need to follow standardization, and FIDIC 99 specifying carrying out Value Engineering study for projects, would you recommend addition of such a clause in PEC(Pakistan Engineering Council)contract documents:

- yes:

- no :

e. What would you recommend out of following :

- Carrying out VE study for projects ,clause (consultant specific):

OR

- Carrying out VECP with contract price sharing clause (contractor specific):

OR

- Both

Additional Comments/Suggestions -----
