SUCCESS FACTORS FOR IMPLEMENTING VALUE ENGINEERING PROPOSALS IN SAUDI ARABIA

BY

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DEDICATION

I dedicate this thesis to my parents, Emad Yousef and Laila Mansour, my brother, and sisters for their endless support and encouragement. To my colleagues whom assisted me without hesitation whenever I needed a hand. To the senior project management specialists Dr. Mohammed Al-Ghamdi and Bashar Nasser who had a positive impact on me and inspired me to do my best in this field.

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ABSTRACT

Full Name : Bader Emad Y Al-Saleh

Thesis Title : Success Factors for Implementing Value Engineering Proposals in Saudi Arabia.

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Value Engineering is one of the best practices that aligns organizations to achieve their corporate objectives. Effective VE study achieves ambitious goals for organizations with respect to function. However, most VE studies encounter problems with implementing the VEPs, due to multiple reasons associated with the implementation of these ideas. Therefore, this research study identifies success factors for implementing Value Engineering Proposals (VEPs). It provides a real illustration of the reasons for not implementing VEPs through investigating thirty-eight (38) VE reports on construction projects that were selected going back six years from a prominent organization database center that contains more than (3500) ideas created during VE workshops. This was done by conducting interviews with VE-specialists and non VE-specialists, and by distributing a questionnaire survey to VE and non VE-specialists in Saudi Arabia. The findings showed that the percentage of the implementation status for the total VEPs was 50% of Not Accepted (NA) Value Engineering Proposals in the implementation meeting. The study identified twenty-one (21) success factors from previous studies and a case study in a prominent organization in Saudi Arabia. The factors were ranked by VE-specialists and non-VE specialists using a questionnaire survey to show different perspectives. The results showed that the most crucial success factor for both VE-specialist's and non VE-specialist's is that proposals must have sufficient information to support the decision-making process, meet the decision maker's'

expectations, and show the detailed benefits of the investment. The second, most important factor, for VE specialist's is obtaining the support of senior management for VEP implementation. Additionally, the third most important success factor agreed by both perspectives is following up to expedite the implementation. Finally, the research study presents recommendations for the effective implementation of VEPs.

Keywords:

Value Engineering Proposal, Value Engineering Facilitator, Value Engineering Workshop, and Value Engineering implementation meeting.

ملخص الرساله

الاسم الكامل: بدر عماد يوسف الصالح

عنوان الرسالة: عوامل النجاح المُعينة في تطبيق مقترحات الهندسة القيميّة في المملكة العربية السعودية

التخصص: ادارة وهندسة التشييد.

تاريخ الدرجة العلمية: محرم، 1438

تعتبر الهنسة القيميّة واحدة من أفضل الممارسات التي تتماشى مع الشركات لتحقيق أهدافها. حيث تتضمن فعالية الدراسة بتحقيق دورها للشركات نسبةً الى آليتها في تطبيق مقترحات الهندسة القيميّة. علماً بأن معظم هذه الممارسات تواجه مشاكل في تحقيق مقترحات الدراسة لأسباب مرتبطة في تطبيق تلك المقترحات لذلك هدفت الدراسة إلى تحديد عوامل تساعد في نجاح تطبيق المقترحات.

و بحثت الدراسة عن الأسباب و عوامل النجاح في 38 تقرير للهندسة القيمية من خلال مركز المعلومات لأحدى الشركات الكبرى في المملكة العربية السعودية في إطار هندسة التشييد. وحيث اشتملت التقاريرعلى 3500 فكرة مقترحة في ورشات عمل الهندسة القيمية وإضافة إلى إجراء مقابلات مع رواد الهندسة القيمية، و تم توزيع استبيان على رواد الهندسة القيمية و مستخدمين المقترحات الفعليين لتقييم عوامل النجاح. ولقد أظهرت الدراسة أن 50% من المقترحات تُرفض خلال الإجتماعات التي ما بعد ورشة العمل، كما أدت الدراسة إلى استنتاج 21 عامل نجاح لتسهم في نجاح تطبيق المقترحات. و تم تقييم العوامل من قبل مستخدميّ المقترحات و خبراء الهندسة القيمية من خلال الاستبيان الموزع لهم لمعرفة وجهات النظر المختلفة. و لعل من أبرز و أهم العوامل التي تم الاتفاق عليها من قبل الطرفين:

- احتواء المقترح على المعلومات الكافية لدعم عملية اتخاذ القرارو الوصول إلى توقعات متخذين القرار، بالاضافة إلى اظهار تفاصيل دقيقة مالية للمقترح،
- توفيرالدعم من كبار المسؤولين لتطبيق مقترحات الدراسة القيميّة، و
- المتابعة في عملية تطبيق مقترحات الهندسة القيميّة.

كما أظهرت الرسالة توصيات لمستخدمين الهندسة القيمية تساهم في تطبيق المقترحات.

كلمات مفتاحية: مقترحات الهندسة القيمية, ورش عمل الهندسة القيمية, و اجتماعات تطبيق المقترحات.

CHAPTER ONE: INTRODUCTION

1.1 Background

Saudi Arabia is ranked as one of the most effective practitioners of Value Engineering taken from among twenty countries listed by SAVE International "The Value Society" (based in the United States), (Dell' Isola, 1997). Organization services in Saudi Arabia seek to have successful projects. Value Engineering is one of the best practices that aligns organizations to achieve corporate objectives. Value Engineering is a very dynamic process at the conceptual stage of a project. Effective VE study achieves ambitious goals for organizations with respect to function. However, direct attempts by organizations to conduct these kinds of best practices usually result in a low level of implementation effort. In its place, best practices for large-scale projects can be used to ensure the success of the organization's projects. The VE tool includes a function to validate the approximate life cycle cost, and to improve quality (Dell' Isola, 1997). Value Engineering is considered to be a successful method for delivering highly visible projects. Historically, successful VE studies have been seen in a number of countries around the world. Due to rapid technology growth and active market competition, owners usually look for more concentrated VE studies in order to save time. However, the project characteristics such as nature, type, complexity, and size, negatively affect the VE systematic methodology (Shen et al., 2003). Obviously, there appear to be several reasons why VEP hasn't developed. First, there is the risk associated with the implementation of these proposals such as, the high cost of the proposal, and the unavailability of resources (Shen et al., 2003). Second, there are the factors affecting the implementation of VEP such as the conflict of interest between the stakeholders involved in the VE study. In both cases the organization service should have the resource capability, while it would be much more valuable to have a well-established methodology for conducting and implementing the Value Engineering

Proposals. However, emerging new technologies in VE studies are likely to result in a sharp increase in the effectiveness of the VEP's implementation.

1.2 Problem Statement:

One important tool to ensure the success of projects is using best practices for management. Value Engineering is one of those practices that aims to obtain an optimum balance of quality, efficiency, performance, and life-cycle-cost of a project. The outcomes of this tool are the *Value Engineering Proposals (VEPs)*. Furthermore, the ideas created during the Value Engineering workshop, which have a potential high value, should be discussed and evaluated during the workshop. However, most VE studies encounter problems with implementing the VEPs, due to multiple reasons associated with the implementation of these ideas. Hence, it is reasonable to ask the following questions related to the research and provide an answer to them:

- To what extent is a lack of implementation prevalent?
- What are the reasons for not implementing Value Engineering Proposals?
- What are success factors required for implementing Value Engineering Proposals?

1.3 Research Objectives:

The research study aims to:

(1) Investigate the extent of the rejection of Value Engineering Proposals during the implementation meeting.

(2) Identify success factors for implementing the Value Engineering Proposals.

(3) Rank the importance of the success factors.

1.4 Research Significance:

The implementation of Value Engineering Proposals adds significant value to construction projects. However, some organizations that conduct Value Engineering studies usually achieve a low level of implementation effort due to a lack of budget, lack of resources, and a lack of awareness of a project's life cycle cost. A study of the success factors for implementing the Value Engineering Proposals will help Value Engineering Practitioners and organizations to promote Value Engineering in the following ways:

- Enhance the implementation of Value Engineering Proposals.
- Provide awareness prior to the implementation of Value Engineering Proposals.
- Recommend criteria for implementing Value Engineering Proposals.

1.5 Research Limitations:

The objectives of the research study are to investigate the size of the problem caused when implementing Value Engineering Proposals (VEPs), investigate the reasons behind not implementing (VEPs), and identify case study success factors for implementing Value Engineering proposals. However, these factors will be assessed and compared with success factors obtained through the review of literature. This study is limited to Value Engineering practitioners and project owners who have experience with Value Engineering in the Eastern Province of Saudi Arabia. The Eastern Province was selected since most the organizations which promote Value Engineering such as SABIC, SECO, and Saudi Aramco are located in this region (Dell' Sola, 1997).

CHAPTER TWO: LITERATURE REVIEW

This chapter reviews previous studies related to the subject topic. The scope of the discussion is divided into six parts. This section introduces the concept of value engineering and its history. The second section discusses the benefits of its implementation. The third section identifies the critical success factors from previous studies. The fourth section discusses factors influencing VE studies. The fifth section identifies risk associated with VE studies. The last section discusses the proposed models for the VE techniques.

2.1 Concept of Value Engineering and its effectiveness

It is important to understand the concept and features of Value Engineering by starting with the capability of the team members. Value Engineering could be defined as a team and function oriented method that improves value while maintaining end user satisfaction. Depending on the request, the traditional value method is often known as: Value Engineering, Value Management, or Value Analysis. The term Value Engineering will be used in this research. SAVE International (2015) defined Value Engineering as a prepared energy to analyze the functions of the machine, project, product, and services for the purpose of identifying the crucial functions with an optimum life cycle cost which are consistent with the required performance, reliability, quality, and safety. In addition, it is also important to understand the VE characteristics in general, which are team effort, function analysis, life cycle costing, and a well-structured methodology.

2.1.1 Value Engineering Phases

A Value Methodology Job Plan is classified by SAVE International (2015) into three stages. These three stages are as follows: *Pre-Workshop Stage; Workshop Stage; and Post-Workshop Stages.* Where a Value Study consists of the following stages: *Information, Function Analysis, Creativity*

Phase, Evaluation Phase, Development Phase, and Presentation Phase. These stages differ in their type and implementation. Each stage of the VE can be influenced by many factors that improve the success of the implementation of ideas during the *Post-Workshop Stage*.

2.1.2 How does Value Engineering Work?

Value engineering practice is an orderly process that attempts to answer six basic questions: (1) What is it? (2) What does it do? (3) What must it do? (4) How much does it cost? (5) What other materials or methods can be used while maintaining the same function? (6) What would be an alternate material? (SAVE International, 2015). These questions should be answered through the use of the Value Methodology Plan.

2.1.3 Value Engineering History in the United States

The Value Engineering concept started in World War II from 1938 to 1945 for two main reasons. First, to maximize profitability by focusing on achieving maximum returns from organization assets is one factor. Second, material and resource shortages are one of the main reasons why VE was established in the United States and specifically at the General Electric Company (GEC) in the late 1940's (Mukhopadhyaya, 2009).

2.1.4 Value Engineering History in Saudi Arabia

General Al-Otaishan established a Value Engineering Practices Program in Saudi Arabia more than 3 decades ago. This has resulted in an approximate cost avoidance of $30 million to $75 million per year at the General Directorate of Military Works (GDMW), and the Saudi Arabian Ministry of Defense and Aviation (MODA) (Dell' Isola, 1997).

2.2 Benefits of Implementing Value Engineering Proposals

A well-structured methodology for the implementation of VEPs benefits organizations with a successful VE study for business units with decisions that include: strategies for assets expansion

possible project disclosure, and resource commitment for further project development. Hwang et al., (2015) stated that cost avoidance in construction projects is between 5%-10%. Dell' Isola (1997) agreed on a similar cost avoidance percentage from VE programs for GDMW-MODA in Saudi Arabia. Whyte and Cammarano (2012) stated that the VE methodology contributes the benefits of avoiding unnecessary capital expenditure (CAPEX) and operational expenditure (OPEX) by using VE techniques for Western Australian companies in both the construction stage and design stage. The results revealed the benefits of implementing the VE techniques' cost benefit analysis, brainstorming, and risk assessment. They are:

(1) Increase project value;

(2) Cost avoidance;

(3) Documentation of outcome;

(4) Claims resolution;

(5) Enhanced effectiveness of a project;

(6) Enhanced communication between team members;

(7) Enhanced standing.

In addition, the study illustrated that the involvement of a contractor and a sub-contractor in the early stage of the VE study will result in an efficient constructability. In a similar study, Dell' Isola (1997) mentioned that the designer provides feedback on the ideas before the proposal gets implemented. However, upper management fear the changes that come from the VE workshop, where in fact Dell' Isola (1997) mentioned that the VE process benefits the design changes for optimization purposes, instead of leaving it to chance. The Implementation of Value Engineering Proposals is one of the most important tools which is partially used to measure a project's performance (Ramly et al., 2015).

2.3 Factors affecting the Implementation of Value Engineering Proposals

There are many influences related to low implementation probability. Firstly, due to ineffective Value Engineering proposals, there is not enough time to implement VEP. Other factors include: management are not aware of future cost avoidance (Life-Cycle-Cost), and inefficient tracking systems which can significantly influence the implementation. Leung et al. (2014) mentioned that participants have different objectives. Therefore, the workshop stage will experience a variety of opinions that will result in an inefficient workshop. The study by Leung et al. (2014) encourages the VE participant to aim for a win-win situation, thus the VE facilitator capability in terms of VE knowledge and conflict management resolution play a major role in achieving participant satisfaction. Dell' Isola (1997) stated eight factors that result in unnecessary cost that will detract from the objective of achieving good value. They are: (1) insufficient information; (2) short-term conditions; (3) not enough ideas; (4) conflict of interest; (5) behavior; (6) change requirements by the owner (7) a lack of communication between the participants and (8) outdated standards. Moon et al. (2012) mentioned that unstructured and unorganized idea generation during the workshop phase will result in the organization missing the value of good ideas for improvement. Fan et al. (2013) identified the factors influencing the VE workshop in Hong Kong, which were: insufficient time for the VE workshop, absenteeism of the team and weak interaction between team members, issues with evaluation and analysis, previous similar VE studies, and a lack of familiarity with VE knowledge. The results showed that Group Decision Support System (GDSS) can be used as a tool to improve the level of communication between the team participants, which can significantly enhance idea generation.

2.4 Risk Associated with Value Engineering Proposals implementation

As mentioned earlier, there is a lot of risks associated with VEP implementation. Therefore, Hwang et al. (2015) stated that managing the risk could attain better value. He studied the relationship between the risk and the VE phases. The results of this study showed that a lack of experience in VE is the most important risk factor among the eighteen risk factors. Zuo et al. (2007) identified 25 risk factors and categorized them as follows: (a) risks which influence designers, (b) risks which influence contractors and subcontractors, (c) risks which influence the owner, and (d) outside issues, which can affect the project objectives time, quality, safety, cost, and environment. Therefore, all parties and stakeholders must work together during the feasibility study to manage the risks efficiently. Yuan et al. (2013) identified seven major risks associated with virtual VE workshops. These risks are: (1) inadequate information, (2) lack of team participation, (3) time management of the VE workshop, (4) technology problems, (5) information security issues, (6) poor coordination because of varied geographical locations, and (7) weak virtual management by the facilitator. The study showed that identification of these risks contributes to the successful implementation of virtual VE workshops.

2.5 Proposed Models approach to contribute to the success of Implementing Value Engineering Proposals

Leung et al. (2014) mentioned that the facilitator capability, in terms of technical knowledge, was responsible for the success of the Vale Engineering workshop. The combination of the VE knowledge with project management principles and techniques by facilitator guaranteed the success of the VE study. Furthermore, Dell' Isola (1997) suggested a common exercise in VE, which is the cost model. Thus, enhancing both the facilitator's and the participant's knowledge about the project content, while increasing a comprehensive understanding of cost, helps decision

makers to identify whether the Value Engineering Proposal can be easily implemented, and aids in deciding between different alternatives.

2.6 Emerging new technologies improve the implementation of VEPs

Assaf et al. (2000) introduced a proposed computerized system to implement Value Engineering studies in a simple, fast, and accurate way. The proposed system opens the way for developers to develop a smart system that can be useful for value practitioner in the following terms:

- Select the best idea, and generate the Life Cycle Cost (LCC) as a checkout system.
- Create a database to keep a reference record for further studies.
- Exclude human error.
- Consume time.

2.7 Reasons for not implementing Value Engineering studies

The study by AlZahrani, (2006) aimed to: (a) verify the Value Engineering awareness program in Saudi Basic Industries Corporation (SABIC) and specifically the Engineering Project Management department (EPM), (b) identify the reasons for the postponement of VE establishment, and (c) recommend ways to enlarge the practice of VE in SABIC-EPM. Further, this study found that the VE concept is not functional at SABIC for several reasons. These reasons were ranked according to the degree of their importance. The two main reasons are:

- Lack of knowledge of the VE concept, and
- Misunderstanding the advantages and financial aspects of VE.

The research by Fan et al. (2008) presented the problem encountered with the implementation of VE in the Hong Kong construction industry. In addition, the study presented the reasons associated with the problems, and introduced a proposed computer based system called a “Group Decision

Support System" (GDSSs) to resolve the problems encountered in the VE study. Further, the research was supported by two validation studies to test the validity of the GDSSs. The following table by Fan et al. (2008) is helpful in overcoming problems in VE workshops.

Table 1: The problems and their reasons encountered in Hong Kong VE studies *Fan et al. (2008)*

Problems	**Reasons**
Short VE duration.	Owner enforces shortening the VE workshop duration in order to cut cost.
No available information.	Poor coordination during the pre-workshop stage.
Absenteeism and low interaction by the participants.	Difficulty in bringing all the information to the meeting, and participants fear of public speaking.
Problems facing the evaluation criteria such as the analysis difficulties.	Inconvenient timing to complete the analysis.
Lack of VE knowledge.	Participants aren't aware of the VE process.
Unavailable database for VE studies.	Lack of reference projects.

2.8 Success Factors for effective Value Engineering studies

In order to implement the Value Engineering Proposal successfully, it's necessary to identify the success factors for all the stakeholders that are involved in the VE process. However, Hwang et al. (2015) investigated the position of VE implementation in Singapore building projects, which was related to project size, and the results showed that among 432 projects the percentage of implementation was 18.1%, which is very low. Shen and Liu (2003) identified 15 critical success factors, and studied their importance according to the degree by which they influence a successful

outcome. These 15 CSF's were organized into four groups, as follows: (a) team impact; (b) owner impact; (c) facilitator capability; (d) organization influence.

Team impact:

(1) *Clear information and preparation:* team preparation in delivering information during the information phase is important for the team members to ensure that they understand the current status of the project.

(2) *Team alignment:* selection of the Value Engineering team is essential to contribute to the success of the study. In addition, it is important that the coordinator makes sure to invite all the stakeholders who are involved in a certain project.

(3) *Team knowledge;* (4) *Team VE experience; and* (5) *Professional level:* the different team compositions in terms of knowledge, experience with Value Engineering, and the involvement of upper management provided the study with the required chemistry to achieve success.

Owner impact:

(6) *Owner support and participation:* as mentioned earlier, owner support and participation helps to increase the engagement of decision makers. However, some organizations mandate the owner's participation to ensure the credibility of the Value Engineering implementation.

(7) *Definite goals of the study:* having clear objectives for a certain project provide the participants with better understanding and the ability to think of alternatives to achieve those objectives. However, the goals of a project must be aligned with the Value Engineering principles and rules. For instance, ignoring mandatory regulations by standard or specification.

(8) *Timing of the VE study:* the most appropriate time for a Value Engineering study is as early as possible, so that project owners can pin point problems before they occur. Obviously, changes implemented at early stages require less effort, resources, materials, logistics, and money.

(9) *Duration of the study:* practically owners aim to fulfill the requirements and start the project as soon as possible. In addition, they require a shorter workshop duration without thinking of the benefits which they can attain from such a study. In Value Engineering, the workshop duration depends on the project size, complexity, and nature. It usually takes five to ten days.

Facilitator Capability:

(10) *Facilitator experience with Value Engineering:* in general, terms the facilitator's knowledge, experience, and capability with VE play a major role through the process of implementation in some organizations. On the other hand, the facilitator's capability in controlling the VE process in terms of communication, time, and cooperation are an essential part in ensuring a successful workshop.

(11) *Managing a workshop:* the control of the workshop usually is the facilitator's role. Therefore, establishing the ground rules of the workshop such as, no side discussions, no criticism, no credibility etc. are essential to achieve the purpose of having a successful Value Engineering study.

(12) *Function analysis:* the aim of the function analysis is to identify the purpose of a project by asking the basic questions of Value Engineering such as: What must it do? What are the alternatives? What does it cost? Then the Functional Analysis System Technique diagram is drawn. This practice lets the team achieve the objective of the study easily with a well-structured methodology.

(13) *Communication skills:* it is obvious that each member of the workshop represent their functional department. Conflicts are to be anticipated as a result of the work created during the VE study, since the study outcomes in another party are being asked to reflect a change. Conflict may be seen as a negative point but can be valuable in a team setting if you maintain honesty, maintain elasticity, think clearly, and avoid censuring the current situation.

Organization Influence:

(14) *Other department's support:* the team should have a high level of communication through trust and cooperation to achieve synergistic (win-win). This level can be achieved through educating the other departments involved in the VE process about the Value Engineering concept and principles, which can enhance the implementation and consideration of the project value.

(15) *Action plan for implementation:* Pucetas and Hunt (1998) stated that a detailed plan for the implementation of the Value Engineering Proposals contributes to having a successful VE study. The plan must consist of the tasks, a timetable, and the responsibilities for finalizing the VE outcome through meetings. However, the best way to achieve a successful post-study is to encourage the project stakeholders to identify the project goals clearly. Shen et al. (2003) recommended that the VE outcome should be shared with all participants, and not just with the owner of the project. Many researchers agreed that the most important CSF is owner participation and involvement in the VE study (Shen and liu, 2003), and Dell' Isola, (1997). In a similar way, Hwang et al. (2015) identified the leading success factor for VE study to be communication between the VE team members. While Ramly et al. (2015) argued that identifying a clear purpose for the VE workshop is the most crucial success factor, followed by owner participation. Pucetas and Hunt, (1998) identified that the most important implementation factor for a successful Value Engineering study is the human factor. The result of this study revealed that the human factor improves implementation of the Value Engineering Proposals, and increases the "Return on Value Engineering Investment (ROI)" to the maximum for the owner.

Fraser (1984) studied the involvement of a value specialist in managing change through emerging problem solving skills among the VE team members, in order to increase the approval of the VEPs change in organizations. In addition, the study enables managers to develop an effective strategy

change plan such as: (a) understanding the organization behavior, (b) adopting change, (c) leadership, (d) attitude, and (e) disagreement.

2.8.1 Success factors for implementing VEPs

The VE guidebook by the Department of Defense in the USA (2011) discussed the steps necessary to undertake a successful VE implementation. These factors will be used as guidance for the VE practitioners to achieve a successful implementation for VEPs as shown below:

1. **Monitor progress:**

Implementation progress should be treated systematically as a VE study. The active contributions of the VE teams ensure the success of the implementation. In addition, holding each person accountable for the deadline dates helps the success of the implementation as well.

2. **Speed up the Implementation:**

The VE team must provide support to reduce the time required for implementation by eliminating any VEP misunderstandings, resolving problems expected to emerge during implementation, and preparing a draft that summarizes and clarifies the action plan required.

3. **Follow-up**:

This stage improves the resulting VEPs and the VE study by evaluating the actual action plan, cost savings, actual results versus expectations, and any technical issues experienced during implementation. The evaluation will result in a list of lessons learned, help to broadcast accomplishments, and help spread the potential success of VEPs.

4. **Meet the decision makers' expectations:**

This success factor can be achieved towards two spectators: 1) Technical ability that requires engineering practicality regarding the proposal, and 2) Administrative reviewers usually focus on cost benefit analysis, long term effects on procedures, and procurement.

5. **Address risk:** usually the decision-making authority committee are interested in risk associated with the VEPs rather than focusing on the value of the proposal. Therefore, understanding the organization's behavior should be taken into consideration, and general risks should not be confused with technical risks.
6. **Align with organization objectives:** the presentation to the decision makers should include all of the advantages to fulfill the strategic objectives of the organization, but this is not necessarily related to cost saving in some cases.
7. **Show the detailed benefits of the investment:** usually VEPs offer more benefits than cost improvement. This success factor emphasizes the clear identification of the benefits, and that they are comprehensively described to decision makers.
8. **Do a life cycle cost analysis:** this is required to allow selecting the best alternative based on the cost analysis estimate that must be totally complete and accurate. The cost estimate analysis may include, but is not limited to, tools, materials, changes to plant, required staff, any required tests, and any costs due to the changes introduced.
9. **Select the best alternatives:** discipline specialists must be consulted to help select between alternatives. The selection procedure can be determined based on life-cycle savings, weighing cost and benefits, major risks, risk mitigation method, and any outstanding technical issues. In case of close significant saving between proposals, ranking them in decreasing order of savings potential is recommended.
10. **Prepare an implementation action plan:** a schedule of required implementation steps must be prepared that may include, but which are not limited to:
    - Identify the implementation staff.
    - Determine the required resources.

- Identify the required documentation and approvals.
- Determine the time required.
- Define expected problems with proposed solutions.
- Testing and evaluating some proposals or even part of a proposal is also helpful.

However, Astle (1968) identified additional success factors for VE studies implementation as shown below:

11. **The VE study must have the complete support of senior management:** senior management must have enough knowledge about Value engineering and be convinced that it always yields positive results.
12. **The VE team leader should report to senior management:** in such cases, senior management will quickly decide based on the successfully finalized reports, and will be aware of the importance of the VE study while they are still receiving reports and are being updated about the study.
13. **Senior management must take an active interest regarding VE study and results:** this can be done by following these steps:
    - Setting realistic objectives for cost saving.
    - Providing pressure for valuable projects that tend to pause.
    - Encouraging successful projects by showing their appreciation to VE studies and members.
    - Commenting on the team activities for the sake of improvement.
14. **VE study must be a team effort:** not only selected people must join the study, but also sometimes labor may add more value to the study than the selected people, and hence all personnel must be involved in the study.

15. **Publicize successful ideas which could be used another time:** any ideas that contribute to cost avoidance must be known and commonly used by everyone.
16. **Fully utilize the company suggestion list:** studying the structure of accepted proposals and the reason for the rejection of previous proposals can do this.
17. **Take a broad view of the VEP benefits that may apply for any other part in the same project:** any successful proposals may work on more than one product or part of the project.
18. **Prioritize the resulting proposals based on the ease of presentation to managers and their implementation:** the more cost saving, easier implementation, best strategically aligned proposals are better to introduce first.

CHAPTER THREE: RESEARCH METHODOLOGY

To achieve the objectives stated for this research, two research instruments are utilized. The first instrument is a case study conducted in a major organization in Saudi Arabia. The case study addresses all the objectives of the report as far as they are reflected in the investigated organization. The details of this case study are described in the following section. The second research instrument utilized is a survey questionnaire that will identify the degree of importance of success factors that were identified from the case study and the literature review.

Figure (1) depicts the overall methodology of this research. The flow chart depicting the research methodology illustrates the scope of the methodology used to define the research objectives. Therefore, dividing the flow chart into research instruments, method, and outcomes (achieved objectives) demonstrates the research methodology sequence. In addition, research instruments are chosen to support the objectives of the research through three main elements, which are: (1) review documents and interviews based on a case study, (2) a literature review, and (3) a survey questionnaire. Furthermore, the outcomes of the study (which are in the final stage), are to:

• investigate the extent of the problem,

• identify success factors for implementing VEPs, and

• rank the importance of the success factors.

Furthermore, the figure shows sub-objectives for the main objectives. The sub-objectives are contingent to the main objectives. At the end of the case study and literature review, success factors are integrated into one summarized list to be distributed through two sets of questionnaires. The

flow chart is like a continuation process chain, where the final stage is the outcome of stages one and two.

The basis of the case study is to: a) review documents from the organization database center, and b) conduct direct interviews with VE and non VE-specialists.

The method of the case study is to investigate the problem size from the organizations' VE reports, and investigate the reasons for not implementing VEPs from two sources. The first source is the interviews with VE and non-VE specialists. The second source is the remark section on the VE reports. The case study research instrument is linked to achieve the first and second objectives through the research methods mentioned. The literature review is the chain between the case study and the survey questionnaire. The outcome of this step is to identify the success factors from previous studies by examining the reasons. The success factors were identified from two sources. The first source is the case study, and the second source is the previous study. The importance of these two sources is substantial in developing a comprehensive discussion and integrating the latest research findings. The intention of ranking the importance of success factors is to compare:

• Rankings by VE and non-VE specialists, and

• Rankings by VE-specialists of success factors identified from the case study and those obtained from the literature review.

The questionnaire survey method is to assess the importance of all of the success factors through two sets of questionnaires. One set is directed to VE specialist and the other one to non VE specialists. The questionnaire survey combines the literature and the case study success factors. The factors were obtained from achieving the second objective. The third objective is achieved through the surveys analysis of ranking the success factors.

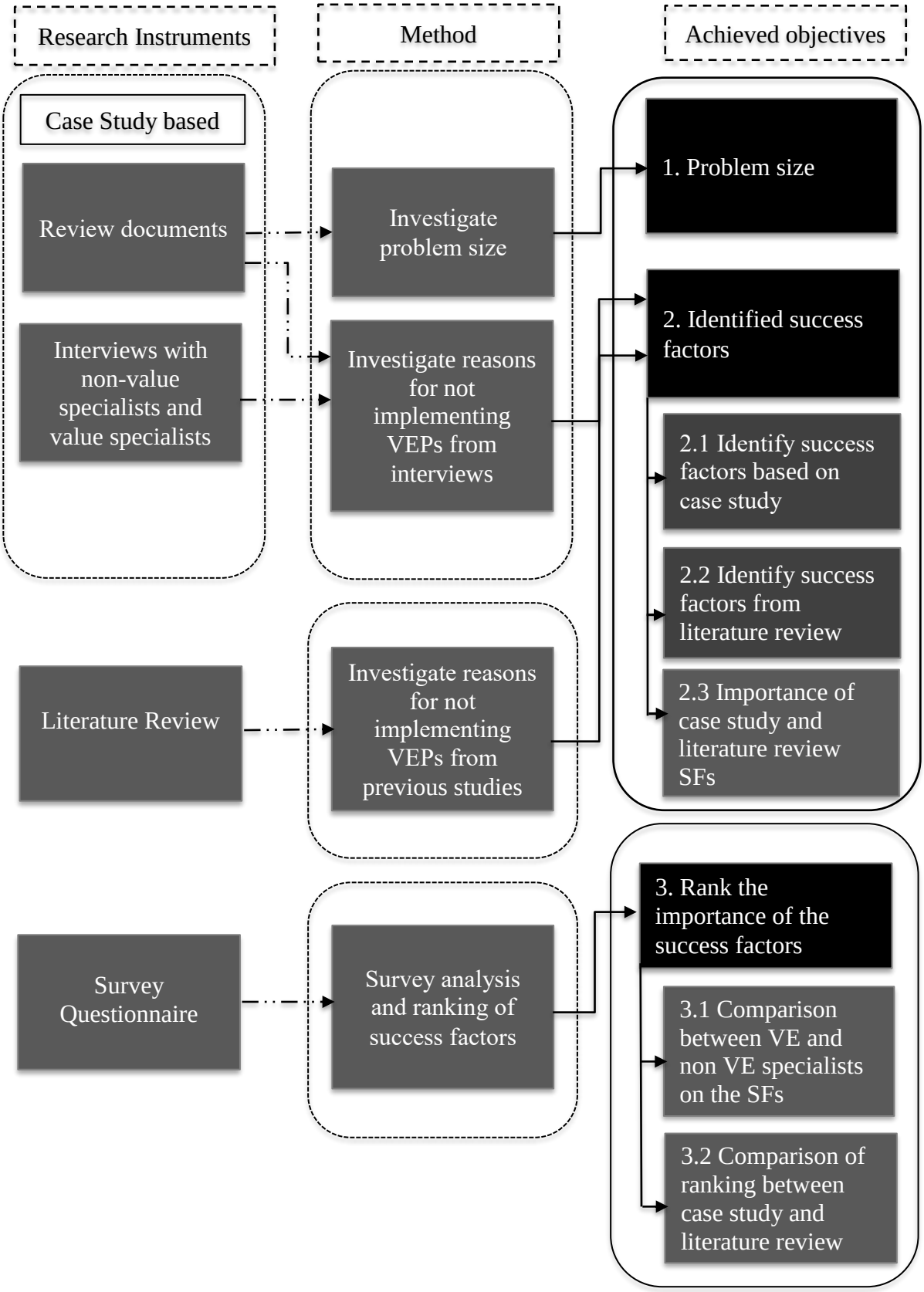

Figure 1: Flow chart of the Research Methodology

3.1 Case study

A case study is a study of an organization, individual or a project. Case studies are useful in construction management research by providing insight and describing phenomena, and are used in project-biography and illustrative anecdotes. The data for a case study is gathered from documents, observations, questionnaires, interviews, and archival records (Fellows and Liu, 2008). The case study in this thesis originated from a major organization in Saudi Arabia. The methods used were reviewing VE reports and conducting direct interviews of VE and non-VE specialists. Starting a research with a case study gives a clear understanding of the problem size and the reasons for not implementing. The purpose of the case study was to provide insight into the problem size from the VE reports and to support the problem statement with the reasons for not implementing. Another purpose for conducting the case study was to study and understand previous reports and look into the reasons for not implementing in order to identify the success factors. The study was also conducted to show and explain to the reader that there are reasons for not implementing VEPs applicable to organizations in the eastern province of Saudi Arabia.

The objectives of this study are: 1) the study will investigate the size of the low implementation problem facing accepted VEPs, and 2) to identify success factors for implementing VEPs from the case study.

3.1.1 Data required

The first objective related to the extent of the problem will be demonstrated by investigating the proportion of not-implemented VEPs as compared to the total of the originally accepted VEPs. The not implemented VEPs are defined as the proposals that were rejected by at least one of decision maker's entity members and documented as Not Accepted (NA) in the final VE report. The total number of VEPs represent the overall ideas created during the Value Engineering

Workshop with a possible high value; those ideas should be discussed, evaluated, and implemented. Therefore, identifying the decision makers group entities contributes to achieving the objectives of the study.

The decision maker's group entities are:

1) Proponent: the owner of the project at the VE workshop plays the role of an operation specialist. His vision is critical to the proposal screening process.
2) Planning Department: the planning department representative at the VE workshop is basically the planning engineer who has a strong background and detailed knowledge of deliverables.
3) Construction agency: consult, control, and supervise the execution of a project. Also, the construction specialist provides the coordination of the field site, and provides reference drawings during the VE workshop. In addition, the specialist is always required to share his construction experience and knowledge during the workshop. His role to align the project with the schedule and budget in accordance with the project specifications.

The reasons for not implementing the VEPs identified through a case study at a prominent organization in the Eastern Province of Saudi Arabia.

The status for the implementation of the VEP during the post study stage by the decision maker's group entities are divided in the final VE report into:

1) Accepted (A): are proposals that where agreed among all the entities that have decision making influence over the implementation.
2) Not accepted (NA): are proposals that were agreed during the VE workshop, and then rejected by the decision maker during the implementation meeting.

3) Accepted for further study (AFS): are proposals which need further study and cannot be quantified at an early stage of the project.

3.1.2 Data collection

This part includes all information required to collect the essential data, and how this data is gathered in order to achieve the objectives of the case study. The extent of the problem facing the Value Engineering Proposals (VEPs) implementation is investigated. Where, the data collection is gathered through a combination of an organization's historical documents and interviews. The data collected from the Value Engineering reports in the organization database center. In addition, there are individual interviews conducted with non VE and value specialists. This has resulted in different perspectives regarding the reasons for the lack of implementation of VEPs. The reasons for not accepting VEPs was obtained from the justification comments documented in the final VE reports and refined by conducting interviews from both the perspectives of the owner's proposals and the value specialists. The output of this case study was a summarized list of case study success factors obtained from the reasons for the lack of implementation of VEPs from different perspectives.

3.1.3 Data analysis

The data gathered from the final VE reports were analyzed by using simple statistical approaches for calculating the percentage of VEPs implementation to obtain the extent of low implementation. The overall percentage of VEPs implementation calculated by dividing the number of Not Accepted (NA) VEPs over the total number of Accepted (A) VEPs.

$$Percentage\ of\ VEPs\ implementation\ = \frac{number\ of\ (NA)\ VEPs}{total\ number\ of\ VEPs}$$

The resulted success factors from this case study obtained after analyzing main reasons for not implementing VEPs

3.2 The Survey questionnaire

Surveys can be conducted on a sampled population through interviews, questionnaires, or both. Surveys are conducted to provide and interpret the perspective of a sampled population towards a specific topic (Fellows and Liu, 2008). In this thesis, the survey was in the form of interviews and questionnaires. The purpose of the survey questionnaire was to provide the degree of importance by VE and non-VE specialists towards all the success factors. This part includes all the information required to collect the essential data, and how data is gathered in order to achieve the objectives of the survey questionnaire.

3.2.1 Data required

Success factors for implementing VEPs were collected through two main sources. The first source was the literature review success factor. The second source was the case study success factors obtained from the reasons identified in the case study.

The case study success factors and previous studies' success factors are integrated and distributed through a questionnaire which is to be assessed. This questionnaire is distributed to value specialists and non VE-specialists in the Eastern Province of Saudi Arabia. Where, the VE-specialist is defined as an individual certified by SAVE International, and may be a facilitator who may or may not guide the team through the VE process. The facilitator's responsibility is to describe the VE process, perform function analysis, control discussion, direct the brainstorming effort, create guidelines for selecting ideas, organize the proposal development effort, and finalize the final report. The non VE-specialist is defined as an individual who is not certified as such; but

who may be familiar with or have had some experience with VE by having attended VE workshops or VE studies.

3.2.2 Data collection

A literature review is a study of previous existing work in the identified field. Previous work can be considered to incorporate the important information and the latest findings into the study (Fellows and Liu, 2008). Literature review provides the link and framework for the research study. It's the column that carries the load from the roof to the foundation. In this thesis, the foundation is analogous to the case study, the column is analogous to the literature review, and the roof is the survey questionnaire.

This part combined the case study success factors with previous success factor studies for implementing VEPs. In addition, these factors were compared and assessed through a questionnaire. The questionnaire was distributed among VE-specialists and non-VE specialists in the Eastern Province of Saudi Arabia. The target respondents are value specialist and project owners who have engagement experience with Value Engineering Practices.

The questionnaire (see Appendix I) was divided into three parts:

Part one: questions that cover general information about the organization surveyed.

Part two: covers the respondent characteristics.

Part three: consists of success factors for implementing Value Engineering Proposals as they are identified from the case study and the previous study success factors. The respondents will be required to assess the success factors and their groups for (part 3) by using a Likert scale 1 to 5. Where, 5= extremely high importance; 4= high importance; 3= moderate importance; 2= low importance; and 1= no importance.

The result of this step is to evaluate the degree of importance of the success factors for implementing Value Engineering Proposals.

3.2.3 Data analysis

The data gathered from the questionnaire is analyzed by using simple statistical approaches for calculating the mean, and median values to obtain ranking of all success factors.

A non-parametric test has been used to measure the association between VE and non-VE specialists. Coolidge (2006) mentioned a test called Spearman's ranking correlation which is best-suited for ordinal variables. The following formula is utilized to calculate *P-Value* Spearman's ranking correlation:

$$r = 1 - \frac{6\,x\,\sum d^2}{n^3 - n}$$

Furthermore, hypothesis testing was conducted to determine the association status of the two perspectives as shown below:

H_0: no association between the VE and non-VE specialist's responses for each success factor

H_1: association between the VE non-VE specialist's responses for each success factor

If *P-Value* ≥ 0.05, then don't reject H_o which means there is no association between variables

If *P-Value* ≤ 0.05, then reject H_o which means there is an association between variables

CHAPTER FOUR: CASE STUDY, RESULTS, AND DISCUSSIONS

This chapter presents the case study conducted at a prominent organization in the Eastern Province of Saudi Arabia. The objective of the case study is to assess the frequency of accepted VEPs that are eventually blocked from implementation and to identify the reasons for not implementing them. These reasons formed the basis for establishing a set of factors needed for the successful implementation of a VEP.

The first section discusses the basis of the VE inside the organization and its process. The second addresses the general information of the data obtained from the Value Engineering reports on projects. The third section presents the results of the extent of the problem facing the accepted VEPs. The fourth section identifies the major reasons for not implementing the Value Engineering Proposals.

4.1 Value Engineering in the organization

The organization uses Value Engineering (VE) studies to significantly improve project value. At first, the organization joined the Construction Industry Institute (CII) in 1993 and promoted the use of CII Best Practices including VE. In 1998 the Value Engineering group was created. Then the organization started a formal implementation of Best Practices and created a Best Practices group in 2000. After that, in 2006 the organization trained local Value Practices consultants to facilitate different best practices. During the period from 1997 until now, VE studies conducted on selected projects have resulted in projected savings of hundreds of millions of dollars.

Given the significant benefits of VE studies, and in light of an expanding capital program, the company initiated a formal practice to conduct VE studies on every new project with an Expenditure Request (ER) value of $30 MM or more.

One of the Company's Business Plan objectives is to maximize profitability by focusing on achieving maximum returns from company assets. Value Engineering is the Value Improvement Practice (VIP) which the Project Management Department is using to achieve this objective, and which will be exercised in conjunction with other Capital Program Process Improvement tools.

4.1.1 Value Engineering Job Plan in the organization

The value job plans outline contains three major steps to effectively analyze the project being studied in order to come up with the maximum number of proposals to achieve the project's required functions. Adherence to the job plan will more effectively assure maximum benefits while offering greater flexibility.

The VE study conducted on projects conforms to the prescribed value engineering job plan as outlined by the Society of American Value Engineers (SAVE International). A summary of the basic processes used in the study is included below in figure (2) to give the reader an idea of the standard VE methodology in a prominent organization.

The VE job plan contains three main stages:

1) Pre-workshop stage
2) Workshop stage
3) Post-workshop stage

The value methodology is a structured, disciplined procedure aimed at improving value. That procedure is called the job plan. The job plan outlines the sequential phases to be followed which support team synergy within a structured process, as opposed to a collection of individual opinions. The activities conducted during each phase of the Job Plan will stimulate the team to identify ideas and develop them into alternatives to the original concept or design.

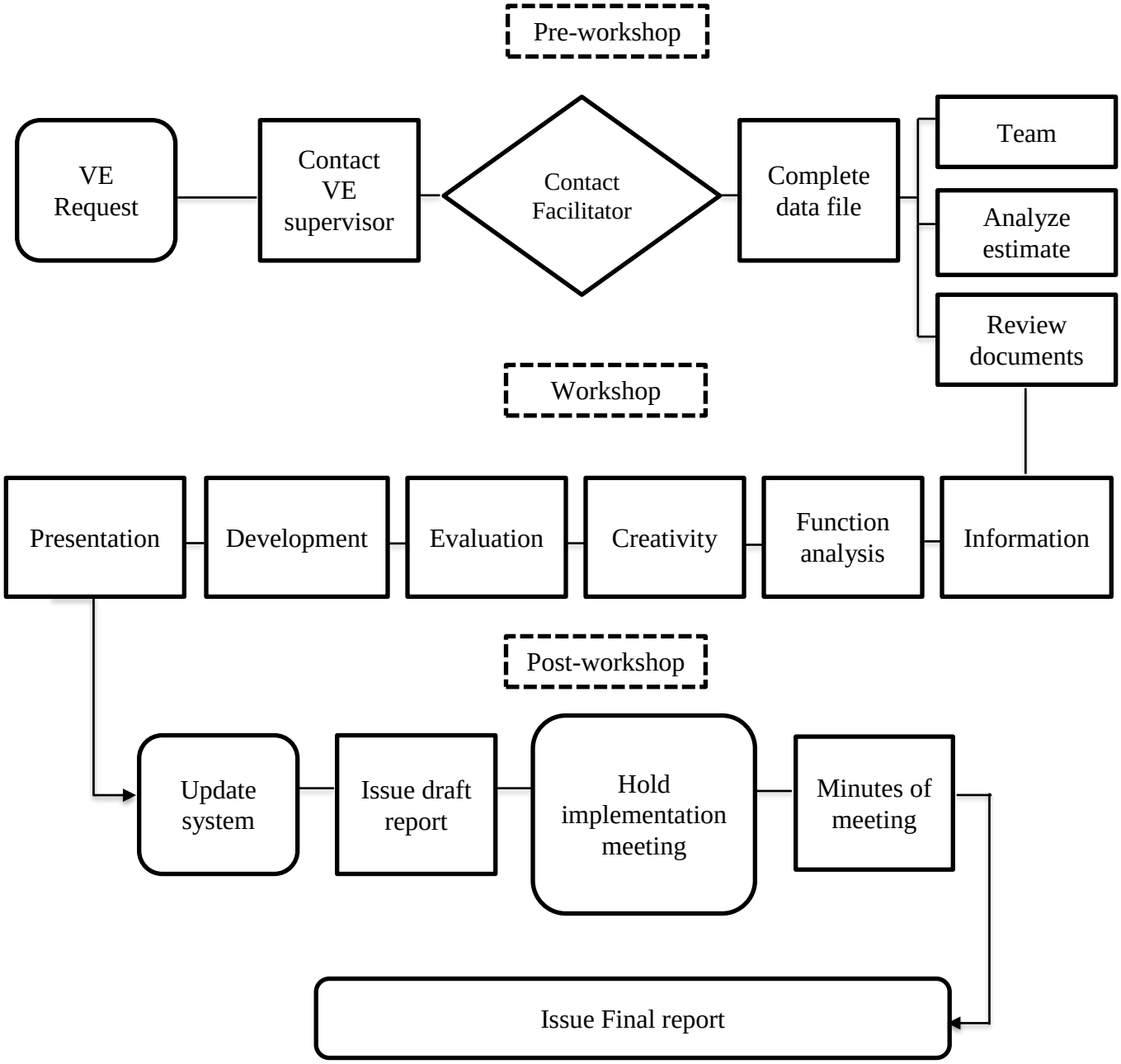

Figure 2: Value Engineer Process in the Organization

1) Pre-workshop stage

All new projects with an Expenditure Request (ER) value of $30 MM or more are required to conduct a Value Engineering study. The best practices coordinator of that project makes a request for a Value Engineering study from the Value Practices Unit (VPU) supervisor. This study is assigned to a certified facilitator, either an internal or a third-party facilitator. The facilitator and the best practices coordinator are leading the effort to handle and prepare items needed prior to the VE workshop. These items could be summarized in the list below:

- Discuss the VE workshop schedule,
- Select the number and composition of the VE study participants,
- Confirm the VE study agenda,
- Discuss the VE process,
- Discuss the role of the VE personnel,
- Acquire the needed documents and information such as cost information, the process and instrumentation diagram, the project execution plan, plot plan, design drawings, and process flow diagrams.
- Select the VE study location including all logistics such as the conference room arrangement, and
- Conduct a site visit if needed.

This effort usually takes three to four weeks of preparation by conducting several meetings, including site visits. This time interval depends on the complexity of the project as well as the VE team involved in the study. Therefore, figure (3) shows the VE team who will be involved in a VE implementation meeting and from which department they will be appointed. The figure also shows that the decision makers are the Proponent, the Construction Agency, and the Planning

Department. The rest of the teams provide support during the final decision for each VEP which need to be Accepted (A), Accepted for Further Study (AFS), or Not Accepted (NA).

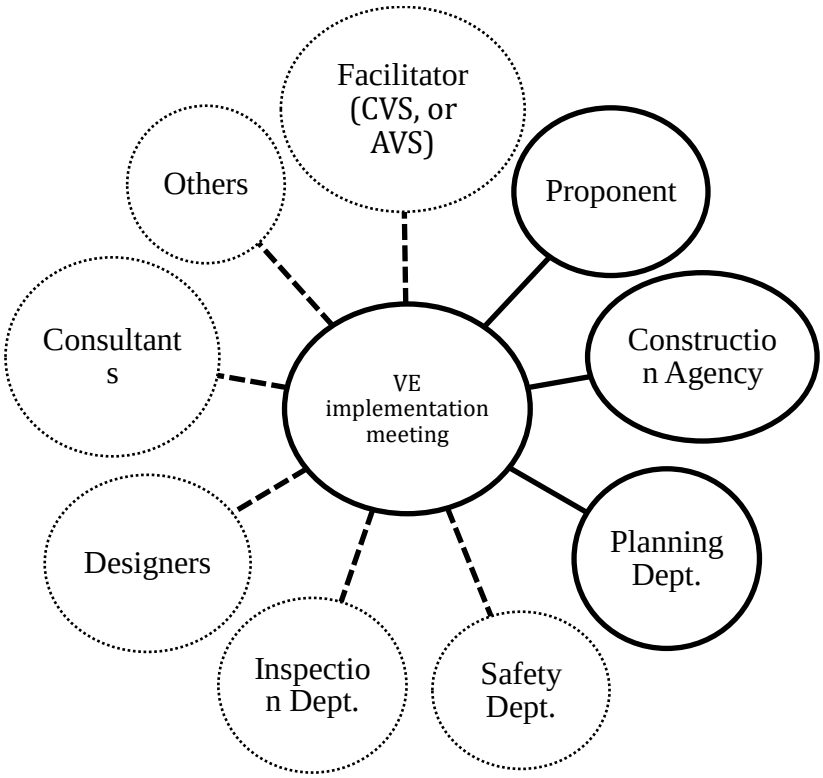

Figure 3: VE team involved in the VE implementation meeting

2) Workshop stage

Information Phase: the team reviews and defines the current conditions of the project and identifies the goals of the study.

Function Analysis Phase: the team defines the project functions using a two-word active verb/measurable noun context. The team reviews and analyzes these functions to determine which need improvement, elimination, or creation to meet the project's goals.

Creative Phase: the team employs creative techniques to identify other ways to perform the project's function.

Evaluation Phase: the team follows a structured evaluation process to select those ideas that offer the potential for value improvement while delivering the project's function and considering the performance requirements and resource limits.

Development Phase: the team develops the selected ideas into proposals with a sufficient level of documentation to allow decision makers to determine if the alternative should be implemented.

Presentation Phase: the team leader develops a report and/or presentation that documents and suggests the capability of the proposals developed by the team and the associated value improvement opportunity.

3) Post-workshop stage:

the goal of the *post-workshop stage* is to attain agreement from the decision-making authority of each VEP, document the acceptance status, and to ease its implementation. During this phase the owner's proposal coordinates and arranges for an implementation meeting with the decision makers. During the implementation meeting, challenges to the change process might appear due to the project circumstances, individual differences and human interpretation. Therefore, the participating of owner's proposals with decision makers is essential to support the technical part of VEP. The meeting must specify needed justifications for Not Accepted (NA) VEPs, and an action path forward plan for those Accepted for Further Study (AFS), and Accepted (A) VEPs.

The VE report passes through two mains stages. The first stage is the draft report that contains all VEPs created during the session without the status of implementation. The second stage is the final VE report that contains the final status for each proposal that is obtained after the implementation meeting. The final report will not be issued without identifying the status of each VEP as resulted from the implementation meeting. The status of the implementation of the VEP

during the post study stage by the decision maker's group entities are grouped in the final VE report into:

1) Accepted (A),
2) Not accepted (NA), and
3) Accepted for further study (AFS).

The issuance of the VE Final Report will be contingent on the outcome of the implementation meeting.

4.2 Information and analysis of Final Value Engineering Reports

Thirty-eight (38) of the Value Engineering Reports (VE reports) were obtained and reviewed for the purposes of this research. A VE Report is the culmination of the VE study. Its content includes:

(1) Introduction,
(2) Project description,
(3) VE session general information,
(4) VE workshop objectives,
(5) VE session agenda,
(6) VE session summary ideas count,
(7) VE session team members,
(8) Implementation meeting information, and
(9) Proposals acceptance status summary.

These reports generate proposals and recommendations for the value specialists, the proponent, planning department, and the construction agency.

Thirty-eight (38) projects conducted over the last 6 years were selected from the organization's database center. They contain over 3,500 ideas created during VE workshops. All of these projects

conducted the VE study at an early stage of a project as a mandatory requirement by the organization. The average duration of a VE workshop for these projects was 4 days with different workshop locations including Dhahran, New York, and Sharjah; while the VE reports were issued in the Eastern Province of Saudi Arabia. The Value specialists are certified from SAVE international as required by the organization in order to facilitate these VE workshops.

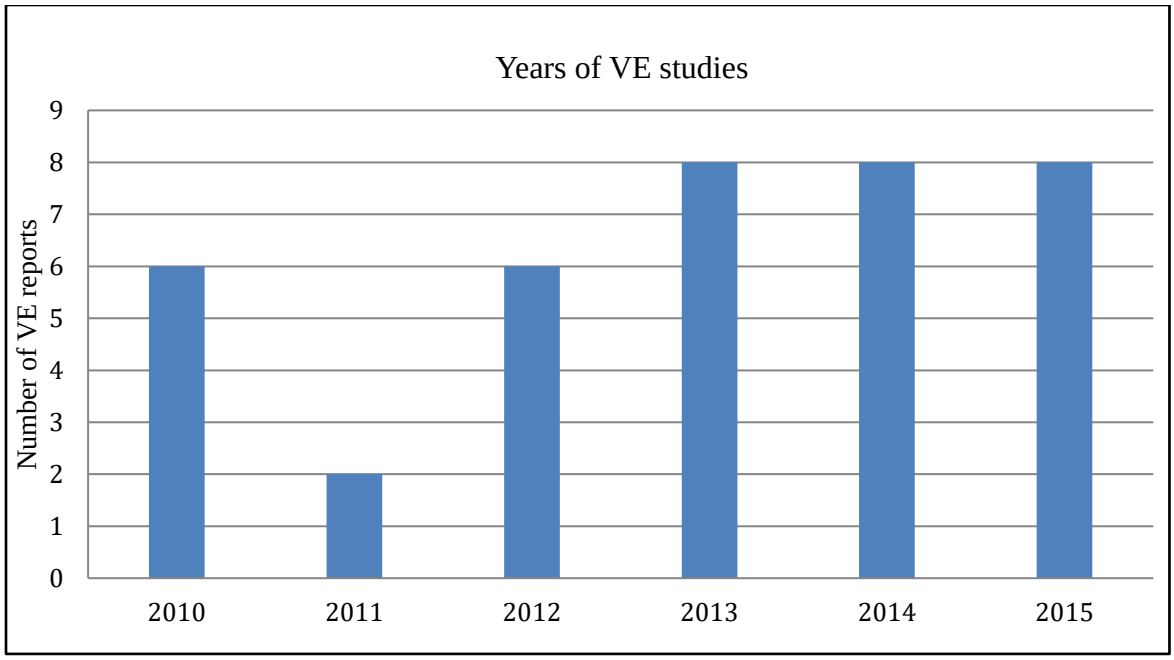

Figure 4: Number of Value Engineering Reports (2010-2015)

As shown in figure (4) the number of reports that have been accessed through the organization database center six reports were from 2010, two reports were from 2011, six reports were from 2012, eight reports were from 2013, 2014, and 2015.

Table (2) illustrates the summary of the data that have been collected from the VE reports. The reports were issued between 2010 and 2015. The total number of the ideas represents all the ideas created during the VE workshop for each project. The idea that has a high potential value to be implemented is called the Value Engineering Proposal. The number of VEPs that were selected was five hundred and eighty (580) proposals with a high potential value (increase functionality

while reducing life cycle cost of $5-10 Million). All accepted proposals by the proponent department and the construction agency were always reviewed by the planning department if they related to scope or cost changes.

The status of all accepted, not accepted, and pending for further study VE proposals were documented in the "Remarks" section of the proposal's worksheet. The issuance of the VE Final Report is contingent on the outcome of the implementation meeting. The implementation status of each VEP incorporated in the final report reflects the decisions finalized and agreed upon during the implementation meeting. The decision is "Accepted (A)", "Accepted for Further Study (AFS)", or "Not Accepted (NA)". Justification for the "Not Accepted (NA)" status was documented, and a follow up plan was addressed and documented for some of the "Accepted for Further Study (AFS)" status.

Table 2: Summary of the Value Engineering Reports with the implementation status

Project No.	Year	Total Number of Ideas	Number of VEPs	A	AFS	NA	Percentage of NA
1	2015	171	35	30	1	4	11%
2	2015	32	5	1	2	2	40%
3	2015	24	2	2	0	0	0%
4	2015	29	2	0	2	0	0%
5	2015	40	4	1	1	2	50%
6	2015	43	12	0	6	6	50%
7	2015	46	5	4	0	1	20%
8	2015	18	1	0	1	0	0%
9	2014	31	13	5	5	3	23%
10	2014	183	30	9	0	21	70%
11	2014	164	18	15	0	3	17%
12	2014	63	1	0	0	1	100%
13	2014	43	20	14	3	3	15%
14	2014	152	8	2	5	1	13%

Table 2: Summary of the Value Engineering Reports with the implementation status ***(Cont'd)***

15	2014	338	23	3	14	6	26%
16	2014	183	30	8	0	22	73%
17	2013	93	7	1	0	6	86%
18	2013	41	7	2	1	4	57%
19	2013	126	50	4	6	40	80%
20	2013	90	12	7	0	5	42%
21	2013	37	2	1	1	0	0%
22	2013	22	22	5	2	15	68%
23	2013	845	18	8	5	5	28%
24	2013	105	33	13	0	20	61%
25	2012	71	21	8	2	11	52%
26	2012	103	13	4	3	6	46%
27	2012	67	14	2	1	11	79%
28	2012	66	14	4	6	4	29%
29	2012	57	17	5	2	10	59%
30	2012	126	50	4	5	41	82%
31	2011	65	5	2	1	2	40%
32	2011	31	11	6	0	5	45%
33	2010	0	18	11	1	6	33%
34	2010	0	14	10	0	4	29%
35	2010	0	8	2	0	6	75%
36	2010	0	25	10	9	6	24%
37	2010	0	3	2	0	1	33%
38	2010	0	7	2	0	5	71%
Total		3505	580	207	85	288	
Overall average of Not Accepted (NA) VEPs			580			288	50%

Table (3) illustrates the type of projects and their description, which provide a clear understanding of the organization projects from 2010 to 2015. Those projects were required to conduct Value Engineering studies due to the applicability of the organization requirements for VE studies such as the project size, project complexity, and project phase. All of the projects reviewed for this research applied the VE study at an early stage of the project, either during the Project Proposal (PP) stage, or during the Design Basis Scoping Paper (DBSP) stage.

Table 3: Summary of the project information and the net impact of Not Accepted (NA) VEPs

No. of Project	Project Type	Project Description	VE Draft Report date	VE Final Report date	Net impact of Not Accepted (NA) VEPs	
					Functionality	Cost
1	Residential	Construct 2,776 housing units, Increment I.	16-Dec-14	29-Jan-15	Low utilization of design spaces for the housing	
2	Gas Plant	Develop Gas Program to support the corporate strategy to meet in-Kingdom energy demand and to reduce crude burning.	10-Mar -15	15-Mar-15	Environmental impact due to crude burning process	
3	Pipeline	Install one redundant line that can be used for either propane or butane services	5-May-15	12-May-15	Weak technical feasibility of the design	
4	Bulk plant	Expand the North Jeddah Bulk plant	3-Nov-15	22-Nov-15	Low utilization with existing condition	
5	Gas plant	Support the corporate objective of reliably supplying oil and gas	9-Jun-15	10-Nov-15	Doesn't meet wastewater specifications	
6	Bulk plant	Meet the demand for refined products in the Makkah Province	17-Jun-15	9-Jul-15	Low utilization with existing condition	
7	Refinery	Provide replacement of all eight hydrocracking reactors	28-May-15	26-Jul-15		Additional cost to the project with total of ($2,200,00)
8	Gas plant	Upgrade the water handling system at Hawiyah	13-Aug-15	30-Aug-15	Reduce the capacity of the water system	
9	Upstream	Construct new pipeline	4-Mar-14	29-Mar-14		Additional cost to the project with total of ($17,000,000)
10	Residential	Construct 3,000 housing units, Increment II	9-May-2014	2-Jul-14	Affects the exterior finishes of the housing units	

Table 3: Summary of the project information and the net impact of Not Accepted (NA) VEPs ***(Cont'd)***

11	Residential	Construct new support facilities for 3,000 housing units	23-Jun-14	25-Jul-14	Doesn't meet the standard specifications	
12	Government	Upgrade government security facilities kingdom wide	30-April-2014	16-Jul-14		Additional cost to the project with total of ($5,000,000)
13	Downstream	Install sour water stripper	23-Jan-14	16-Feb-14	Doesn't meet the standard specifications	
14	Upstream	Arabian heavy delivery to east-west pipeline	15-May-14	9-Jul-14	Increase the risk associated with the existing condition	
15	Gas plant	Construct new gas plant	10-April-14	1-May-14	Affect the contractual agreement with third party	
16	Residential	Construct new housing units, Increment I	25-June-14	2-Jul-14	Affect the quality of the housing units	
17	Pipeline	Increase product pipeline capacity	19-Sept-13	25-Nov-13	Impact operation flexibility	
18	Upstream	Construct and upgraded to handle additional production	28-April-13	18-Jun-13	Increase the risk associated with the existing condition	
19	Gas plant	Increase gasification plant project	13-Feb-13	17-Jul-13	Doesn't meet the standard specifications	
20	Residential	Construct national guard family compound	26-jun-13	25-Aug-13	Impact the project schedule	
21	Government	Upgrade government check point's and support facilities	21-Jan-13	20-May-13	Change the scope of the project	
22	Downstream	Upgrade oil and oily water systems	26-Jan-13	27-April-13	Not accepting VEPs due to potential delay of other projects.	
23	Utility	Upgrade industrial drainage system	18-Sept-13	07-Nov-13	Affect the safety of project personnel	

Table 3: Summary of the project information and the net impact of Not Accepted (NA) VEPs ***(Cont'd)***

24	Upstream	Refined products distribution facility	10-Dec-2012	14-July-2013	Violate company procedure	
25	Pipeline	Construct crude oil pipeline from Bahrain to Saudi Arabia	10-Sept-2012	17-Dec-2012	Affect the reliability of the pipeline	
26	Electrical	Upgrade substation	15-Oct-2012	20-Nov-2012	Doesn't meet the safety standard	
27	Pipeline	Expand east west pipeline capacity Phase II	25-Jan-2012	16-April-2012		Additional cost to the project with total of ($1,000,000)
28	Pipeline	Install additional pipeline loops for existing refinery	2-Dec-2012	29-Dec-2012	Affect the performance of the existing facility	
29	Upstream	Upgrade mechanical water pumps	15-Feb-2012	4-May-2012	It is not practical to implement as it needs long lead material	
30	Pipeline	Expand the central area pipeline	28-March-2012	10-June-2012	Not safe to rehab the pipeline during operation	
31	Public project	Upgrade hospital capacity	2-Nov-2011	20-Nov-2011	Does not support Company Corporate objective	
32	Pipeline	Expand east west pipeline phase I	July-2011	August-2011	It is not practical to implement as it needs special spare parts	
33	Public project	Construct new historic city in Jeddah	Oct-2010	Nov-2010	It will create security issues and affect aesthetic of the city	
34	Public project	Construct new university in Jeddah	April-2010	May-2010		Additional cost to the project totals ($11,000,000)
35	Public project	Construct utility plant for the new university	Nov-2010	Oct-2013	Limitation of the space to expand	

Table 3: Summary of the project information and the net impact of Not Accepted (NA) VEPs ***(Cont'd)***

					the existing pond	
36	Public project	Construct new perimeter security fence for the new university	Oct-2010	Oct-2010	It will create security issues and affect aesthetic of the university	
37	Upstream	Construct Natural Gas Liquid plant	Dec-2010	Dec-2010	Inefficient & inconvenient way to complete operation	
38	Residential	Develop site preparation and residential complex	July-2010	July-2010	Contradicts existing system	

The VE draft report can be immediately issued after the VE workshop while the final report is issued after the implementation status by the decision makers. This difference is important to conduct the implementation meeting to give the status of the VEPs so that the facilitator can issue the final report. After investigating the minutes of the implementation meetings for all the VE reports of the Not Accepted VEPs, a conclusion was drawn that the net impact presents the negative effect for not implementing the proposals due to functionality and cost.

4.2.1 Examples of VE studies on projects

This section introduces examples of VE studies obtained for the Value Engineering Reports (VE reports). Three project examples were selected from 2013, 2014, and 2015.

Example one: project A conducted the VE workshop in the Eastern Province of Saudi Arabia within two consecutive days in 2015. The project scope is mainly to upgrade a bulk plant. The purpose of the proposed facilities is to efficiently meet the Kingdom's refined product demands in Makkah Province. A new pipeline system with an ultimate capacity of 576 MBD is planned to deliver products from a newly constructed to an expanded bulk plant. This study addressed the Design Basis of Scoping Paper study conducted by the design firm and in coordination with the

prominent organization planning department. A multi-disciplined team consisting of twenty-eight (28) members attended the VE workshop. The VE team identified a total of forty-three (43) ideas as opportunities to add value to the project. After the ideas were screened, and evaluated in the VE workshop, it resulted in thirty-one (31) rejected ideas and twelve (12) VEPs without final status. The implementation meeting was held after the VE workshop, and attended by the project main stakeholders. This meeting resulted in rejecting six (6) VEPs. The remaining six were Accepted for further study (AFS). The estimated cost impact on the project due to the rejected VEPs was $ 8 Million. Most of the rejected VEPs impacted the project negatively. The minutes of the implementation meeting showed a low implementation effort towards each rejected VEP due to the following reasons:

- VEP impacted the project scope negatively,
- Not enough support to get cost information about the VEP, and
- The VEP may result in a major impact on the project schedule.

Example two: project B conducted the VE workshop on two consecutive days in 2014. The VE team identified a total of one hundred and eighty-three (183) ideas to further add value to the project. After the ideas were screened and evaluated they resulted in thirty (30) VEPs. The number of Accepted (A) VEPs was eight (8), the number of Not Accepted (NA) VEPs was twenty-two (22), while there were zero Accepted for further study (AFS) VEPs. This VE report shows the percentage of not accepted VEPs was 73%. The rejection of these proposals was agreed at the implementation meeting between all of the decision group members.

Example three: project C conducted the VE workshop on three consecutive days in 2013. The VE team identified a total of one hundred and twenty-six (126) ideas to further add value to the project. After the ideas were screened and evaluated it resulted in fifty (50) VEPs. The number of Accepted

(A) VEPs was four (4), the number of Not Accepted (NA) VEPs was forty (40), and the number of Accepted for further study (AFS) VEPs was six (6). This VE report shows the percentage of the rejected VEPs was 80.

4.3 Extent to which Value Engineering Proposals are not implemented

The extent to which acceptable Value Engineering Proposals (VEPs) were rejected was illustrated in table (2) above. The total number of VEPs in the reports was five hundred and eighty (580). Two hundred and seven (207) were Accepted, eighty-five (85) were Accepted for Further Study, and two hundred and eighty-eight (288) were Not Accepted. The proposals were accepted through the entire process and rejected at the implementation meetings by the decision makers group entities.

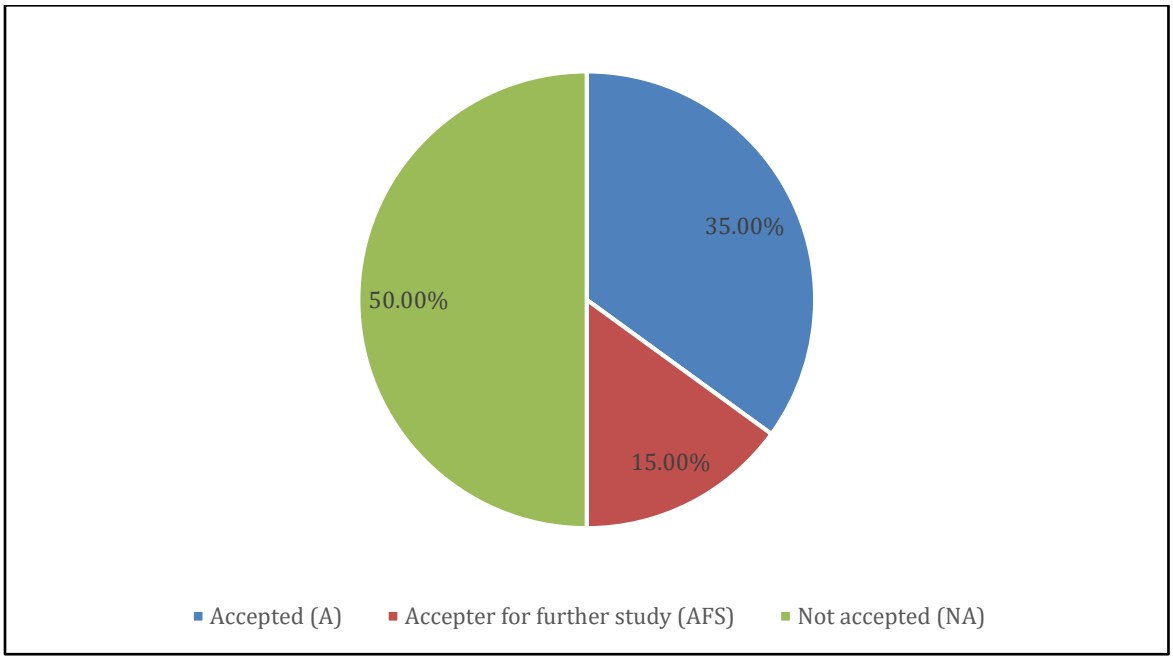

Figure 5: Summary of the total implementation status of the VEPs

Figure (5) displays the mean percentile of the VEPs implementation status of the Value Engineering Reports (VE reports). As mentioned earlier, the decision group members must agree on the status with a justification for the rejected VEPs. The finding shows that the percentage of

the implementation status for the total VEPs was 50% of Not Accepted (NA), 35% of Accepted (A), and (15%) of Accepted for further study (AFS). Clearly, the percentage of rejected proposals was high compared with the other implementation status, which supports the problem statement of this research. The proposals were accepted through the entire process and rejected at the implementation meetings by the decision makers group entities.

4.4 Reasons for not implementing VEPs

The reasons for not implementing the acceptable VEP's were gathered from two sources of information. The first source was interviewing individuals who were familiar with the related project, who are either VE-specialists or non VE-specialists. Table (4) illustrates the basic information about the interviewee's in terms of certification level according to SAVE International for either in-house or third party facilitators, and their experience in the project management field for the owner's proposals and facilitators. Eight (8) interviews were conducted in a prominent organization in the eastern province. The identification of the reasons for not implementing VEPs from different perspectives enriched the understanding of the real reasons which occurred in that leading organization. Interviews conducted in this study had a significant positive impact where they obtained real reasons applicable to the organization. One of the interview's purposes was to show different points of view regarding the subject. Different questions and discussions went on based on the interviewee's role and position. The interviews that were conducted discussed three main elements which are as follows:

- Information regarding the interviewee's organization including, but not limited to, the year VE practice was started, the mandatory requirements, and the number of VE studies conducted by the interviewee's organization.

- Information regarding the interviewee including, but not limited to, the experience of the VE, certification level, and his role in the organization.
- Identifying the real reasons for not implementing VEPs was discussed and the methods of having a successful implementation or how to mitigate those reasons in order to have a successful implementation.

Table 4: Interviewee's basic information and their role on the VE study

Interviewee	**Interviewee's role**	**VE Certification level**	**Project Management experience**
1	In-house VE facilitator	Certified Value Specialists (CVS)	20 years
2	In-house VE facilitator	Certified Value Specialists (CVS)	15 years
3	In-house VE facilitator	Associate Value Specialist (AVS)	10 years
4	In-house VE facilitator	Associate Value Specialist (AVS)	5 years
5	Third party facilitator	Certified Value Specialists (CVS)	30 years
6	Third party facilitator	Certified Value Specialists (CVS)	20 years
7	Owner's proposals	Associate Value Specialist (AVS)	25 years
8	Owner's proposals	None	20 years

The second source was the reasons obtained from the "Remarks section" in the Value Engineering Reports (VE reports). As a specific reason for not implementing VEPs, the organization categorized the reasons as related to (a) development, (b) management decision, and (c) implementation.

4.4.1 Reasons related to Development

Such reasons are generally due to inappropriate timing of the VEP or to its poor quality. The following are reasons related to the same group:

4.4.1.1 Reasons due to Timing

a. Late submission of VEPs to higher management for acceptance: this is related to the needed time to implement the VEP within a specific time frame and the time for implementing the VE study itself, and it reflects on the time for studying the VEP, or inconvenient timing to present the proposal to decision makers.

b. Technical constraints: this is related to the "Technical feasibility" of a project, where usually some VEPs require more studies and consultation with vendors, designers, and end users, which require more time.

4.4.1.2 Reasons due to Poor Quality

a. Major scope impact: different entities have different interests. This reason is related to the construction agency specifically, which is generally interested in avoiding any scope changes as that is usually disruptive to the project.

b. Safety concerns: some VEPs could impact safety and difficulty in reaching an "Acceptable level of risk". While other VEPs wish to eliminate all risks, which is almost impossible, and would also be extremely difficult and very expensive.

c. Major schedule impact: the VEP will be rejected if the proposal changes the schedule of the project by the construction agency, because they are driven by schedule.

d. Project performance: the features and characteristics of a VEP that adds to its capability to meet project specifications.

    - Effect on project efficiency: when a VEP is measured by a common measure such as "Efficiency", and an uncommon measure such as "Flexibility", for example:

the developed VEP was not maintaining the efficiency and plant capacity performance.

- Reliability impact: usually, the operations and maintenance personnel require a reliable project or system to perform its required function during a specific time frame while some VEPs impact reliability.

4.4.2 Reasons related to Management Decision

Such reasons are generally due to organization procedures, management awareness, and other factors related to management. The following are reasons related to the same group:

4.4.2.1 Reasons due to Organizational Influence

a. The authority of the department representative always plays a major role in the decision-making process. Sometimes departments send their representatives to attend but without having the authority to make decision.

b. Sometimes VEPs contradict other departments' points of view.

c. Not enough support to get cost information from the company due to confidentiality.

d. Complicated organization procedure VEPs usually require changes, and organization procedure in terms of changes makes those proposals difficult to implement and to get approval from higher management.

e. Ambiguity in the provided information about the project, which increases the gap between the amount of information needed to propose a realistic VEP and the amount of available information during the VE workshop.

f. Strategic alignment concerns resulting in rejection of a VEP because it is not strategically aligned with the business objective of the project.

g. Lack of VE personnel needed to plan, execute, and track the implementation of the VEP.

h. Unavailability of external technical staff or consultants. Where, sometimes VEP require external staff for further technical studies to demonstrate the expected VEP benefit.

i. Not enough budget assigned to implement the VEPs. Usually, the budget requires a high initial cost to execute the VEP, but will result in reducing the life cycle cost. Therefore, an inadequate budget results in low implementation of VEPs.

j. Lack of VE knowledge needed to understand the positive outcome of a VE by the organization personnel, which results in low interest towards VEP implementation.

4.4.3 Reasons related to Implementation

These are the reasons related to changing the conditions that would affect implementation:

a. Changes in technology with time: sometimes a recently emerging technology is a reason for rejecting the VEP.

b. Staff changes may bring in a new owner of the proposal with a different viewpoint and strong justifications to convince higher management to reject the proposal.

c. Change in market condition: the economics of the VEP have changed.

d. Late changes: sudden changes may contradict the existing VEP, which leads to rejection.

CHAPTER FIVE: SURVEY, RESULTS, AND DISCUSSIONS

This chapter presents the questionnaire survey that was distributed in the Eastern Province of Saudi Arabia to achieve the objective of the research study. The objective of the survey is to identify the degree of importance of the success factors as previously identified in the case study and the literature review.

The questionnaire survey is crucial to the ranking of the success factors and in determining the degree of importance of each factor in the point of view of both VE and non VE specialists. The questionnaire was developed on the basis of identified success factors from the literature review and case study. The data was collected from both VE and non VE specialists working in companies located in the eastern province of Saudi Arabia. The results of the survey show that the most important success factors agreed by both VE and non VE specialists are that the VEP should have sufficient information to support the decision-making process, meet the decision maker's expectations, and show the detailed benefits of the investment.

5.1 Success Factors for implementing VEPs

Success factors for implementing VEPs were previously identified based on analysis from the literature review and from the case study. As a reminder, a list of combined factors from both sources is shown in table (5). However, the case study success factors are more related to the environment inside the organization as shown below:

1. **Allow enough time for VEP development:** the time for developing the VEP will be reflected in the implementation of Value Engineering Proposals. The development outlines a detailed technical analysis to determine the best alternatives available to decision makers.

Therefore, it is important to allow enough time for development to get a smooth approval from decision makers.

2. **VEP team members should insist on adequate, but not excessive, safety regulations:** this means to draw a line of safety, which is very important for organizations. This results in understanding the difference between what is unsafe, safe, or safer in the VE team.
3. **Align VEPs with an organization's overall benefits:** this success factor is related to the owners' proposals. Where, they have to strategically justify the VEP to align with business benefits.
4. **Increase local content:** developing all VEPs that contribute to establishing a well-structured local economy. This can be achieved through better support and increased opportunities for the local vendors, manufacturers, and contractors to bid for future projects.
5. **Allow for enough human resources to plan, track, and execute VEPs:** having a dedicated team to plan, track, and execute VEPs is one of the important success factors to ensure the process of implementation.
6. **Provide external staff to support the decision-making process**: where, sometimes VEP require external staff for further technical studies to demonstrate the expected VEP benefit. The availability of these people is important during the implementation meeting of the VE study.
7. **Simplify an organization's procedure for implementing VEPs:** simplify the organization procedure such as the waver requirements, and change the order procedure by taking into consideration the value of the cooperative objective. This would consequently increase the success of the VEP implementation.

8. **VEPs must take into consideration conflicting points of view regarding project performance, reliability, maintainability, and cost within the project scope:** in order to reduce the conflicting points of view among the different stakeholders within the VE workshop, it is highly recommended to keep in mind the following items to implement the VEP successfully, such as:

- Reduce cost on projects
- Improve project quality
- Enhance project performance
- Increase project efficiency
- Maintain the required reliability: this can be achieved by considering the consequences of the operation and maintenance. Where, maintainability and maintenance are often important parts of reliability and the ease with which a product can be maintained in order to:
    - Isolate or correct defects or their cause,
    - Repair or replace faulty components without having to replace still-working parts,
    - Prevent unexpected breakdowns,
    - Maximize a product's useful life,
    - Meet new requirements,
    - Make future maintenance easier.

9. **Proposals must have sufficient information to support the decision-making process, meet the decision maker's expectations, and show the detailed benefits of the investment:** as an example, the availability of cost information. The more cost information the higher the chances of implementing VEPs because it places the decision makers in a situation to make a decision.

10. **Assign sufficient budget to execute the VEPs with a high initial cost, while resulting in reducing the life cycle cost:** ideal VEPs that improve functionality and reduce the life cycle cost. However, a VE could spend more on capital expenditure (initial costs) but reduce the operational expenditure (recurring and non-recurring costs). Therefore, assigning budget for the VE package to spend more during the initial stage reduces the life cycle cost is essential for a successful implementation of VEPs. This may be done by preparing financial support and by also assigning a team for testing and developing VE proposals in coordination with the VE team leader.

11. **Department representative needs to have full authority during the implementation meeting:** the inability of any team member to make decisions may prevent him from expressing thoughts that may be rejected by his upper management, and which will also waste other team members' time.

12. **Provide a VE awareness program through such things as programs or campaigns and establish a Value Management Board (VMB):** these success factors could be achieved through four main steps:

a) Making a special short VE session for managers, and presenting a VE preliminary presentation to other departments,

b) Establish a VE reward program for those who successfully implement VEPs,

c) Publish a VE newsletter, and

d) Increase the number of VE certified employees.

13. **Monitor changes in new technologies that could impact VEPs:** changing technologies is a very dynamic process because of the level of competition in the technology market. It is

essential to look forward to new methods of using existing technology. Therefore, being aware of the latest developments in technology leads to a successful VEPs implementation.

14. Monitor changes in market conditions that could impact VEPs: changes in market conditions could be due to economic changes, cultural changes, or business changes. The economic changes manifest in decreasing or increasing inflation and interest rates. Other economic changes may occur in the value currency in relation to the market condition. Hence, taking into consideration changes in the market conditions will contribute to the successful development of each VEP.

15. Establish a classified VEPs database to be a reference for other VE studies: VEP is influenced by two main parameters, namely life cycle cost, and function. These VEPs are either ideal value, good value, or low value. Where, ideal value means an increase in the functionality and reduction in the life cycle cost of the VEP with a minimum of implementation effort, good value means maintaining the required functionality and reducing the life cycle cost of the VEP with a medium implementation effort, and low value means maintaining the required functionality and maintaining the same life cycle cost of the VEP with a high degree of implementation effort. Therefore, establishing a database for the ideal value of VEPs to be used as a reference eases the process of transferring the knowledge, and consumes the time available for other VE studies.

As mentioned earlier, this part summarized the previous studies and case study success factors in order to assess these factors as per their degree of importance by the VE-specialists and non VE-specialists.

Generally, VE studies will be successfully completed after a reasonable time is spent practicing them, which will also develop the value of the practitioners' skills as well as developing the culture and knowledge of attendees. Therefore, it is highly recommended to bear practicing VE studies in the early years as it is summarized in table (5). The table shows all the twenty-one (21) success factors gathered from both the case study and the literature review. Each success factor is numbered and associated with its source. The sources of the factors are the literature review and case study, while some are from both sources.

The success factors are classified into the following categories: a) *Development, b) Management Decision, and c) Implementation.* Categorizing the factors makes it easier for the reader to acquire a general understanding of the success factors. It's important to note that all of the success factors contribute to the implementation of VEPs.

The success factors in the Development category must be realistic in terms of safety, schedule, and they should have a positive effect on the project performance. Each VEP should be well developed and refined. The success factors that fall under this category are important for the second category, which is the management decision quality and timing of the VEPs.

The Management category has two sub categories: 1) Organization Support, and 2) Policy and Procedure Development. The Organization Support can be achieved through providing enough resources to plan, track, and execute the implementation regarding the level of awareness that should be present in the organization concerning VEP implementation. Policy and Procedure Development is related to the knowledge of the VE shared across the organization, which views continuous improvement. It mentions the authority given to the department representative during the implementation meeting. Moreover, it simplifies the organization procedure in terms of implementation.

The third category contains the factors related to implementation. The factors that fall under implementation are more related to changing conditions where they give an indication to be aware of changes in technology and market conditions. This is in addition to having a structured plan for implementation including follow-ups.

The case study success factors were obtained from individual personnel, both VE and non-VE specialists inside the organization. During the interviews, the interviewees were asked about the reasons related to the environment. Therefore, the success factors from the case study are more related to the organization's environment by:

- Simplifying the organization's procedure for implementing VEPs.
- Raising awareness in the organization regarding VE.
- Taking into consideration conflicting points of view in the department.
- Empowering the VE staff.
- Taking into account the changes in market conditions and adapting new technologies during the VEP implementation.

The literature review of the success factors is designed to streamline the process for implementing VEPs. The overview of the previous study demonstrates a common basis to implement VE studies successfully. Astle, (1963) conducted a study to identify success factors for VE studies implementation. The study was based on the writer's own knowledge and experience in VE. On the other hand, factors from the case study were based on VE and non-VE specialists in an organization in the eastern province. This indicates that the success factors come from different perspectives and experiences are more related to the organization environment. The case study success factors were taken from VE and non-VE specialists' insights, which gives a better, more effective and accurate indication of the success factors.

The case study and literature review success factors are aligned in seven (7) factors as shown in table (5). The alignment is caused by the nature of the success factors. The factors are applicable to all VE organizations and practitioners nationally and internationally in order to have a successful implementation of VEPs. In addition, most factors are related to:

- The alignment of VEPs with the organization's overall benefit.
- Organization support in providing resources and providing sufficient information for VEP implementation.
- The consequences of developing VEP such as doing a Life Cycle Cost analysis for prioritization.

The nature of all the success factors contributes to the successful implementation of VEPs regardless of its source.

Table 5: Summary of identified success factors for VEPs implementation

No.	Success factors	Source
I. Development		
1	Allow enough time for VEP development	Case study
2	VEP team members should insist on adequate, but not excessive, safety regulations	Case study
3	VEPs must take into consideration conflicting points of view of regarding project performance, reliability, maintainability, and cost within the project scope	Case study
4	Do life cycle cost analysis for each VEP for prioritization	Literature
5	Organizations should publicize successful VEPs for implementation for direct use of future project	Literature
6	Proposals must have sufficient information to support decision making process, meet decision maker's expectations, and show detailed benefits of the investment	Both
7	Align VEPs with organization's overall benefits	Both
II. Management Decision *(Organization support)*		
8	Prioritize proposals based on the ease for presentation to managers and their implementation	Literature
9	Allow for enough human resources to plan, track, and execute VEPs	Both
10	Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost	Literature
11	Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board	Case study
12	Try to obtain the support of senior management	Both
(Policy & procedure development)		
13	Share the VE experience across the organization with view to continuous improvement	Literature
14	Department representative needs to have full authority during the implementation meeting	Both
15	Simplify organization's procedure for implementing VEPs	Case study
16	Recognize and address VEP risk to decision makers	Literature
III. Implementation		
17	Monitor changes in new technologies that could impact VEPs	Case study
18	Monitor changes in market conditions that could impact VEPs	Case study
19	Establish a classified VEPs database to be a reference for other VE studies	Case study
20	Prepare implementation action plan	Both
21	Follow up to expedite implementation	Both

5.2 Questionnaire development

The core of the questionnaire was to identify the list of success factors. The factors were extracted from two sources. The first source was the case study, and the second source was the literature review success factors. The case study success factors were obtained by first asking about the reasons through interviews with VE and non-VE-specialists to obtain their point of view, then asking about solutions. In addition, the case study success factors were obtained from the reasons included in the VE reports. The reports included a remarks section (reasons) for not implementing VEPs.

The questionnaire survey was developed over a three-week interval and based on eight (8) direct interviews with VE and non VE specialists. Two sets of questionnaire surveys were developed to obtain different perspectives toward the importance of success factors. The direct interviews conducted with high certification levels enrich the development of the survey based on their feedback and experience. In addition, the thesis advisor added major improvements and refined the development of the two different sets of surveys. During the interviews, the main goal was to uncover the reasons for not implementing VEPs.

"VE and non VE-specialists'' questionnaires (see Appendix I) were divided into three parts:

Part one:

Questions that cover general information about the organization surveyed.

Part two:

Covers the respondent characteristics.

Part three:

Consists of success factors for implementing Value Engineering Proposals as they are identified from the case study and previous study success factors.

5.3 Questionnaire data collection

The questionnaire survey was sent to two different categories of respondents. The first category was a VE-specialist defined as an individual certified from SAVE International, and who may be a facilitator who may or may not guide the team through the VE process. The second category was the non VE-specialist defined as an individual who is not certified as such; but who may be familiar with or have some experience with VE by having attended VE workshops or VE studies in order to verify whether a variation in perspectives exists. The respondents were contacted via email. Some respondents received the questionnaire by email and others received hard copies which were delivered to them in the Eastern Province, for example in the cities of Jubail and Dammam.

The first category: the total number of questionnaires sent to VE-specialists was fifty (50). The collected questionnaires were thirty-three (33), while seven (7) questionnaires were rejected due to incompleteness. Consequently, the valid number was twenty-six (26), and the valid percentage of VE-specialist's questionnaires was 79%.

The second category: the total number of questionnaires sent to non VE-specialists was seventy (70). The collected questionnaires were fifty (50), and (9) questionnaires were rejected due to two reasons: a) incompleteness, and b) contradictions. As a result, the valid number was forty-one (41), and the valid percentage of non VE-specialist's questionnaires was 82%.

5.4 Survey results, analysis, and discussion

This section presents different characteristics of VE and non VE-specialists' organizations and individuals. Furthermore, different views of the targeted respondents are also included. The different perspectives contribute to achieve the objective of the study.

5.4.1 Characteristics of respondents' organization

Since most of the non VE respondents were employers in the same VE respondent's organizations, the following section presents the characteristics of the VE and non VE-specialists' organizations.

5.4.1.1 Characteristics of VE-specialists' organizations

This part includes information about the time the organizations started practicing VE, the mandatory requirements for applying VE, the status of conducting VE in-house or outsourcing, the number of Certified Value Specialists (CVS), and the number of VE studies conducted on VE-specialist's organizations.

The time when respondent's organizations started practicing VE

The questionnaire targeted different organizations in the eastern province of Saudi Arabia who have engagement experience in VE. Figure (6) shows the percentages of different organization experiences based on the time they started practicing VE studies. The result states that 43% of the respondents' organizations started practicing VE more than 15 years ago, while 27% of organizations started practicing VE either from between 5 to less than 10 years, or 10 to less than 15 years. However, only 3% of them started practicing VE less than 5 years. Most organizations started practicing VE more than 15 years ago, and this indicates their wealth of knowledge for handling VE studies.

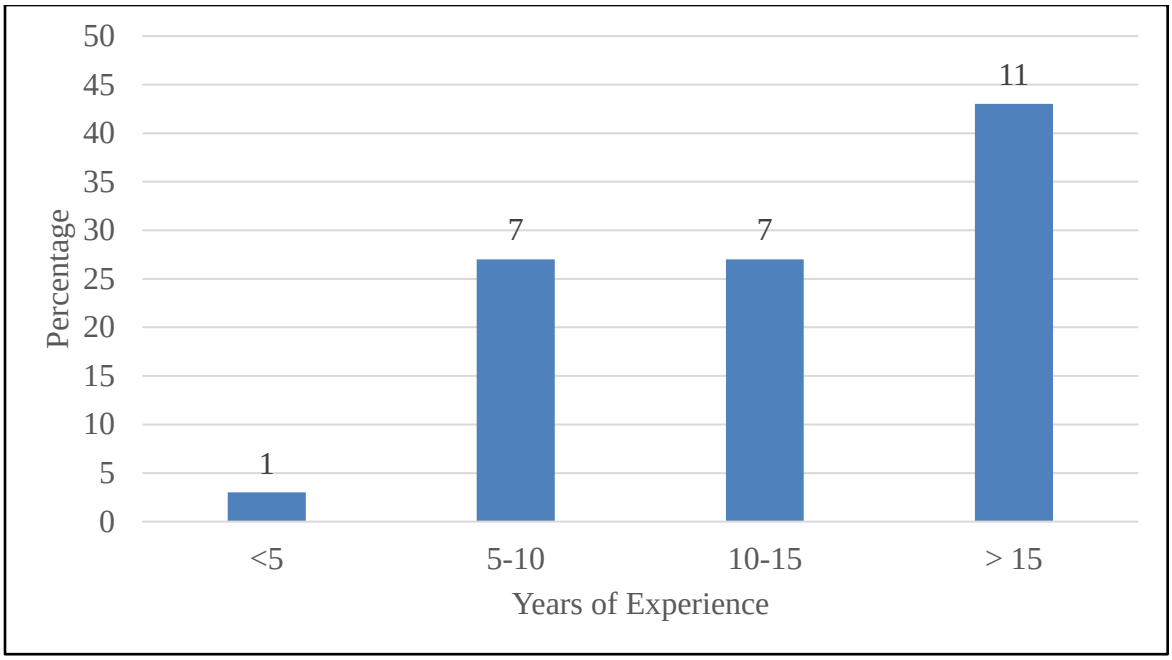

Figure 6: Years of experience in practicing VE by respondents' organization

Mandatory requirements for applying VE by respondents' organizations

The mandatory requirements for applying VE vary from one organization to another, and it depends on the type of project complexity or the need for VE. Figure (7) shows the mandatory requirements of the VE-specialists' organizations. It can be seen that 69% of respondents' organizations categorized mandate requirements based on the project budget, and only 31% of these organizations categorized them based on other requirements made by consultant companies, such as project complexity.

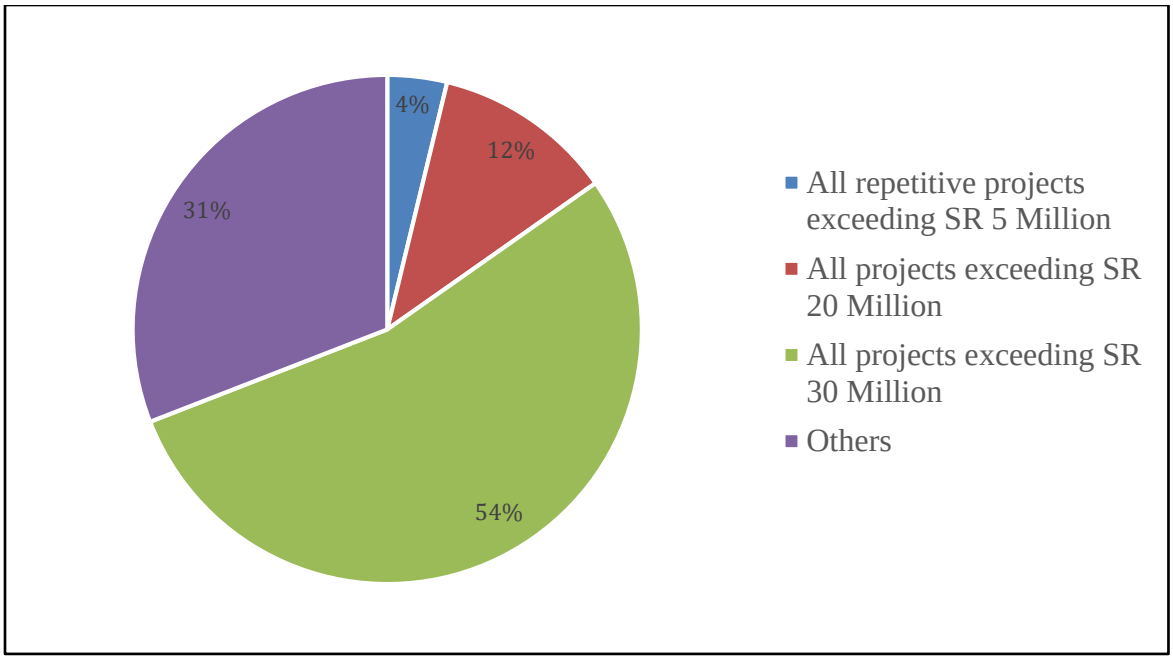

Figure 7: Mandatory requirements for applying VE by respondents

It can be also seen that 78% of respondents' organizations mandate VE based on a project budget only when the project budget exceeds SR 30 Million, 17% of respondents' organizations mandate VE based on a project budget for all projects that are more than SR 20 Million, while only 5% of respondents' organizations mandate VE based on a project budget only when the project budget exceeds SR 5 Million, as shown in figure (8). Thus, it was discovered that a majority of respondents' organizations are following the VE mandatory requirements based on the project budget.

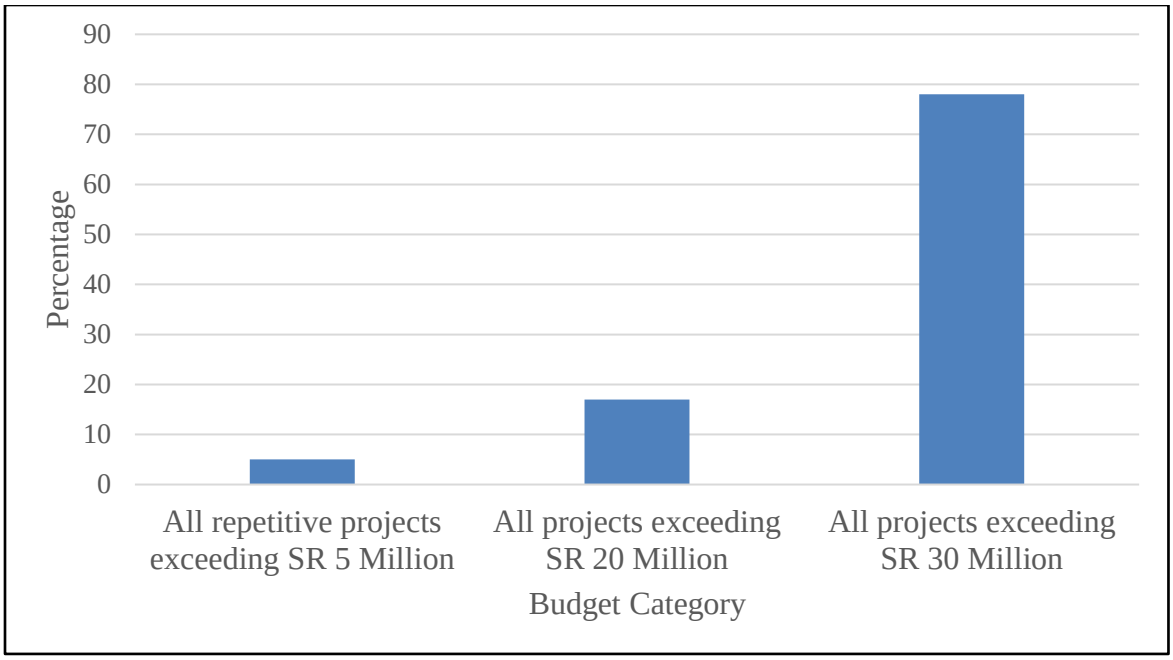

Figure 8: Mandatory requirements based on budget category

Number of Certified Value Specialists (CVS) in respondent's organizations

SAVE International Gulf Chapter Certification statistics presented at the 5th Gulf Value Engineering Conference show that in Saudi Arabia there are eighteen (18) Certified Value Specialists (CVS), and certification level is considered one of the organizations capability in VE (SAVE International, 2014). Figure (9) shows that 32% have more than three CVSs, 20% have two CVSs, and 4% have three CVSs. Therefore, these organizations have a high capability for practicing and conducting VE studies. On the other hand, 39% of the organizations' respondents have only one CVS because they are third party consultancy companies.

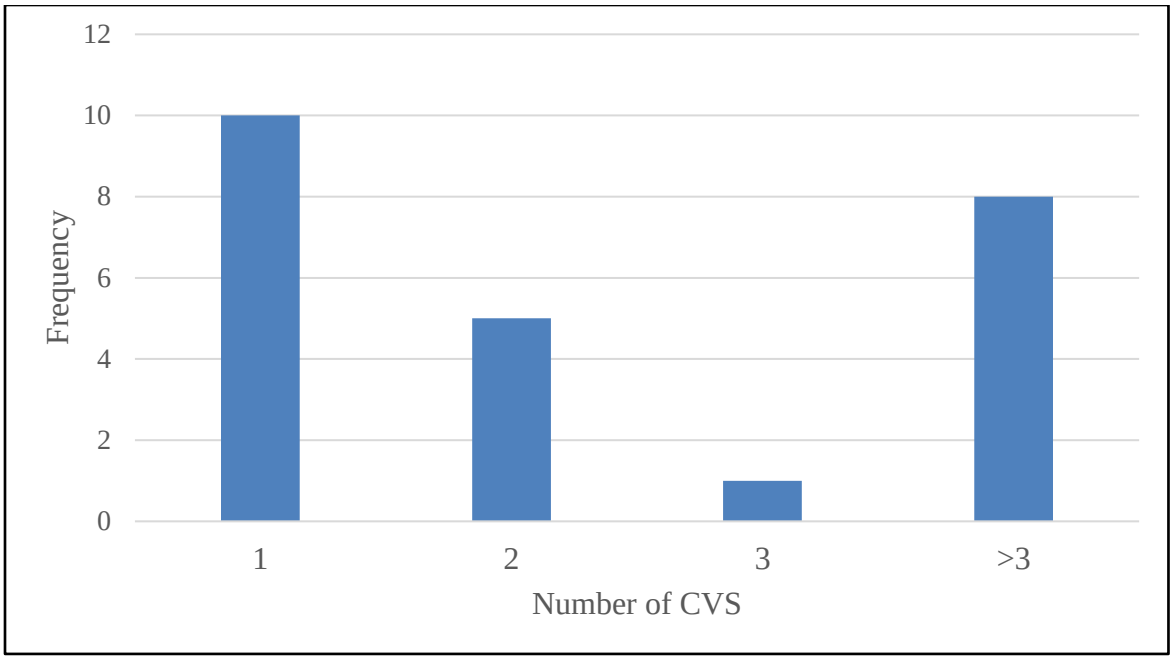

Figure 9: Number of Certified Value Specialists (CVS) in respondents' organizations

Organization experience in VE versus their number of Certified Value Specialists (CVS)

Organization VE staff determine the strength and experience of practicing VE studies. Therefore, the four main levels of an organization's experience as discussed above have a different number of VE certification levels. This study focuses mainly on the number of Certified Value Specialists (CVS) inside the organization. As an example, the results indicate that most of the organizations that promoted VE studies for more than 15 years have more than three CVSs with 46% as shown in figure (10).

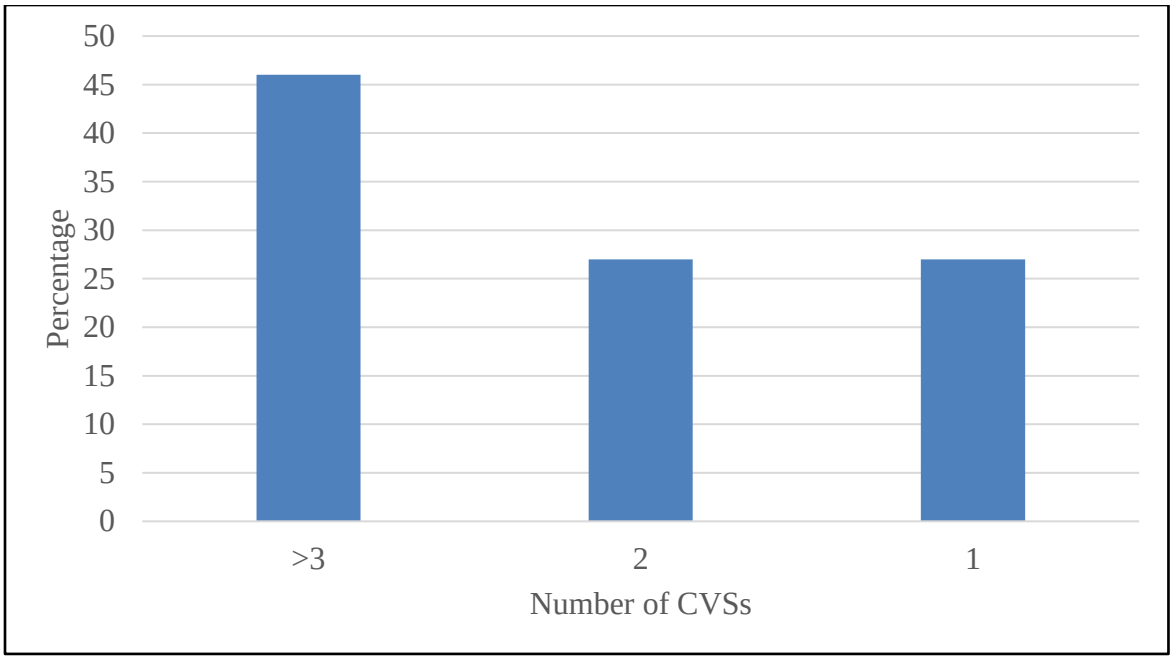

Figure 10: Number of Certified Value Specialists (CVS) in organizations which have promoted VE studies for more than 15 years

Status of conducting VE in-house or outsourcing on respondent's' organizations

The organization's philosophy of applying VE in-house or outsourcing varies from one organization to another. Figure (11) shows the frequencies and the percentages of conducting VE in-house or outsourcing, for VE-specialist's organizations. The results revealed that 81% of VE-specialist respondent's organizations were conducted in-house, while only 19% were outsourcing their VE studies. This confirms that organizations have a high capability in terms of certified VE personnel. Therefore, organizations that conduct in-house VE studies are definitely more accountable, and empower their VE staff for successful VEPs implementation.

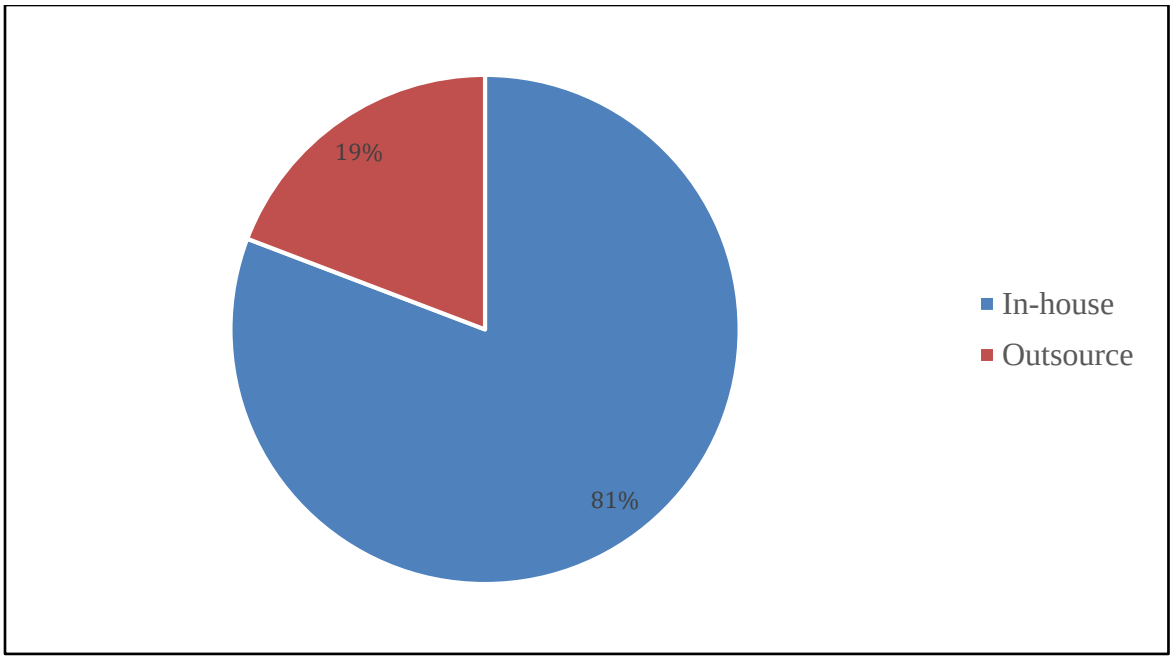

Figure 11: Status of conducting VE in-house or outsourcing on respondents' organizations

Organizations' experience versus status of conducting VE in-house or outsourcing

The results show that organizations which promote VE studies for lengthier periods are often those which conduct VE in-house. Figure (12) shows all organizations that have promoted VE studies for more 15 years, conducted VE in-house; all organizations that have promoted VE studies for 10 to less than 15 years also conducted VE in-house; whereas only 29% of organizations which promoted VE studies for five to less than ten years conducted VE in-house. However, organizations that outsource VE studies are less interested in implementation than organizations which conduct their VE in-house.

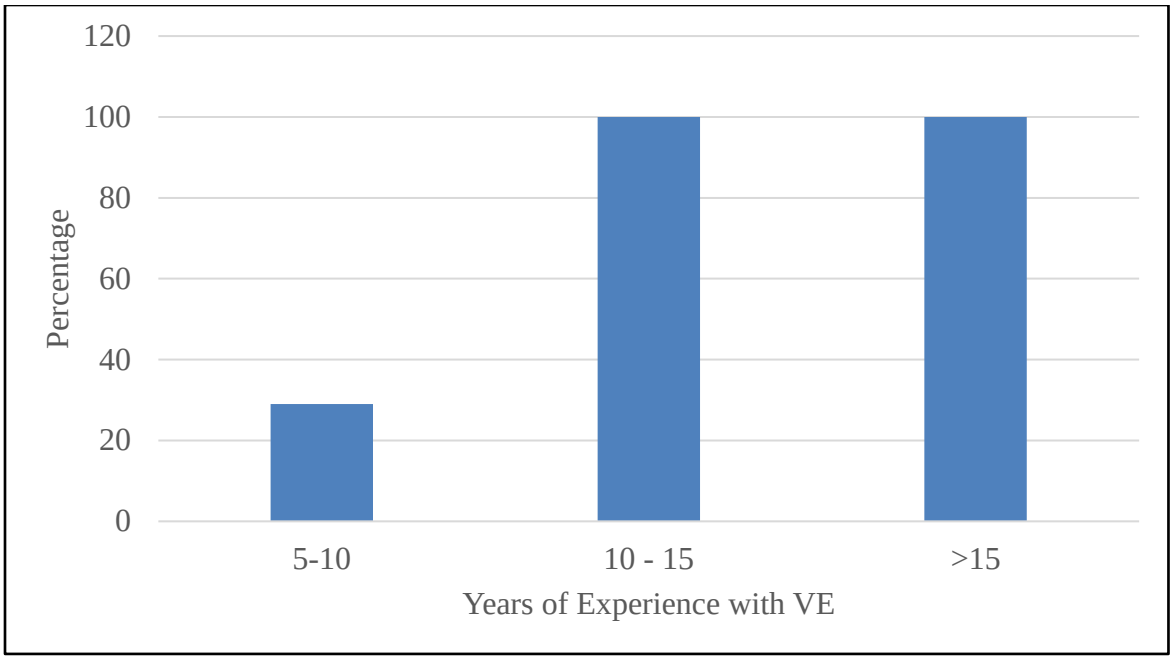

Figure 12: Percentage of VE studies conducted in-house versus years of experience with VE

Number of VE studies conducted in respondents' organizations

The number of VE studies conducted plays a major role in organizations because it increases the learning curve for practicing VE, and enriches VE knowledge among all employees involved in that particular study. The result indicates that 46% of respondents' organizations conducted more than 15 VE studies per year, while the number was 31% for 10 to less than 15 studies per year, and 16% for 5 to less than 10 VE studies per year, as shown in table (7). Thus, enhances the reliability of the study results that is reflected on the organizations' experience with VE studies.

Table 7: Number of VE studies conducted by respondents'

	Frequency	Percent	Valid Percent	Cumulative Percent
< 5 VE studies per year	1	3.8	4.0	4.0
5-10 VE studies per year	4	15.4	16.0	20.0
10-15 VE studies per year	8	30.8	32.0	52.0
> 15 VE studies per year	12	46.2	48.0	100.0
Total	25	96.2	100.0	
Missing	1	3.8		
Total	26	100.0		
Mean	3.24			
Median	3.00			

5.4.1.2 Characteristics of non VE-specialist organizations

This part includes information about the status of conducting VE in-house or outsourcing, the number of VE studies conducted, and the mandatory requirements for applying VE on non VE-specialists' previous projects.

Status of conducting VE in-house or outsourcing

The organization philosophy of applying VE in-house or outsourcing varies from one organization to another. Figure (13) shows the frequencies, and the percentage of conducting VE in-house or outsourcing, for non VE-specialist's organizations. The results revealed that 80% of non VE-specialist respondents' organizations conducted VE in-house. However, only 20% were outsourcing their VE studies. Thus, non VE-specialists are highly exposed to VE methodology, which gives credibility to their opinion.

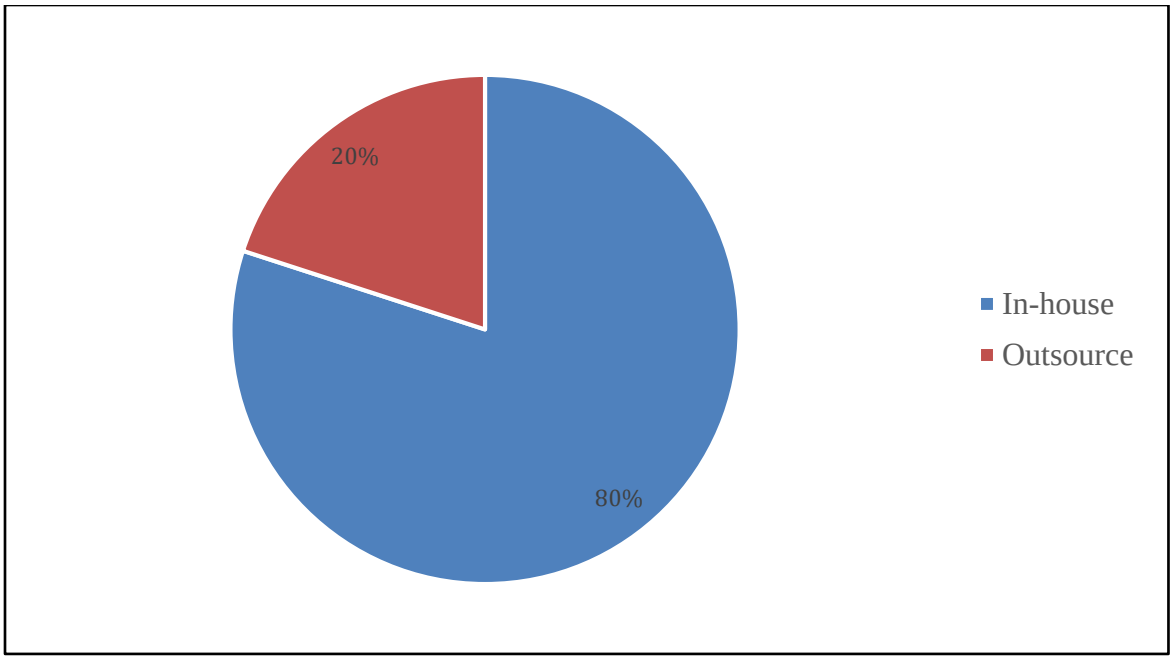

Figure 13: Status of conducting VE in-house or outsourcing

Number of VE studies conducted by respondents'

Table (8) presents the number of VE studies conducted on construction projects. Clearly, the results indicate that 59% of non VE-specialists conducted less than 5 VE studies, 25% of organizations conducted five to less than ten VE studies, 7% of organizations conducted between 10 to more than 15 VE studies, with an equal percentage for more than 15 VE studies. These results support the conclusion that non VE-specialists are less qualified than VE-specialists.

Table 8: Number of VE studies conducted by respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
< 5 VE studies	24	58.5	60.0	60.0
5-10 VE studies	10	24.4	25.0	85.0
10-15 VE studies	3	7.3	7.5	92.5
> 15 VE studies	3	7.3	7.5	100.0
Total	40	97.6	100.0	
Missing	1	2.4		
Total	41	100.0		
Mean	1.60			
Median	1.00			

Mandatory requirements for applying VE studies

Different mandatory requirements for applying VE studies are followed by different organizations based on the necessity for applying VE studies and the type of project complexity. Figure (14) shows the mandatory requirements of the non VE-specialists' organizations. It can be seen that 66% of respondents' organizations categorized mandate requirements based on project budget, whereas only 34% of these organizations categorized them based on other requirements made by consultant companies such as project complexity.

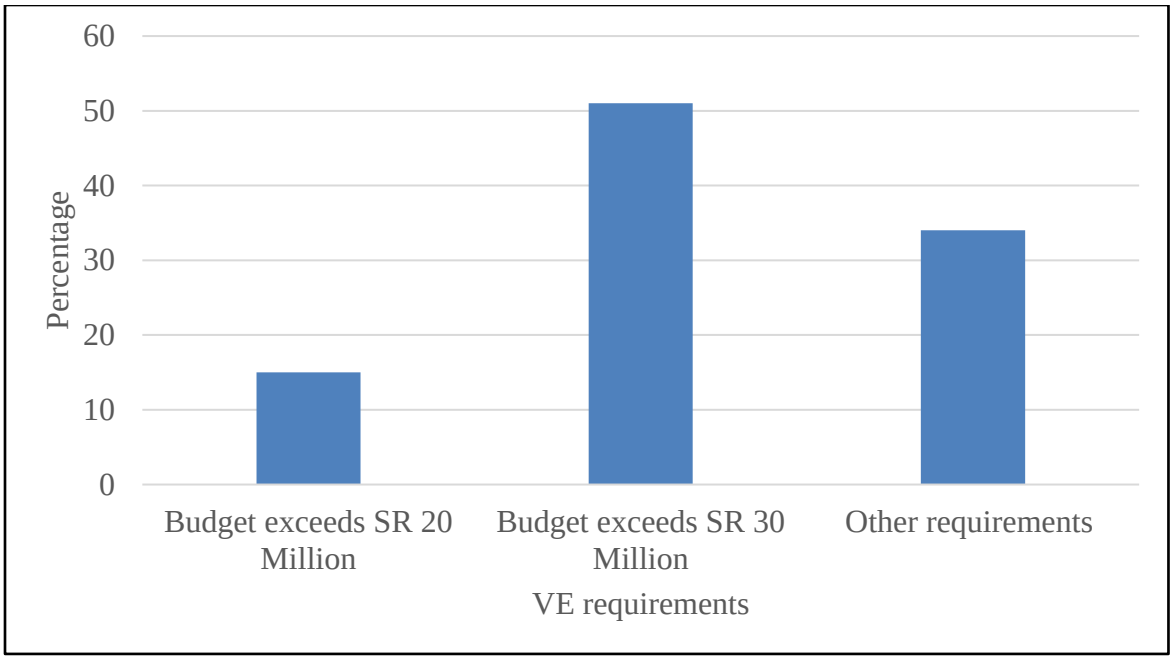

Figure 14: Mandatory requirements for applying VE studies

It can be seen that 78% of respondents' organizations mandate VE based on project budget only when the project budget exceeds SR 30 Million, while 22% of respondents' organizations mandate VE based on project budget for all projects that are more than SR 20 Million, as shown in figure (15). Similar to the VE respondents' organizations, non-VE organizations are following VE mandatory requirements based on project budget.

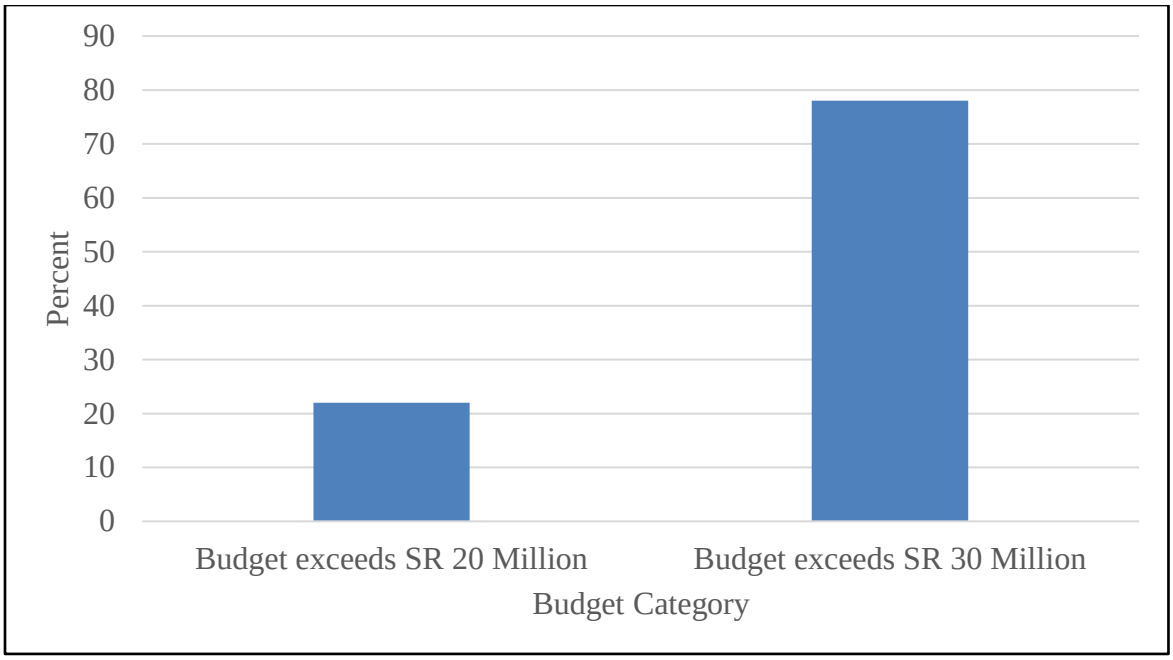

Figure 15: Mandatory requirements based on budget category

5.4.2 Characteristics of individual respondents

This section includes information about the VE and non VE specialists' characteristics, in terms of their experience and familiarity with VE.

5.4.2.1 Characteristics of VE-specialist respondents

This part presents information about the certification level of VE-specialists according to SAVE international certification levels, the number of VE studies that have been facilitated, and the number of VE workshops that have been attended.

Certification level of VE-specialists

Value Engineering Specialists play a major role throughout the VE process. SAVE International offer three certification levels, which from the lowest to the highest level respectively are:

1) Associate Value Specialist (AVS);

2) Value Methodology Practitioner (VMP); and

3) Certified Value Specialist (CVS).

The distribution of the level of VE certification participation in this study is shown in figure (16). As mentioned earlier, the number of Certified Value Specialists is few in Saudi Arabia. Where, the total active certifications in the Eastern Province of Saudi Arabia is eighty (80) Associate Value Specialist (AVS). There are a few reasons for not having any Value Methodology Practitioners (VMP certificate level). First, SAVE International allows the practitioners to move from the first to the third level if the candidate complies with the credential requirements and passes the CVS exam. Second, there is no active VMP certificate in Saudi Arabia registered at SAVE International. Interestingly, 50% of the respondents wrote their position as CVS, and an equal percentage for AVS. This reiterates the contribution of value engineering specialists through this research study.

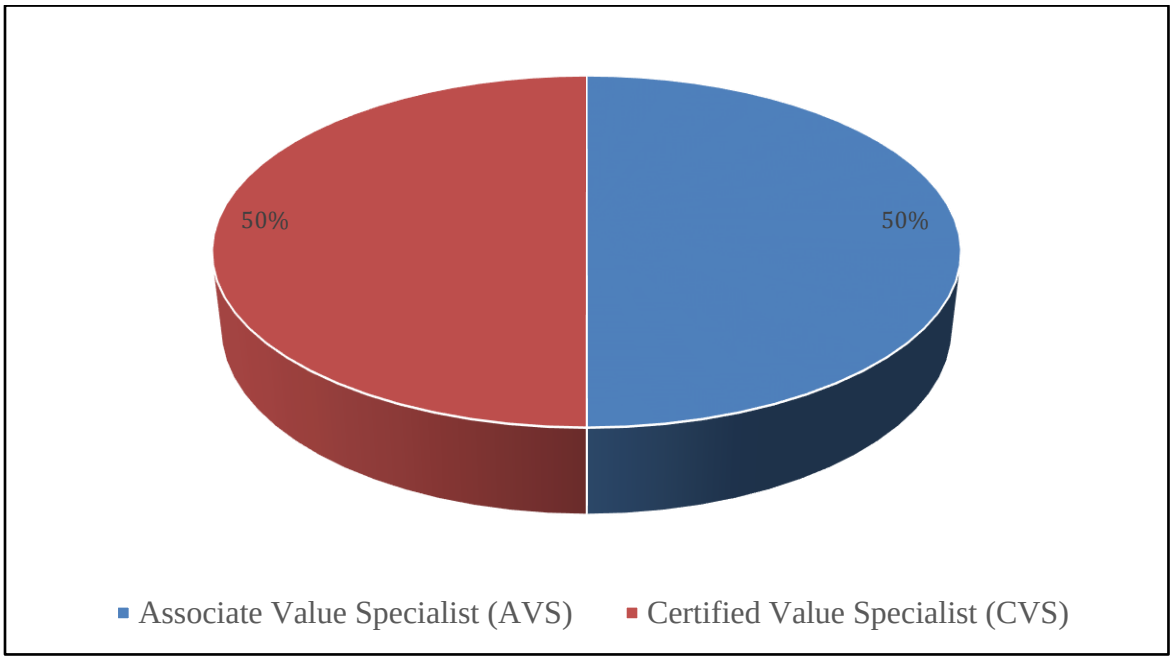

Figure 16: Certification level of VE-specialist according to SAVE International

Number of facilitated VE studies

The VE facilitation experience of respondents is shown in table (9). These specialists should be certified by SAVE international in order to conduct a VE study as per most of the organization's requirements. It can be seen that 46% of respondents facilitated VE studies for more than 30 VE studies, 19% facilitated for less than 10 VE studies, and 4% for 10 to less than 20 VE studies. However, 23% of the respondents never facilitated VE studies. This demonstrates their high level of capability in the facilitation of VE studies. On the other hand, the greater degree of facilitation experience could enhance the implementation of VEPs since they usually contribute to implementation process of VEPs.

Table 9: Number of VE studies have been facilitated

	Frequency	Percent	Valid Percent	Cumulative Percent
None	6	23.1	23.1	23.1
< 10	5	19.2	19.2	42.3
10-20	1	3.8	3.8	46.2
20-30	2	7.7	7.7	53.8
>30	12	46.2	46.2	100.0
Total	26	100.0	100.0	
Mean	3.35			
Median	4.00			

Number of attended VE workshops

Participation in VE workshops is a hands-on experience for VE-specialists to facilitate similar VE sessions through their organization's projects. The number of VE workshops which have been attended by the respondents is shown in figure (17). Hence, 54% of the respondents have participated in more than 30 VE workshops which enhances the reliability of the study results due to the high level of experience of VE, while 23% have participated in less than 10 VE workshops,

and 8% have participated in 10 to less than 20 VE workshops. However, 12% of the respondents have never participated in a VE workshop. Therefore, there should a starting point for those who have never participated, or participated in only a few sessions, to be a VE-facilitator by learning from experienced facilitators. This will lead to an improvement in the soft facilitation skills and the VE techniques, which will lead to a successful implementation of VEPs.

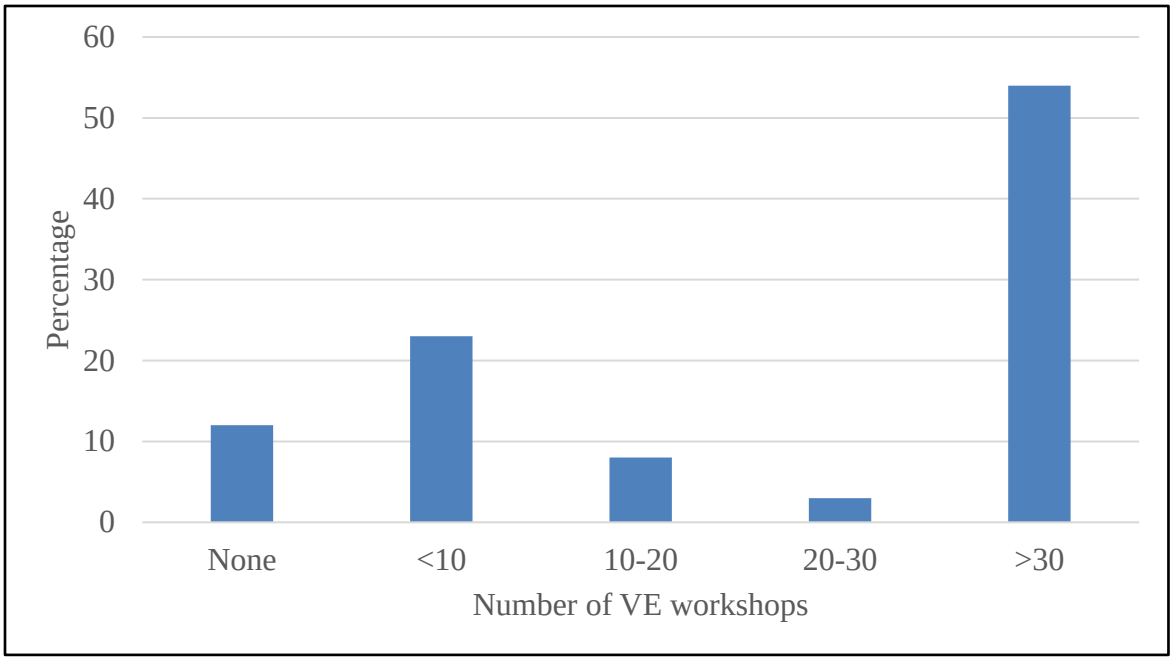

Figure 17: Number of VE workshops attended by VE-specialists

5.4.2.2 Characteristics of non VE-specialist respondents

This part presents information about the number of VE workshops attended, the status of attendance at VE courses, and the familiarity of non VE specialist respondents with VE concepts.

Number of VE workshops attended by respondents

Participation in VE workshops enriches the knowledge of the VE process for non VE-specialists. The distribution of non VE-specialist participation in VE workshops is shown in figure (18). It can

be seen that 66% of respondents participate in less than 10 VE workshops, 15% of respondents participate in 10 to less than 19 VE workshops, and 5% of respondents participate in 20 to less than 30 VE workshops. Interestingly, 7% of respondents participate in more than 30 VE workshops, while 7% of respondents have never attended a VE workshop. It can be concluded that the majority of non VE-specialists have enough exposure to VE studies process and procedure, which enhances the results of the study.

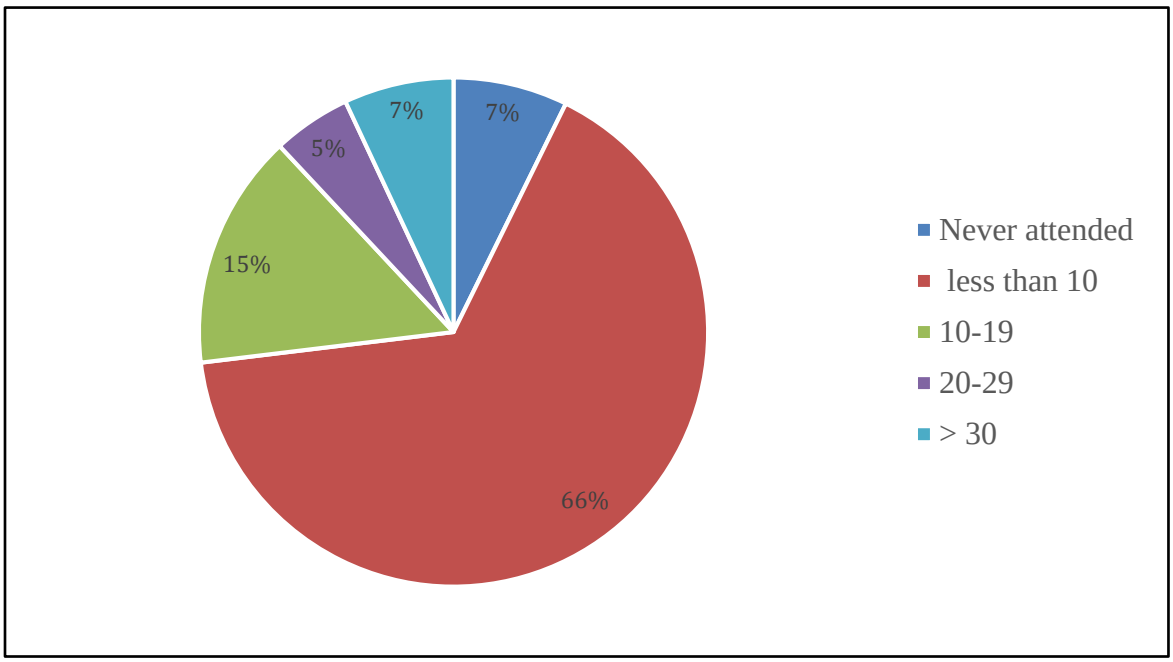

Figure 18: Number of VE workshops attended by non VE-specialists

Enrolment in VE courses

Most of the respondents' organizations enroll their project management teams in VE courses. The percentages of non VE-specialist respondents who have attended a VE course is shown in figure (19). The results illustrate that a majority of 66% of the respondents have attended a VE course while, while only 36% have never attended a VE course. Hence, the majority of non VE-

specialists have sufficient knowledge about VE, which solidifies their effective participation in VE studies and the successful implementation of VEPs as well.

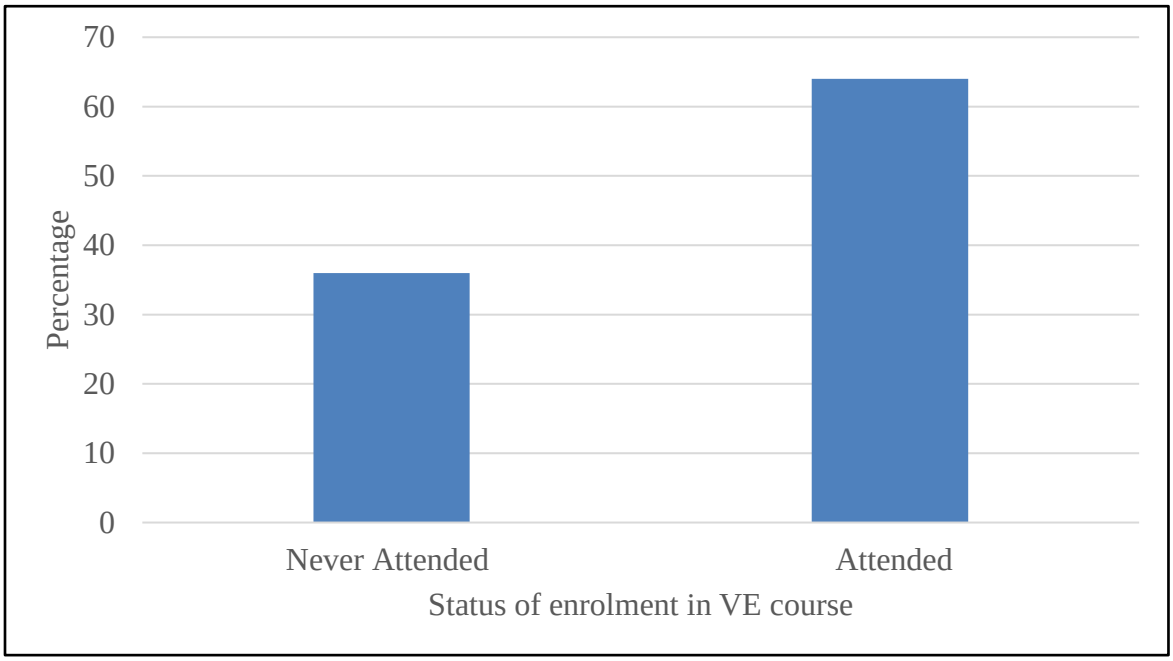

Figure 19: Enrolment of non VE-specialist's in VE course

Familiarity of respondents with the VE concept

Understanding the VE concept is crucial among the team members, especially the end users, and consequently could contribute to a successful implementation. It can be seen in table (10) that 98% of non VE-specialists are familiar with the VE concept. Out of a total of forty (40) of the respondents who are familiar with the VE concept, 35% are familiar but have never attended a VE course. However, these respondents added very comprehensive definitions about VE on the survey sheet. This revealed that the respondents are aware of the importance of the VE concept.

Table 10: Familiarity of respondents with VE concept

	Frequency	Percent	Valid Percent	Cumulative Percent
Unfamiliar	1	2.4	2.4	2.4
Familiar	40	97.6	97.6	100.0
Total	41	100.0	100.0	
Mean	1.98			
Median	2.00			

5.4.3 Respondents' perspectives on the importance of success factors

This section presents VE and non VE-specialists' perspectives toward the importance level of each success factor. Their point of view contributes to achieving the objectives of the study. In addition, a summary table illustrates the ranks, the median, and the mean values. The following is the result for each success factor ranked according to their degree of importance:

5.4.3.1 VE Specialists' perspectives on the importance of success factors

This part presents VE-specialists' perspectives toward the importance level of each success factor.

1. **Proposals must have sufficient information to support the decision-making process, meet decision makers' expectations, and show the detailed benefits of the investment.**

   This success factor was identified from both the literature review and the case study. The results show that 65% of VE-specialist respondents agreed strongly with the high importance, 23% agreed with the high importance, and 8% agreed on the moderate importance of this success factor. Interestingly, the result indicates that 4% gave no importance at all to this success factor. These results support the previous studies' outcome. The lack of sufficient information for VEP development such as cost data, and project technical feasibility with other

interference projects, is common for most of the organizations in Saudi Arabia. Therefore, VE-specialist respondents agreed very strongly with the importance of the availability of sufficient information to allow decision makers to see the whole picture of the project discussed during the VE workshop in the Eastern Province of Saudi Arabia.

2. Try to obtain the support of senior management.

This success factor was identified from both the literature review and the case study. The results show that 58% of VE-specialist respondents agreed very strongly with the high importance, 31% agreed with the high importance, and 11% agreed with the moderate importance of this success factor. Most senior management do not give much thought to the outcome of the VE due to their conservative way of handling business, fear of change, and the low confidence in VEPs in most of organizations in the Eastern Province of Saudi Arabia. Therefore, VE-specialist respondents asserted the importance of obtaining support from senior management.

3. Follow up to expedite implementation.

This success factor was identified from both the literature review and the case study. The results show that 54% of VE-specialist respondents agreed very strongly with the high importance, 35% agreed with the high importance, and 11% agreed with the moderate importance on this success factor. This was also supported by the previous studies, which indicates that all VE practitioners around the world have a common understanding of implementation follow up. VE-specialist respondents usually criticize the low level of implementation of VEPs.

4. **Prepare an implementation action plan.**

This success factor was identified from both the literature review and the case study. The results show that 54% of VE-specialist respondents agreed with the high importance, 39% agreed very strongly with the high importance, and 8% agreed on the moderate importance on this success factor. VE-specialist respondents have shared their thoughts with previous studies, where they consider this factor to be a common practice of the implementation team. As mentioned earlier, this also supports the low level of implementation of VEPs.

5. **Allow enough time for VEP development.**

This success factor was identified from the case study as a case study success factor. The results show that 58% of VE-specialist respondents agreed very strongly with the high importance, 23% agreed with the high importance, and 16% agreed with the moderate importance. Interestingly, the result indicates that 4% gave no importance to this success factor. The intention of respondents regarding this success factor is related to the timing of VEP development that must be specific, measurable, attainable, reliable, and have a timely outcome to be presented to decision makers. However, the urgent need to start construction of most projects will result in expediting things at the preliminary stage where VE studies fall.

6. **The department representative needs to have full authority during the implementation meeting.**

This success factor was identified from both the literature review and the case study. The results show that 58% of VE-specialist respondents agreed with the high importance, 34% agreed very strongly with the high importance, and 8% agreed with the moderate importance of this success factor.

7. **Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board.**

This success factor was identified from the case study as a local success factor. The results show that 50% of VE-specialist respondents agreed very strongly with the high importance, and 36% agreed with the high importance. Interestingly, 7% of respondents agreed with the moderate importance as well as the low importance of this success factor.

8. **VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope.**

This success factor was identified from the case study as a local success factor. The results show that 54% of VE-specialist respondents agreed with the high importance, 31% agreed very strongly with the high importance, and 16% agreed with the moderate importance of this success factor.

9. **Establish a classified VEPs database to be a reference for other VE studies.**

This success factor was identified from the case study as a local success factor. The results show that 50% of VE-specialist respondents agreed with the high importance, 31% agreed very strongly with the high importance, and 16% agreed on the moderate importance of this success factor. Interestingly, the result indicates that 4% gave it a low importance.

10. **Simplify the organization's procedure for implementing VEPs.**

This success factor was identified from the case study as a local success factor. The results show that 50% of VE-specialist respondents agreed with the high importance, 27% agreed very strongly with the high importance, and 19% agreed with the moderate importance of this success factor. Interestingly, the result indicates that 4% gave it a low importance.

11. Allow for enough human resources to plan, track, and execute VEPs.

This success factor was identified from both the literature review and the case study. The results show that 50% of VE-specialist respondents agreed with the high importance, 27% agreed very strongly with the high importance, and 16% agreed with the moderate importance of this success factor. Interestingly, the result indicates that 8% gave it a low importance.

12. Organizations should publicize successful VEPs for implementation for direct use of future projects.

This success factor was identified from the literature review as a previous study success factor. The results show that 39% of VE-specialist respondents agreed very strongly with the high importance, 31% agreed with the moderate importance of this success factor, and 27% agreed with the high importance. Interestingly, the result indicates that 4% gave no importance at all to this success factor.

13. Align VEPs with the organization's overall benefits.

This success factor was identified from both the literature review and the case study. The results show that 50% of VE-specialist respondents agreed with the high importance, 23% agreed very strongly with the high importance, as well as moderate importance, and 4% gave it a low importance.

14. Do a life cycle cost analysis for each VEP for prioritization.

This success factor was identified from the literature review as a previous study success factor. The results show that 42% of VE-specialist respondents agreed with the high importance, 27% agreed very strongly with the high importance, as well as moderate importance, and 4% gave it a low importance.

15. Assign enough budget to execute VEPs which have a high initial cost, but which will result in reducing the life cycle cost.

This success factor was identified from the literature review as a previous study success factor. The results show that 42% of VE-specialist respondents agreed with the high importance, 27% agreed very strongly with the high importance, and 23% agreed with the moderate importance. Interestingly, the result indicates that 8% gave it a low importance.

16. Recognize and address VEP risk to decision makers.

This success factor was identified from the literature review as a previous study success factor. The results show that 46% of VE-specialist respondents agreed with the high importance, 35% agreed with the moderate importance, and 19 % agreed with the high importance.

17. Share the VE experience across the organization with a view to continuous improvement.

This success factor was identified from the literature review as a previous study success factor. The results show that 54% of VE-specialist respondents agreed with the high importance, 19% agreed very strongly with the high importance, as well as moderate importance, and 8 % agreed with the high importance.

18. Monitor changes in new technologies that could impact VEPs.

This success factor was identified from the case study as a local success factor. The results show that 39% of VE-specialist respondents agreed with the high importance, 35% agreed with the moderate importance, and 23% agreed very strongly with the high importance. Interestingly, the result indicates that 4% gave it a low importance. The respondents rarely experienced changing technologies which has low agreement percentage compared with other factors.

19. Prioritize proposals based on the ease for presentation to managers and their implementation.

This success factor was identified from the literature review as a previous study success factor. The results show that 42% of VE-specialist respondents agreed with the high importance, 23% agreed very strongly with the high importance, as well as moderate importance, and 7.7% gave it a low importance. Interestingly, the result indicates that 4% gave it no importance. Since managers have a low confidence and interest level in some VEPs, this factor has a low level of agreement among other factors. Moreover, the issue of the prioritization of VEPs is commonly presented to managers, which reduces the attention of VE-specialist respondents toward this success factor.

20. VEP team members should insist on adequate, but not excessive, safety regulations.

This success factor was identified from the case study as a local success factor. The results show that 46% of VE-specialist respondents agreed with the high importance, 35% agreed with the moderate importance, and 16% agreed very strongly with the high importance. Interestingly, the result indicates that 4% gave it no importance. Organizations usually focus on the cost and technical value of VEPs more than the safety regulations. This lowered the percentage of respondents' agreement with this success factor.

21. Monitor changes in market conditions that could impact VEPs.

This success factor was identified from the case study as a local success factor. The results show that 46% of VE-specialist respondents agreed with the high importance, 39% agreed with the moderate importance, and 11% agreed very strongly with the high importance. Interestingly, the result indicates that 4% gave it a low importance. VE-specialist respondents

rank this success as the least important factor because they focus on the development and acceptance of VEPs.

Table (11) shows the frequencies, mean value, median value, and ranking for each success factor by the VE-specialists as it was obtained on the questionnaire survey. Furthermore, respondents ranked each of the success factors on a Likert scale corresponding to 5= extremely high importance; 4= high importance; 3= moderate importance; 2= low importance; and 1= no importance. The calculated ranking prioritized the success factors based on their importance from the VE-specialists' view.

Table 11: VE-specialists' views on the Importance of the Success Factors

No.	Success factors	5	4	3	2	1	Mean Score	Median Score	Rank
1	Allow enough time for VEP development	15	6	4	0	1	4.31	5	4
2	VEP team members should insist on adequate, but not excessive, safety regulations	4	12	9	0	1	3.69	4	20
3	VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope	8	14	4	0	0	4.15	4	8
4	Do a life cycle cost analysis for each VEP for prioritization	7	11	7	1	0	3.92	4	13
5	Organizations should publicize successful VEPs for implementation for direct use of future projects	10	7	8	0	1	3.96	4	11
6	Prioritize proposals based on the ease for presentation to managers and their implementation	6	11	6	2	1	3.73	4	19
7	Align VEPs with the organization's overall benefits	6	13	6	1	0	3.92	4	13

8	Allow for enough human resources to plan, track, and execute VEPs	7	13	4	2	0	3.96	4	11
9	Simplify the organization's procedure for implementing VEPs	7	13	5	1	0	4.00	4	10
10	Proposals must have sufficient information to support the decision-making process, meet decision makers' expectations, and show the detailed benefits of the investment	17	6	2	1	0	4.50	5	1
11	Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost	7	11	6	2	0	3.88	4	15
12	Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board	13	9	2	0	2	4.19	4.5	7
13	Department representative needs to have full authority during the implementation meeting	9	15	2	0	0	4.27	4	6
14	Recognize and address VEP risk to decision makers	5	12	9	0	0	3.85	4	16
15	Try to obtain the support of senior management	15	8	3	0	0	4.46	5	2
16	Share the VE experience across the organization with a view to continuous improvement	5	14	5	2	0	3.85	4	16
17	Monitor changes in new technologies that could impact VEPs	6	10	9	1	0	3.81	4	18
18	Monitor changes in market conditions that could impact VEPs	3	12	10	1	0	3.65	4	21
19	Establish a classified VEPs database to be a reference for other VE studies	8	13	4	1	0	4.08	4	9
20	Prepare implementation action plan	10	14	2	0	0	4.31	4	4
21	Follow up to expedite implementation	14	9	3	0	0	4.42	5	3

5.4.3.2 Non VE-specialists' perspectives on the importance of success factors

This part presents non VE-specialists' perspectives toward the importance level of each success factor.

1. **Proposals must have sufficient information to support the decision-making process, meet decision makers' expectations, and show the detailed benefits of the investment.**

   This success factor was identified from both the literature review and the case study. The results show that 56% of non VE-specialist respondents agreed very strongly with the high importance, 40% agreed with the high importance, and 4% agreed with the moderate importance. Similar to VE-specialists, non VE-specialists ranked this factor the same. This strengthens the research study.

2. **Prepare an implementation action plan.**

   This success factor was identified from the literature review as a previous study success factor. The results show that 51% of non VE-specialist respondents agreed very strongly with the high importance, 42% agreed with the high importance, and 7% agreed with the moderate importance of this success factor, similar to the VE-specialists.

3. **Follow up to expedite the implementation.**

   This success factor was identified from both the literature review and the case study. The results show that 42% of non VE-specialist respondents agreed very strongly with the high importance, 49% agreed with the high importance, and 9% agreed with the moderate importance of this success factor.

4. **Monitor changes in market conditions that could impact VEPs.**

This success factor was identified from the case study as a local success factor. The results show that 44% of non VE-specialist respondents agreed very strongly with the high importance, as well as high importance, and 10 % agreed with the moderate importance. Interestingly, the result indicates that 2% gave it a low importance. Unlike VE specialists, non VE-specialists have a low level of experience with the procedures of the development and acceptance of VEPs. However, non VE-specialists are more experienced with executing projects. Therefore, this success factor was ranked higher than other factors due to the non VE-specialists' familiarity with the market conditions in Saudi Arabia which are currently changing because of the state of the oil market.

5. **VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope.**

This success factor was identified from the case study as a local success factor. The results show that 56% of non VE-specialist respondents agreed with the high importance, 37% agreed very strongly with the high importance, and 7% agreed with the moderate importance of this success factor.

6. **Establish a classified VEPs database to be a reference for other VE studies.**

This success factor was identified from the case study as a local success factor. The results show that 47% of non VE-specialist respondents very strongly agreed with the high importance, 34% agreed with the high importance, and 20% agreed with the moderate importance of this success factor.

7. Allow enough time for VEP development.

This success factor was identified from the case study as a local success factor. The results show that 44% of non VE-specialist respondents agreed with the high importance, 39% very strongly agreed with the high importance, and 15% agreed with the moderate importance. Interestingly, the result indicates that 2% gave it no importance.

8. Try to obtain support from senior management.

This success factor was identified from both the literature review and the case study. The results show that 46% of non VE-specialist respondents very strongly agreed with the high importance, 37% agreed with the high importance, and 20% agreed with the moderate importance. Interestingly, the result indicates that 2% gave no importance to this success factor. Unlike VE specialists, non VE-specialists are not involved with VE studies procedures. Therefore, they have a different perspective regarding this success factor.

9. Do a life cycle cost analysis for each VEP for prioritization.

This success factor was identified from the literature review as a previous study success factor. The results show that 49% of non VE-specialist respondents agreed with the high importance, 34% very strongly agreed with the high importance, and 17 % agreed with the moderate importance of this success factor.

10. Recognize and address VEP risk to decision makers.

This success factor was identified from the literature review as a previous study success factor. The results show that 49% of non VE-specialist respondents agreed with the high importance, 32% agreed with the moderate importance, and 19 % agreed with the high importance.

11. Monitor changes in new technologies that could impact VEPs.

This success factor was identified from the case study as a local success factor. The results show that 61% of non VE-specialist respondents agreed with the high importance, 27% gave it extreme importance, and 7% agreed with the moderate importance. Interestingly, the result indicates that 5% gave it a low importance.

12. Align VEPs with the organization's overall benefit.

This success factor was identified from both the literature review and the case study. The results show that 56% of non VE-specialist respondents agreed with the high importance, 26% very strongly agreed with the high importance, and 17% agreed with the moderate importance of this success factor.

13. Allow for enough human resources to plan, track, and execute VEPs.

This success factor was identified from both the literature review and the case study. The results show that 49% of non VE-specialist respondents agreed with the high importance, 97% very strongly agreed with the high importance, and 19% agreed with the moderate importance. Interestingly, the result indicates that 2% gave it low importance.

14. The department representative needs to have full authority during the implementation meeting.

This success factor was identified from both the literature review and the case study. The results show that 56% of non VE-specialist respondents agreed with the high importance, 24% very strongly agreed with the high importance, and 20% agreed with the moderate importance of this success factor.

15. Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board.

This success factor was identified from the case study as a local success factor. The results show that 51% of non VE-specialist respondents agreed with the high importance, 24% very strongly agreed with the high importance, as well as with the moderate importance.

16. Share the VE experience across the organization with a view to continuous improvement.

This success factor was identified from the literature review as a previous study success factor. The results show that 61% of non VE-specialist respondents agreed with the high importance, 20% agreed with the moderate importance, and 17 % very strongly agreed with the high importance. Interestingly, the result indicates that 2% gave it a low importance.

17. VEP team members should insist on adequate, but not excessive, safety regulations.

This success factor was identified from the case study as a local success factor. The results show that 37% of non VE-specialist respondents agreed with the high importance, 29% very strongly agreed with the high importance, and 27% agreed with the moderate importance. Interestingly, the result indicates that 7% gave it low importance.

18. Organizations should publicize successful VEPs for implementation for direct use of future projects.

This success factor was identified from the literature review as a previous study success factor. The results show that 42% of non VE-specialist respondents agreed with the high importance, 27% very strongly agreed with the high importance, and 24% agreed with the moderate importance. Interestingly, the result indicates that 7% gave no importance to this success

factor. The involvement of non VE-specialists is less than VE-specialists with this success factor. Therefore, they ranked this factor lower than the VE-specialists ranked it.

19. Simplify the organization's procedure for implementing VEPs.

This success factor was identified from the case study as a local success factor. The results show that 51% of non VE-specialist respondents agreed with the high importance, 27% agreed with the moderate importance, and 20% very strongly agreed with the high importance. Interestingly, the result indicates that 2% gave it a low importance. Again, the engagement of non VE-specialists in this type of organization procedure for implementing VEPs was considerably low. Therefore, this factor ranked as one of the lowest success factors.

20. Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost.

This success factor was identified from the literature review as a previous study success factor. The result shows that 49% of non VE-specialist respondents agreed with the high importance, 27% agreed on the moderate importance, and 20% very strongly agreed with the high importance. Interestingly, the result indicates that 5% gave it no importance.

21. Prioritize proposals based on the ease of presentation to managers and their implementation.

This success factor was identified from the literature review as a previous study success factor. The results show that 51% of non VE-specialist respondents agreed with the moderate importance, 29% agreed with the high importance, and 15% very strongly agreed with the high importance. Interestingly, the result indicates that 5% gave it no importance.

Table (12) shows the frequencies, mean value, median value, and ranking for each success factor by the non VE-specialists as it was obtained from the questionnaire survey. Furthermore, the respondents ranked each of the success factors on a Likert scale corresponding to 5= extremely high importance; 4= high importance; 3= moderate importance; 2= low importance; and 1= no importance. The calculated ranking prioritized the success factors based on their importance from the non VE-specialists view.

Table 12: Non VE-specialists' view of the Importance of Success Factors

No.	Success factors	5	4	3	2	1	Mean Score	Median Score	Rank
1	Allow enough time for VEP development	16	18	6	1	0	4.20	4	7
2	VEP team members should insist on adequate, but not excessive, safety regulations	12	15	11	3	0	3.88	4	17
3	VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope	15	23	3	0	0	4.29	4	4
4	Do a life cycle cost analysis for each VEP for prioritization	14	20	7	0	0	4.17	4	9
5	Organizations should publicize successful VEPs for implementation for direct use of future project	11	17	10	3	0	3.88	4	17
6	Prioritize proposals based on the ease for presentation to managers and their implementation	6	12	21	2	0	3.54	3	21
7	Align VEPs with organization's overall benefits	11	23	7	0	0	4.10	4	11
8	Allow for enough human resources to plan, track, and execute VEPs	12	20	8	1	0	4.05	4	13
9	Simplify organization's procedure for implementing VEPs	8	21	11	1	0	3.88	4	19

10	Proposals must have sufficient information to support the decision-making process, meet the decision maker's expectations, and show the detailed benefits of the investment	23	16	2	0	0	4.51	5	1
11	Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost	8	20	11	2	0	3.83	4	20
12	Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board	10	21	10	0	0	4.00	4	15
13	Department representative needs to have full authority during the implementation meeting	10	23	8	0	0	4.05	4	13
14	Recognize and address VEP risk to decision makers	13	20	8	0	0	4.12	4	10
15	Try to obtain the support of senior management	15	19	7	0	0	4.20	4	7
16	Share the VE experience across the organization with a view to continuous improvement	7	25	8	1		3.93	4	16
17	Monitor changes in new technologies that could impact VEPs	11	25	3	2	0	4.10	4	11
18	Monitor changes in market conditions that could impact VEPs	18	18	4	1	0	4.29	4	4
19	Establish a classified VEPs database to be a reference for other VE studies	19	14	8	0	0	4.27	4	6
20	Prepare an implementation action plan	21	17	3	0	0	4.44	5	2
21	Follow up to expedite implementation	17	20	4	0	0	4.32	4	3

5.4.4 Comparison between VE-specialist's and non VE-specialist's perspectives

Twenty-one (21) success factors were ranked earlier based on two different perspectives. To achieve the objective of ranking the success factors by VE and non VE-specialists figure (20) was created to show the variation or similarity between both perspectives toward each success factor. Moreover, the figure represents the X-axis of twenty-one (21) success factors organized from 1 to 21 as ranked by VE-specialists, and the Y-axis represents the difference in rank between VE and non-VE specialists for each success factor. The results show that the most crucial success factor for both VE-specialists and non VE-specialists is the first factor (1) proposals must have sufficient information to support the decision-making process, meet the decision maker's expectations, and show the detailed benefits of the investment as agreed from both perspectives. Additionally, the third most important success factor agreed by both sides is (3) following up to expedite implementation, and success factor (17) share the VE experience across the organization with a view to continuous improvement. From the results a slight difference in the ranking can also be seen from both perspectives toward the fourth factor (4) preparing an implementation action plan and the fifth factor (5) allowing enough time for VEP development success factors. Interestingly, the second factor (2) the trying to obtain support from senior management success factor, was found to be ranked differently according to the different levels of involvement in VE procedures by both VE-specialists and non VE-specialists. Moreover, both VE and non VE-specialists had different perspectives toward the sixth factor (6) the department representative needs to have full authority during the implementation meeting. This is because VE-specialists usually face the issue of having a representative with less authority during the implementation meeting. However, there was a moderate difference in the perspectives toward factor (18) monitor both new technology; and a large difference toward factor (21) monitor market condition changes that could influence

VEPs. The reason why this variance exists is due to the fact that non VE-specialists have little experience in the approach to the development and acceptance of VEPs. Non VE-specialists have more experience with project execution, therefore they are more familiar with the market. For the aforementioned reason, non VE-specialists consider monitoring changes in market conditions that could impact VEPs to be one of the most important success factors. Non VE-specialists are more aware of new technology and that is why they gave a higher ranking to monitoring changes in new technologies that could impact VEPs success factors. It can also be derived from the figure below that there are slight differences in perspectives on factor nineteen (19) prioritize proposals based on the ease of presentation to managers and their implementation ranking, and the fact that VEP team members should insist on adequate, but not excessive, safety regulations.

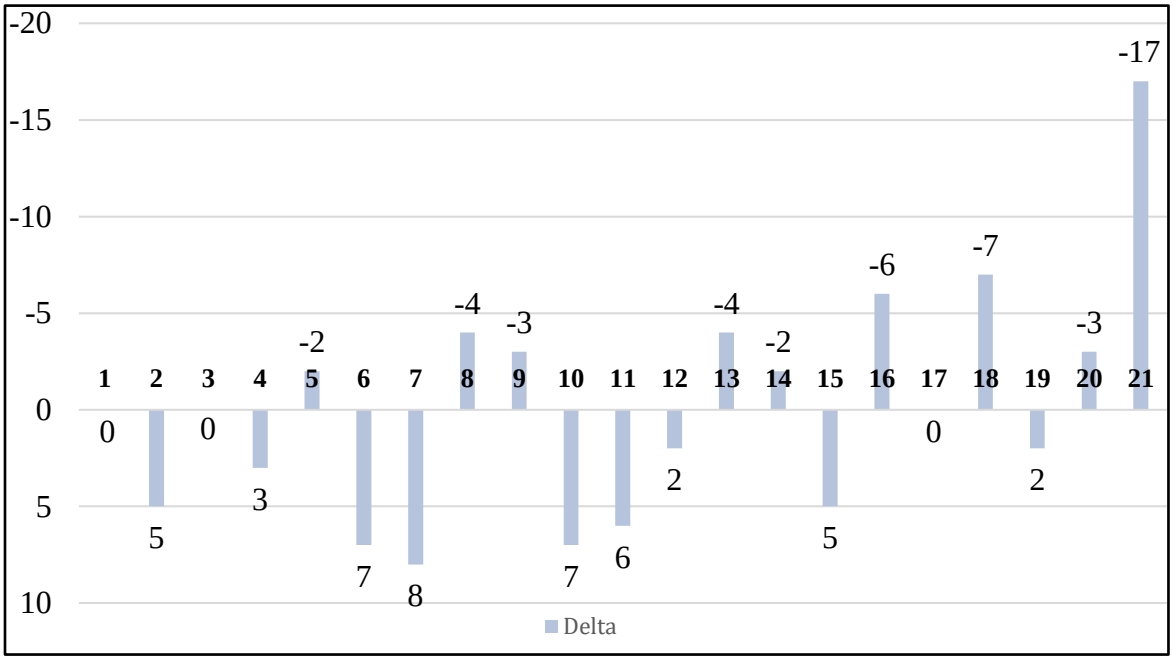

Figure 20: Variations between ranks of VE and non-VE specialists

A comparison of VE-specialists and non VE-specialists' rankings in addition to the median of all success factors are displayed in figure (21). The figure represents all success factors from the point

of view of both the VE and non VE-specialists. Where, the blue line is the ranking of the VE, the red line is for the non-VE, and the green line represents the median for the all success factors.

As shown in figure (21), in success factors number 1, 3, and 17 both the VE and non VE specialists had the same perspective and the same ranking. Although factor number 17 was below the median, this factor is in agreement. Factor numbers 1 and 3 were above the median and in agreement.

The rest of the factors are not in agreement. Slight differences were observed where factor number 4 was ranked 4 by VE specialists, while it was ranked 7 by non VE specialists. Specifically, factor number 4 was off by 3, success factor number 5 was off by 2, 8 was off by 4, and 9 was off by 3.

Moderate differences were observed in success factors 6, 7, 10, 11, and 15. Where factor numbers 6, 11, and 16 were off by 6, success factor number 7 was off by 8, and success factor number 10 was off by 7. Success factor number 15 had a difference of 5. Success factor number 21 had the highest difference of 17.

It can also be seen from the figure that success factor numbers 13, 14, 18, 19, and 20 had a slight difference and were off by 3, 2, 4, 2, and 3 respectively.

The non VE specialists ranking was exactly on the median for success factor numbers 14 and 18. On the other hand, success factor numbers 11 and 12 were on the median in the ranking of the VE specialists, with a slight difference between the rankings of number 2.

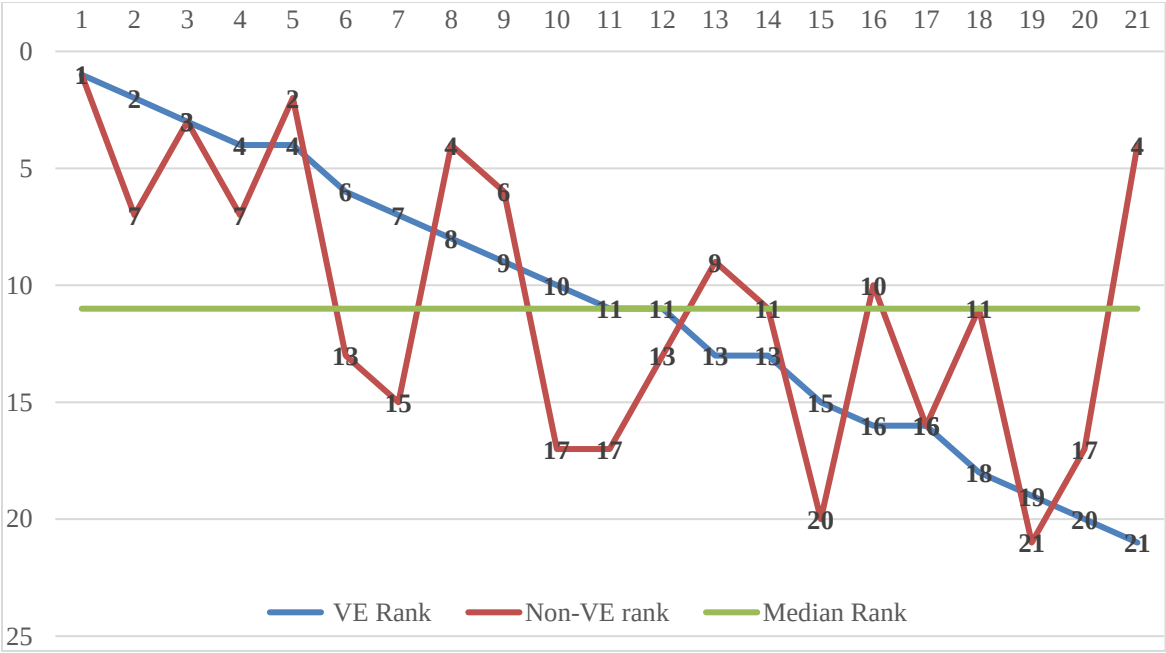

Figure 21: Ranks of VE and non-VE for all success factors

5.4.5 Importance of success factors identified through case study and literature review or both

This section presents the importance of the rankings given by VE-specialists through the case study and literature success factors or both.

Table (13) shows the rankings of VE-specialists and the source of each non-common success factor listed under their categorization. Since the study was conducted in the Eastern Province of Saudi Arabia, the results revealed that most of the case study success factors are ranked higher than the literature review success factors. In addition, the results of the interviews and questionnaire surveys from experts in VE, who are involved in the VE practice in Saudi Arabia, were more focused on the most important success factors in the Easter Province to solve the main issues facing VEPs implementation. Therefore, these success factors mainly represent the case study success factors in the table. In general, both case study and literature success factors are important to the

successful implementation of VEPs. However, case study success factors are more applicable to the organizations in the Eastern Province of Saudi Arabia.

Table 13: VE importance ranking of success factors that are non-common to the case study and literature review

Non-common Success factors	**Rank**	**Source**
I. Development		
Allow enough time for VEP development	4	Case study
VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope	8	Case study
Organizations should publicize successful VEPs for implementation for direct use of future projects	11	Literature
Do a life cycle cost analysis for each VEP for prioritization	13	Literature
VEP team members should insist on adequate, but not excessive, safety regulations	20	Case study
II. Management Decision *(Organization support)*		
Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board	7	Case study
Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost	15	Literature
Prioritize proposals based on the ease of presentation to managers and their implementation	19	Literature
(Policy & procedure development)		
Simplify the organization's procedure for implementing VEPs	10	Case study
Share the VE experience across the organization with a view to continuous improvement	16	Literature
Recognize and address VEP risk to decision makers	16	Literature
III. Implementation		
Establish a classified VEPs database to be a reference for other VE studies	9	Case study
Monitor changes in new technologies that could impact VEPs	18	Case study
Monitor changes in market conditions that could impact VEPs	21	Case Study

Table (14) shows the common factors categorized into the three aforementioned categories. The factors were identified from the literature review and case study, and ranked by VE-specialists. The factors identified from the two sources show important results that demonstrate that the nature of the success factors is everywhere, whether it be in Saudi Arabia or elsewhere.

The merging of the previous study and the case study success factors created a point of agreement, which leads to the discovery of important results including:

- The most important success factor is 'Proposals must have sufficient information to support the decision-making process, meet decision makers' expectations, and show the detailed benefits of the investment' ranked by VE-specialists and identified from the literature review and case study. This factor is classified under the Development category; this illustrates the importance of factors in the development category.
- The second most important success factor falls under the Management Decision category, that is 'Try to obtain the support of senior management' ranked by VE-specialists and identified by both sources.

The third most important success factor is classified under the Implementation category, that is 'Follow up to expedite implementation' ranked by VE-specialists and identified by both sources.

Table 14: VE importance ranking of success factors that are common to case study and literature review

Common Success factors	Rank	Source
I. Development		
Proposals must have sufficient information to support the decision-making process, meet decision makers' expectations, and show the detailed benefits of the investment	1	Literature review and case study (both)
Align VEPs with the organization's overall benefits	13	
II. Management Decision *(Organization support)*		
Try to obtain the support of senior management	2	
Allow for enough human resources to plan, track, and execute VEPs	11	
(Policy & procedure development)		
Department representative needs to have full authority during the implementation meeting	6	
III. Implementation		
Follow up to expedite implementation	3	
Prepare implementation action plan	4	

To understand the relation between the VE and non-VE specialists' perspectives, a T-test was conducted for all success factors. Furthermore, the test is based on proposing a hypothesis for the correlation of success factors as shown below:

H_0: no association between the VE and non-VE specialist's responses for each success factor.

H_1: association between the VE non-VE specialist's responses for each success factor.

Table (15) presents Spearman's ranking correlation coefficient for the twenty-one success factors to determine the association between the VE and non-VE specialists based on the *P-Value.* Whenever the *P-Value* is greater than 0.05 then there is no association between the two perspectives and vice versa.

Table 15: Results obtained for ranking correlation

No.	Success factors	Mean Score VE	VE Ranking	Mean Score non VE	non VE Ranking	D	D^2
1	Allow enough time for VEP development	4.31	4	4.20	7	3	9
2	VEP team members should insist on adequate, but not excessive, safety regulations	3.69	20	3.88	17	3	9
3	VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope	4.15	8	4.29	4	4	16
4	Do a life cycle cost analysis for each VEP for prioritization	3.92	13	4.17	9	4	16
5	Organizations should publicize successful VEPs for implementation for direct use of future projects	3.96	11	3.88	17	6	36
6	Prioritize proposals based on the ease of presentation to managers and their implementation	3.73	19	3.54	21	2	4
7	Align VEPs with the organization's overall benefits	3.92	13	4.10	11	2	4
8	Allow for enough human resources to plan, track, and execute VEPs	3.96	11	4.05	13	2	4
9	Simplify the organization's procedure for implementing VEPs	4.00	10	3.88	19	9	81
10	Proposals must have sufficient information to support the decision-making process, meet the decision maker's expectations, and show the	4.50	1	4.51	1	0	0

Table 15: Results obtained for ranking correlation ***(Cont'd)***

	detailed benefits of the investment						
11	Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost	3.88	15	3.83	20	5	25
12	Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board	4.19	7	4.00	15	8	64
13	Department representative needs to have full authority during the implementation meeting	4.27	6	4.05	13	7	49
14	Recognize and address VEP risk to decision makers	3.85	16	4.12	10	6	36
15	Try to obtain the support of senior management	4.46	2	4.20	7	5	25
16	Share the VE experience across the organization with a view to continuous improvement	3.85	16	3.93	16	0	0
17	Monitor changes in new technologies that could impact VEPs	3.81	18	4.10	11	7	49
18	Monitor changes in market conditions that could impact VEPs	3.65	21	4.29	4	17	289
19	Establish a classified VEPs database to be a reference for other VE studies	4.08	9	4.27	6	3	9
20	Prepare implementation action plan	4.31	4	4.44	2	2	4
21	Follow up to expedite implementation	4.42	3	4.32	3	0	0
Total							729

The test was conducted by using Spearman's ranking correlation which is best-suited for ordinal variables. The following formula was utilized to calculate *P-Value* Spearman's ranking correlation:

$$r = 1 - \frac{6\,x\,\sum d^2}{n^3 - n}$$

Furthermore, hypothesis testing was conducted to determine the association status of the two perspectives as shown below:

H_0: no association between the VE and non-VE specialists' responses for each success factor.

H_1: association between the VE non-VE specialists' responses for each success factor.

If *P-Value* ≥ 0.05, then don't reject H_o which means there is no association between variables.

If *P-Value* ≤ 0.05, then reject H_o which means there is an association between variables.

Table 16: Spearman's rank correlations

Correlations				
			VE	Non VE
Spearman's rho	VE Specialists	Correlation Coefficient	1.000	.536*
		Sig. (2-tailed)	.	.012
		N	21	21
	Non VE-Specialists	Correlation Coefficient	.536*	1.000
		Sig. (2-tailed)	.012	.
		N	21	21
*. Correlation is significant at the 0.05 level (2-tailed).				

When you perform a test, we find that as above table Spearman's (0.536*) Significant in α = 0.05 and P. Value = (0.012), indicating that the two rankings are similar.

CHAPTER SIX: RESEARCH SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter describes the summary of the research study, the findings concluded from the results of the study, the conclusions, and makes appropriate recommendations for VE practitioners for the successful implementation of VEPs. Recommendations for future research were also included.

6.1 Summary of the research study

One of the most important tools to ensure the success of projects is using the best practices of management. Value Engineering is one of those practices that have an optimum balance of quality, efficiency, performance, and the life-cycle-cost of a project. A study of success factors for implementing the Value Engineering Proposals will be helpful to Value Engineering Practitioners, and organizations which promote Value Engineering to optimize, enhance, and improve construction projects (Life Cycle Cost) thereby achieving the functionality desired.

This study intended to: a) investigate the extent of rejection of Value Engineering Proposals during the implementation meeting, b) identify success factors for implementing the Value Engineering Proposals, and c) assess the importance of success factors by Value Engineering Specialists and non-Value Engineering Specialists.

The extent of the rejection of the VEPs was calculated by utilizing a case study to gather information from thirty-eight VE studies on projects from a prominent organization in the Eastern Province of Saudi Arabia. The major reasons for not implementing VEPs were gathered from VE reports and direct interviews with different parties involved in the VE process to obtain the case study success factors. The factors were obtained from a combination of case study results and literature review. Finally, twenty-one (21) success factors were ranked by VE and non VE-

specialists through a questionnaire to garner practical data from organizations that promote VE practices in Saudi Arabia. The acquired data from the questionnaire was analyzed using basic statistical equations.

6.2 Findings

This section presents the major and minor findings of the research study.

6.2.1 Major findings

a) The extent of problem size was investigated through thirty-eight (38) VE reports in a prominent organization, and resulted in an average of 50% of VEPs rejected during the implementing meeting.

b) Twenty-one (21) success factors which increase the probability of implementing VEPs were obtained from the case study and literature review. The following are the success factors for implementing VEPs:

    1. Allow enough time for VEP development
    2. VEP team members should insist on adequate, but not excessive, safety regulations
    3. VEPs must take into consideration conflicting viewpoints regarding project performance, reliability, maintainability, and cost within the project scope
    4. Do a life cycle cost analysis for each VEP for prioritization
    5. Organizations should publicize successful VEPs for implementation for direct use of future projects
    6. Prioritize proposals based on the ease of presentation to managers and their implementation
    7. Align VEPs with the organization's overall benefits
    8. Allow for enough human resources to plan, track, and execute VEPs

9. Simplify the organization's procedure for implementing VEPs
10. Proposals must have sufficient information to support the decision-making process, meet the decision maker's expectations, and show the detailed benefits of the investment
11. Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost
12. Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board
13. The department representative needs to have full authority during the implementation meeting
14. Recognize and address VEP risk to decision makers
15. Try to obtain the support of senior management
16. Share the VE experience across the organization with a view to continuous improvement
17. Monitor changes in new technologies that could impact VEPs
18. Monitor changes in market conditions that could impact VEPs
19. Establish a classified VEPs database to be a reference for other VE studies
20. Prepare an implementation action plan
21. Follow up to expedite implementation.

c) Twenty-one (21) success factors were assessed by VE and non-VE specialists through a questionnaire survey. The success factors are classified into the following categories: a) *Development, b) Management Decision, and c) Implementation* as shown in table (17):

Table 17: Ranked success factors by VE and non VE-specialists

No.	Success factors	VE Rank	Non-VE rank	Source
I. Development				
1	Allow enough time for VEP development	4	7	Case study
2	VEP team members should insist on adequate, but not excessive, safety regulations	20	17	Case study
3	VEPs must take into consideration conflicting points of view of regarding project performance, reliability, maintainability, and cost within the project scope	8	4	Case study
4	Do life cycle cost analysis for each VEP for prioritization	13	9	Literature
5	Organizations should publicize successful VEPs for implementation for direct use of future project	11	17	Literature
6	Proposals must have sufficient information to support decision making process, meet decision maker's expectations, and show detailed benefits of the investment	1	1	Both
7	Align VEPs with organization's overall benefits	13	11	Both
II. Management Decision *(Organization support)*				
8	Prioritize proposals based on the ease for presentation to managers and their implementation	19	21	Literature
9	Allow for enough human resources to plan, track, and execute VEPs	11	13	Both
10	Assign enough budget to execute VEPs with a high initial cost, but which will result in reducing life cycle cost	15	20	Literature
11	Raise VE awareness through such things as programs, or campaigns, and establish a Value Management Board	7	15	Case study
12	Try to obtain the support of senior management	2	7	Both
(Policy & procedure development)				
13	Share the VE experience across the organization with view to continuous improvement	16	16	Literature
14	Department representative needs to have full authority during the implementation meeting	6	13	Both
15	Simplify organization's procedure for implementing VEPs	10	19	Case study
16	Recognize and address VEP risk to decision makers	16	10	Literature
III. Implementation				
17	Monitor changes in new technologies that could impact VEPs	18	11	Case study
18	Monitor changes in market conditions that could impact VEPs	21	4	Case study
19	Establish a classified VEPs database to be a reference for other VE studies	9	6	Case study
20	Prepare implementation action plan	4	2	Both
21	Follow up to expedite implementation	3	3	Both

6.2.2 Minor findings

It is believed that a number of outcomes were covered by the research which will be of importance to the reader. The following is a list of minor findings:

1. The results show that 42% of organizations in the Eastern Province of Saudi Arabia started practicing Value Engineering more than 15 years.
2. An Average of 69% of respondents' organizations categorized the mandate requirements based on project budget, and only 31% of these organizations categorized them based on other requirements made by consultant companies such as project complexity.
3. An average of 78% of respondents' organizations mandate VE based on project budget only when the project budget exceeds SR 30 Million, 17% of respondents' organizations mandate VE based on project budget for all projects that are more than SR 20 Million, while only 5% of respondents' organizations mandate VE based on project budget only when the project budget exceeds SR 5 Million.
4. An average of 46% of organizations in the Eastern Province of Saudi Arabia conduct more than 15 VE studies per year.
5. The results show that 81% of organizations in the Eastern Province of Saudi Arabia conduct VE in-house.

6.3 Conclusion

The study of VEPs implementation in Saudi Arabia established a strong platform of recommendations for VE practitioners to have a successful implementation of VEPs. This is because the findings show that the percentage of the implementation status for the total VEPs was 50% of Not Accepted (NA). The percentage of rejected proposals was high due to the major reasons which were identified as part of the study. The wide range of the VE reports referenced, and the interviews with individuals who have hands-on experience with VE, supported the study to identify the local reasons for not implementing VEPs. These reasons are applicable to organizations in Saudi Arabia. The reasons were categorized into three categories, namely reasons related to development, reasons related to management, and reasons related to implementation. The VE reports and interviews show a low implementation effort towards each rejected VEP due to the following major reasons:

- Lack of sufficient information for VEP development.
- Not enough support from senior management.
- Lack of resources to follow up the implementation of VEPs.
- Lack of VE personnel needed to plan, execute, and track the implementation of the VEP.
- Not enough time for VEP development to get the approval of decision makers.
- Departments representatives in the implementation meeting don’t have the authority to make decisions.

Twenty-one (21) success factors were identified by the case study and literature review, which increase the probability for implementing VEPs due to merging the international and local experience. In general, both the case study and literature success factors are important to the successful implementation of VEPs. However, the case study success factors are more applicable

to organizations in the Eastern Province of Saudi Arabia. Not restricting the ranking to just one point of view from only VE or non VE Specialists, gave the study a robust ranking that is commonly identical, although different in some factors. The results show that the most important success factors for VE-specialists are 1) Proposals must have sufficient information to support the decision making process, meet the decision maker's expectations, and show the detailed benefits of the investment as agreed by both perspectives, 2) Try to obtain the support of senior management, 3) Follow up to expedite implementation, 4) Prepare an implementation action plan, 5) Allow enough time for VEP development, and 6) The department representative needs to have full authority during the implementation meeting.

The study aimed to identify success factors for the successful implementation of VEPs and assess those factors, in order to enhance the development and improve the outcome of VE studies.

6.4 Recommendations

The following are the recommendations for VE organizations, VE teams, and for open research studies.

6.4.1 Recommendations for VE studies

Based on the results of the research study the following are the recommendations for a successful VEP implementation:

1. VE organizations are advised to expedite the availability of cost information for the use in VE study to back up the decision-making process.

2. VE organizations are advised to mandate a VE course for team members prior to a VE workshop, in order to get the best value of VEPs.

3. VE organizations are advised to dedicate a full committed team to plan, track, and execute the VEPs implementation.

4. VE organizations are advised to develop a VE awareness program or campaign for higher management.

5. VE organizations are advised to mandate the implementation of VEPs through procedures.

6. VE organizations are advised to empower the VE staff unit and the VE team members

7. VE organizations are advised to develop a joint venture with organizations that promote VE programs such as SAVE International, the Japanese Society of Value Engineering, or the Indian Society of Value Engineering.

8. VE organizations are advised to benchmark with other companies that have a well-structured methodology for implementing VEPs.

6.4.2 Recommendations for VE teams

1. VE teams are advised to streamline the decision-making process to make the organization more active and efficient.
2. VE teams are advised to become more fiscally responsible and meet corporate objectives to ensure the proper implementation of VEP.
3. VE teams are advised to find an approach to minimize risks.
4. VE teams are advised to learn from the experience of others and from past lessons learned.
5. VE teams are advised to seize any opportunity to upgrade the organization's technology.
6. VE teams are advised to design an approach to improve the quality, operability, and maintainability of the VEP.

6.4.3 Recommendations for further studies

The following are areas for open research, which if explored, would add validity to the outcomes of this research:

1. Since this study was limited to investigating the percentage of rejected VEPs during the implementation meeting, it is highly important for future studies to be carried out by using the size of the rejected VEPs as a percentage of cost ratio because it gives real indications of the decision for rejecting that particular VEP.
2. Similar studies can be done in government agencies in Saudi Arabia and the results can be compared to check if they have a similar ranking for each success factor. In addition, this will give an indication as to what degree those government agencies should implement VEP.
3. The study was limited to the Eastern Province and, since not all regions are the same, it would be better to scale up to other regions.

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Appendix I

KING FAHD UNIVERSITY OF PETROLEUM'S & MINERALS

CONSTRUCTION ENGINEERING AND MANAGEMENT DEPARTMENT

SURVEY ON SUCCESS FACTORS FOR IMPLEMENTING VALUE ENGINEERING PROPOSALS IN SAUDI ARABIA

Dear respondent,

A study is being conducted on the implementation of Value Engineering Proposals in the Eastern Province of Saudi Arabia. The objective of the study is to identify the success factors for implementing Value Engineering Proposals (VEPs).

We would like you to participate in this study by completing the attached questionnaire. The questionnaire is designed for Value Engineering Personnel (i.e. Value engineering specialists, owner's proposals, and etc.) who have hands-on experience in value engineering practices. The questionnaire is divided into three sections that would take less than 10 minutes of your valuable time. The information that you will provide shall be kept strictly confidential and shall be used only for research purpose, which will be aggregate based.

Your contribution towards this study will be greatly appreciated, as it will add significant value to the research and the research results will be of great benefits to industries. If you would like to be briefed with the results of this study, please contact me on my mobile/e-mail at any time.

Thank you, looking forward for your cooperation.

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Value Engineering (VE): *is a study to come up with creative ideas to improve quality, enhance performance, increase efficiency, and eliminate unnecessary costs on projects.*

Value Engineering Proposals (VEPs): *are ideas created during the Value Engineering workshop with possible high value, those ideas should be discussed, and evaluated during the workshop.*

This Questionnaire is for **Value Engineering specialists** and contains three parts as shown below:

Part one: This part includes questions obtaining information regarding your organization. Please select the suitable answer?

Name (Optional):_____

Organization:_____

Department/Unit: _____

Job title:_____

1. When did your organization start practicing Value Engineering?
   A. Less than 5 years ago [ ]
   B. 5 to less than 10 years ago [ ]
   C. 10 to less than 15 years ago [ ]
   D. More than 15 years ago [ ]
2. What is your mandatory requirement for applying Value Engineering on your organization?
   A. All repetitive projects that are more than SR 5 million [ ]
   B. All projects that are more than SR 20 million [ ]
   C. All projects that are more than SR 30 million [ ]
   D. Others, please specify_____
3. What is the number of Certified Value Specialist (CVS) in your organization?
   A. One CVS [ ]
   B. Two CVSs [ ]
   C. Three CVSs [ ]
   D. More than three CVSs [ ]
4. Does your company conduct Value Engineering study in-house?
   A. Yes [ ]
   B. No [ ]
5. What is the approximate number of VE studies that are conducted in your organization per year?
   A. Less than 5 VE studies per year [ ]
   B. 5 to less than 10 VE studies per year [ ]
   C. 10 to less than 15 VE studies per year [ ]
   D. More than 15 VE studies per year [ ]

Part two: This part includes questions obtaining information regarding the individual completing the questionnaire. Please select the suitable answer?

1. What is your certification level according to SAVE International?

   A. Associate Value Specialist (AVS) [ ]
   B. Value Methodology Practitioner (VMP) [ ]
   C. Certified Value Specialist (CVS) [ ]
   D. None of the above [ ]

2. Have you ever facilitated Value Engineering studies, and if so how many?

   A. No [ ]
   B. Yes [ ], for:
      a) Less than 10 VE studies [ ]
      b) 10 to less than 20 VE studies [ ]
      c) 20 to less than 30 VE studies [ ]
      d) More than 30 VE studies [ ]

3. Have you ever participated in Value Engineering workshops, and if so how many?

   A. No [ ]
   B. Yes [ ], for:
      a) Less than 10 VE workshops [ ]
      b) 10 to less than 20 VE workshops [ ]
      c) 20 to less than 30 VE workshops [ ]
      d) More than 30 VE workshops [ ]

Part three: The following is a list of factors for your organization that could potentially impact the implementation of Value Engineering Proposals (VEPs). You are kindly requested to indicate your level of agreement by placing (✓) in the boxes next to each factor:

For successful implementation of VEPs:	Extremely high importance	High importance	Moderate importance	Low importance	No importance
Allow enough time for VEP development					
VEP team members should insist on adequate, but not excessive, safety regulations					
VEPs must take into consideration conflicting view of point regarding project performance, reliability, maintainability, and cost within the project scope					
Do life cycle cost analysis for each VEP for prioritization					
Organizations should publicize successful VEPs for implementation for direct use of future project					
Prioritize proposals based on the ease for presentation to managers and their implementation					
Align VEPs with organization's overall benefits					
Allow for enough human resources to plan, track, and execute VEPs					
Simplify organization's procedure for implementing VEPs					
Proposals must have sufficient information to support decision making process, meet decision makers expectations, and show detailed benefits of the investment					
Assign enough budget to execute VEPs with high initial cost, but will result on reducing life cycle cost					
Provide VE awareness through such things as programs, or campaigns, and establish Value Management Board					
Department representative needs to have full authority during the implementation meeting					
Recognize and address VEP risk to decision makers					
Try to obtain the support from top management					
Share the VE experience across the organization with view of continuance improvement					

For successful implementation of VEPs:	Extremely high importance	High importance	Moderate importance	Low importance	No importance
Monitor changes in new technologies that could impact VEPs					
Monitor changes in market conditions that could impact VEPs					
Establish a classified VEPs database to be a reference for other VE studies					
Prepare implementation action plan					
Follow up to expedite implementation					
Please specify others:					

Appendix II

This Questionnaire is for **non-Value Engineering specialists** and contains three parts as shown below:

Part one: This part includes questions obtaining information regarding your organization. Please select the suitable answer?

Name (Optional):_____
Organization:_____
Department/Unit: _____
Job title:_____

1. Does your company conduct Value Engineering study in-house?
   A. Yes [ ]
   B. No [ ]
2. What is the approximate number of VE studies you conducted on your previous projects?
   A. Less than 5 VE studies [ ]
   B. 5 to less than 10 VE studies [ ]
   C. 10 to less than 15 VE studies [ ]
   D. More than 15 VE studies [ ]
3. What was the mandatory requirement for applying Value Engineering on your project?
   A. All repetitive projects that are more than SR 5 million [ ]
   B. All projects that are more than SR 20 million [ ]
   C. All projects that are more than SR 30 million [ ]
   D. Others, please specify_____

Part two: This part includes questions obtaining information regarding the individual completing the questionnaire. Please select the suitable answer?

1. Have you ever attended a Value Engineering workshop on a construction project, if so how many?
   A. No [ ]
   B. Yes [ ], for:
      a) Less than 10 VE workshops [ ]
      b) 10 to less than 20 VE workshops [ ]
      c) 20 to less than 30 VE workshops [ ]
      d) More than 30 VE workshops [ ]
2. Have you ever attended a Value Engineering course?
   A. No [ ]
   B. Yes [ ]
3. Are you familiar with the Value Engineering studies?
   A. No [ ]
   B. Yes, [ ] How: _____

Part three: The following is a list of factors for your organization that could potentially impact the implementation of Value Engineering Proposals (VEPs). You are kindly requested to indicate your level of agreement by placing (✓) in the boxes next to each factor:

For successful implementation of VEPs:	Extremely high importance	High importance	Moderate importance	Low importance	No importance
Allow enough time for VEP development					
VEP team members should insist on adequate, but not excessive, safety regulations					
VEPs must take into consideration conflicting view of point regarding project performance, reliability, maintainability, and cost within the project scope					
Do life cycle cost analysis for each VEP for prioritization					
Organizations should publicize successful VEPs for implementation for direct use of future project					
Prioritize proposals based on the ease for presentation to managers and their implementation					
Align VEPs with organization's overall benefits					
Allow for enough human resources to plan, track, and execute VEPs					
Simplify organization's procedure for implementing VEPs					
Proposals must have sufficient information to support decision making process, meet decision makers expectations, and show detailed benefits of the investment					
Assign enough budget to execute VEPs with high initial cost, but will result on reducing life cycle cost					
Provide VE awareness through such things as programs, or campaigns, and establish Value Management Board					
Department representative needs to have full authority during the implementation meeting					
Recognize and address VEP risk to decision makers					
Try to obtain the support from top management					
Share the VE experience across the organization with view of continuance improvement					

For successful implementation of VEPs:	Extremely high importance	High importance	Moderate importance	Low importance	No importance
Monitor changes in new technologies that could impact VEPs					
Monitor changes in market conditions that could impact VEPs					
Establish a classified VEPs database to be a reference for other VE studies					
Prepare implementation action plan					
Follow up to expedite implementation					
Please specify others:					

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